

REGULATIONS AND SYLLABUS

2019-2020

- 🔍 School of Fundamental and Applied Sciences
- 🔍 School of Life Sciences
- 🔍 School of Humanities and Social Sciences



**ASSAM
DON BOSCO UNIVERSITY**

Tapesia Gardens
Sonapur - 782402
Assam

Azara, Guwahati - 781017
Assam, India



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SCHOOL OF FUNDAMENTAL AND APPLIED SCIENCES

SCHOOL OF LIFE SCIENCES

SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

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NOTE

This handbook contains important information to help guide and inform you during your programme of study. We recommend that you keep this handbook for the duration of your studies in the University so that you can refer to it as needed. Please note that the onus of ignorance of the regulations and information contained in this handbook will be on the student and will not be ground for any consideration. You are also required to keep abreast of the amendments and additions to the regulations and syllabus that will be officially notified from time to time.

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REGULATIONS

ASSAM DON BOSCO UNIVERSITY REGULATIONS

GRADUATE DEGREE PROGRAMMES

The following are the regulations of the Assam Don Bosco University concerning the Graduate Programmes leading to the award of the Bachelor’s Degree in various disciplines made subject to the provisions of its Statutes and Ordinances.

1.0 Academic Calendar

- 1.1. Each academic year is divided into two semesters of approximately 18 weeks duration: an Autumn Semester (July – December) and a Spring Semester (January – June). The Autumn Semester shall ordinarily begin in July for students already on the rolls and the Spring Semester shall ordinarily begin in January. However, the first semester (Autumn, for newly admitted students) may begin later depending on the completion of admission formalities.
- 1.2. The schedule of academic activities approved by the Academic Council for each semester, inclusive of the schedule of continuing evaluation for the semester, dates for the conduct of end-semester examinations, the schedule of publication of results, etc., shall be laid down in the Academic Calendar for the semester.

2.0 Duration of the Programme

- 2.1. The normal duration of the Graduate Programme shall be as per the table given below:

Programme	Number of Semesters	Number of Years
Bachelor of Technology (BTECH)	8	4
Bachelor of Computer Applications (BCA)	6	3
Bachelor of Business Administration (BBA)	6	3
Bachelor of Commerce (BCOM)	6	3
Bachelor of Arts (BA) Honours	6	3
Bachelor of Science (BSc) Honours	6	3

- 2.2. However, students who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 4 more semesters (2 years) to complete all the requirements of the degree.
- 2.3. Under exceptional circumstances and depending on the merit of each case, a period of 2 more semesters (1 year) may be allowed for the completion of the programme.

3.0 Course Structure

- 3.1. The Choice Based Credit System (CBCS) shall be followed for the Graduate Degree Programmes. Credits are allotted to the various courses depending on the number of lecture/tutorial/laboratory hours per five-day cycle (one week) of classes assigned to them using the following general pattern:
 - 3.1.1. Lecture : One hour per cycle/week is assigned 1 credit.
 - 3.1.2. Tutorial : One hour per cycle/week is assigned 1 credit.
 - 3.1.3. Practical : Two hours per cycle/week is assigned 1 credit.
- 3.2. The courses offered for the Graduate Degree Programmes are divided into two baskets – Core Courses and Elective Courses. (Core courses will include “Core Courses” and “Ability Enhancement Courses” mentioned in CBCS guidelines. Elective Courses will include

“Discipline Specific Electives”, “Generic Electives”, optional “Dissertation or Project”, and “Skill Enhancement Courses”).

3.3. Core Courses: Core courses are those in the curriculum, the knowledge of which is deemed essential for students who are pursuing the said Degree Programme.

3.3.1 A student shall be required to take all the core courses offered for a particular programme.

3.3.2 The number of credits required from core courses shall be as prescribed by the competent academic authority.

3.4. Elective Courses: These are courses in the curriculum which give the student opportunities for specialisation and which cater to his/her interests and career goals.

These courses may be selected by the student and/or offered by the department conducting the programme, from those listed in the curriculum according to the norms laid down by the competent academic authority.

3.4.1 The number of credits which may be acquired through elective courses shall be prescribed by the competent academic authority.

3.5. These categories of courses may further be subdivided into departmental, school or institutional, depending on the department which offers the course. The schema of categorisation of courses into baskets is as given below:

*Core Courses	
Departmental Core (DC)	Core courses which are offered by the department conducting the programme
School Core (SC)	Core courses which are offered by a department other than the department conducting the programme, from within the same School
Institutional Core (IC)	Core courses which are offered by departments of the University from Schools other than the parent School
*Elective Courses	
Departmental Elective (DE)	Elective courses which are offered by the department conducting the programme
School Elective (SE)	Elective courses which are offered by a department other than the department conducting the programme, from within the same School
Institutional Elective (IE)	Elective courses which are offered by departments of the University from Schools other than the parent School

***UGC Equivalent Courses** - Core Paper (DC), Ability Enhancement Compulsory Course (IC/SC), Skill Enhancement Course (IE), General Elective (IE/SE), Discipline Specific Elective (DE)

***AICTE Equivalent Courses** - Basic Science Course (IC), Engineering Science Course(IC), Open Elective Course (IC), Humanities and Social Science Courses (IC),Mandatory Course (IC), Professional Core Course (DC), Professional Elective Course (DE)

3.6. In order to qualify for a Graduate Degree, a student is required to complete the minimum credit requirements as prescribed by the competent academic authority.

3.7. In addition to the prescribed credit requirement a student shall have to complete the requirements of Extra Academic Programmes (EAP) as may be prescribed by the School.

Students shall be awarded P/NP grades for the EAP, which shall be recorded in the Grade sheet but not taken into account for computing the SGPA and the CGPA.

- 3.8. Students who secure a CGPA of at least 8 at the end of the 4th semester may opt to take one audit course per semester from any Department from the 5th semester onwards, provided the course teacher permits the auditing of the course. This shall be done under the guidance of the Departmental Faculty Advisor/mentor. The student is free to participate in the evaluation process for such courses. However, an attendance of 75% is necessary for obtaining a P grade for such courses. When auditing courses offered by other departments, it shall be the responsibility of the student to attend such courses without missing courses of one's own department and semester.
- 3.9. In addition, students may also opt for additional elective courses in consultation with their mentors. Students are required to participate in the evaluation process of such courses. The grades obtained for such courses shall be recorded in the grade sheet, but not taken into account for computing SGPA and CGPA.
- 3.10 It shall be the prerogative of the department to not offer an elective course which has less than 5 students opting for it.
- 3.11 The medium of instruction shall be English and examinations and project reports shall be in English.
- 3.12 The course structure and syllabi of the Graduate Degree Programmes shall be approved by the Academic Council of the University. Departmental Boards of Studies (DBS) shall discuss and recommend the syllabi of all the courses offered by the department from time to time before forwarding the same to the School Board of Studies (SBS). The SBS shall consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.
- 3.13 The curriculum may include industry training and /or fieldwork for a specified time.
This is to be satisfactorily completed before a student is declared eligible for the degree. There shall be credit allocation for such industrial training or fieldwork. Normally these activities shall be arranged during convenient semester breaks as shall be determined by the School Board of Studies.
- 3.14 **Faculty Advisor/Mentor:** A faculty advisor/mentor (and a co-mentor to perform the duties of a mentor during the absence of the mentor) shall be assigned for groups of students. Generally the faculty advisor/mentor shall be assigned by the concerned department, in consultation with the Director of the School concerned. (For the first year students of the BTECH programme, the Director of the School of Technology may assign the faculty advisor/mentor from departments belonging to other Schools teaching at the SOT). Faculty advisors/mentors shall help their mentees to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them.

4.0 Admission

- 4.1 All admissions to the Graduate Degree Programmes of the University shall be on the basis of merit. There may, however, be provision for direct admission for a limited number of NRI/FN students.
- 4.2 Eligibility Criteria
 - 4.2.1 To be considered for admission to a Graduate Degree Programme a candidate should have passed the Higher Secondary examination of a recognised Board of Higher

Secondary Education or an equivalent examination of any University / Board securing grades/marks as specified in the table below.

- 4.2.2 A candidate must also obtain qualifying marks required by the University in entrance tests/personal interview as the case may be. These marks shall be valid only for the academic year for which the test is held.
- 4.2.3 Admission will be on the basis of performance of the candidate at the qualifying examination, entrance test and/or personal interview.

Programme	Grade /Marks requirement from qualifying examinations	Entrance Examinations / Personal Interview
BTECH	Passed the qualifying examination in the Science Stream with 45% in the aggregate of all subjects and 45% in the aggregate of Physics, Chemistry and Mathematics	National Entrance Test such as JEE / State level entrance examination such as CEE or the ADBU Entrance Examination for Engineers
BBA, BCA, BCOM, BA Honours	Passed the qualifying examination in any stream with aggregate marks specified by appropriate academic body	Satisfactory performance in the Personal Interview
BSc Honours	Passed the qualifying examination in the science stream with aggregate of Physics, Chemistry and Mathematics specified by appropriate academic body	Satisfactory performance in the Personal Interview

- 4.3 Reservation of seats for the programme shall be as per the guidelines laid out in the Statutes of the University.
- 4.4 Admissions shall ordinarily close after a specified period from the date of commencement of the first semester, through a notification. However, in exceptional cases, admission of a candidate after the last date may be recommended to the University with justification, by the School / Departments concerned. Under such an event, this period shall not exceed four weeks from the date of commencement of the first semester.
- 4.4.1 The attendance of such students shall be computed from the date of admission.
- 4.4.2 Such students may be offered the opportunity of taking part in in-semester assessment modules which may have already been completed.
- 4.5 All candidates shall be required to satisfy the norms prescribed by the University for medical fitness prior to admission.
- 4.6 Lateral Entry into the BTECH Programmes**
- 4.6.1 Polytechnic diploma holders in different disciplines and B.Sc. Degree holders having Physics, Chemistry and Mathematics shall be eligible for admission to degree courses in Engineering and Technology in the third semester BTECH Programme against vacancies and/or seats in addition to the sanctioned intake in the first year.
- 4.6.2 Such diploma holders should have been bonafide students of polytechnics duly approved by the government and should have pursued an AICTE approved three-year diploma curriculum in an appropriate branch of Technology.

4.6.3 Only diploma holders who have secured a minimum of 45% in the aggregate in the relevant discipline and B.Sc. students who have secured a minimum of 45% marks in the aggregate shall be eligible for consideration for admission. The students belonging to B.Sc. Stream, would have to clear the subjects: Engineering Graphics/Engineering Drawing and Engineering Mechanics of the First Year Engineering Programme along with the Second year subjects.

4.6.4 Such admissions shall be on the basis of merit in the ADBU entrance test and a personal interview.

5.0 University Registration

5.1 Candidates shall have to register as bona-fide students with the University as per the University regulations within a period specified by the University, by a formal application routed through the Director of the School concerned.

5.2 For registration the following category of students have to obtain Migration Certificates from the University/Board last attended:

All first Semester and third semester (Lateral Entry) students of Master’s Degree Programmes
Students of Bachelor’s Degree (First Semester) who completed their Higher Secondary Examination in Boards other than AHSEC

Students of BTECH (Third Semester – Lateral Entry) who completed their 3-year Diploma under the governments of States other than the Assam.

6.0 Attendance

6.1. To be permitted to appear for the end-semester examination of a particular course, a student is required to have a minimum attendance of 75% for that course.

6.2 Deficiency in attendance up to 10% may be condoned by the Director of the School in the case of leave taken for medical and other grievous reasons, which are supported by valid medical certificates and other requisite documents.

6.3 Some students, due to exceptional situations like their own serious sickness and hospitalization or death of members of inner family circle (restricted to only father, mother, siblings), may have attendance below 65%. Such students may be given bonus attendance percentage for a particular course based on his/her attendance for that course during the remaining days of the current semester, as given in the following table:

Attendance during the remaining days of the current semester	Bonus percentage available in the current semester
95% or more	5
90% or more but less than 95%	4
85% or more but less than 90%	3
80% or more but less than 85%	2
75% or more but less than 80%	1

They shall be permitted to appear for the end-semester examination of the course if on the strength of this bonus attendance percentage, they obtain 65% attendance for that course.

6.4 If the sum of the credits of the courses for which a student is unable to appear at the end-semester examinations exceeds 50% of the total credits allotted for the semester, he/she shall not be permitted to appear for the entire end-semester examinations in view of clause 10.5 of these Regulations.

6.5 The School may propose to set aside a certain portion of the in-semester assessment marks for attendance. The number of marks and modalities of their allotment shall be made known to the students at the beginning of each semester.

6.6 Leave

6.6.1 Any absence from classes should be with prior sanctioned leave. The application for leave shall be submitted to the Office of the Director of the concerned School on prescribed forms, through proper channels, stating fully the reasons for the leave requested along with supporting documents.

6.6.2 In case of emergency such as sickness, bereavement or any other unavoidable reason for which prior application could not be made, the parent or guardian must promptly inform the office of the Director of the concerned School.

6.6.3 If the period of absence is likely to exceed 10 days, a prior application for grant of leave shall have to be submitted through the Director of the concerned School to the Registrar of the University with supporting documents in each case; the decision to grant leave shall be taken by the Registrar on the recommendation of the Director of the concerned School.

6.6.4 The Registrar may, on receipt of an application, also decide whether the student be asked to withdraw from the programme for that particular semester because of long absence.

6.7 It shall be the responsibility of the student to intimate the concerned teachers regarding his/her absence before availing the leave.

7.0 Grading System

7.1 Three types of courses are offered in the Graduate programmes:

- **Graded courses:** For the majority of the courses, students shall be assessed and given grades.
- **Pass/No-Pass courses:** There are some courses for which the students are expected to obtain a P grade to be eligible for the degree.
- **Audit Courses:** A third category of courses are audit courses. These are optional.

However, students who opt for these courses must have the required attendance to obtain a P grade in the course.

7.2 Based on the performance of a student, each student is awarded a final letter grade in each graded course at the end of the semester and the letter grade is converted into a grade point. The correspondence between percentage marks, letter grades and grade points is given in the table below:

Marks (x) obtained (%)	Grade	Description	Grade Points
$90 \leq x \leq 100$	O	Outstanding	10
$80 \leq x < 90$	E	Excellent	9
$70 \leq x < 80$	A+	Very Good	8
$60 \leq x < 70$	A	Good	7
$50 \leq x < 60$	B	Average	6
$40 \leq x < 50$	C	Below Average	5
$x < 40$	F	Failed	0

In addition, a student may be assigned the grades 'P' and 'NP' for pass marks and non- passing marks respectively, for Pass/No-pass courses, or the grade 'X' (not permitted).

- 7.2.1 A student shall be assigned the letter grade 'X' for a course if he/she is not permitted to appear for the end semester examination of that course due to lack of requisite attendance.
- 7.2.2 A letter grade 'F', 'NP' or 'X' in any course implies failure in that course.
- 7.2.3 A student is considered to have completed a course successfully and earned the credits if she/he secures a letter grade other than 'F', 'NP', or 'X'.
- 7.3 At the end of each semester, the following measures of the performance of a student in the semester and in the programme up to that semester shall be computed and made known to the student together with the grades obtained by the student in each course:
 - 7.3.1 The Semester Grade Point Average (SGPA): From the grades obtained by a student in the courses of a semester, the SGPA shall be calculated using the following formula:

$$SGPA = \frac{\sum_{i=1}^n GP_i \times NC_i}{\sum_{i=1}^n NC_i}$$

- Where GP_i = Grade points earned in the i^{th} course
- NC_i = Number of credits for the i^{th} course
- n = the number of courses in the semester

- 7.3.2 The Cumulative Grade Point Average (CGPA): From the SGPA's obtained by a student in the completed semesters, the CGPA shall be calculated using the following formula:

$$CGPA = \frac{\sum_{i=1}^n SGP_i \times NSC_i}{\sum_{i=1}^n NSC_i}$$

- Where SGP_i = Semester Grade point average of i^{th} semester
- NSC_i = Number of credits for the i^{th} semester
- n = the number of semesters completed

- 7.3.3 The CGPA may be converted into a percentage by multiplying CGPA by 10.
- 7.4 Both the SGPA and CGPA shall be rounded off to the second place of decimal and recorded as such. Whenever these CGPA are to be used for official purposes, only the rounded off values shall be used.
- 7.5 There are academic and non-academic requirements for the Graduate programmes where a student shall be awarded the 'P' and 'NP' grades. Non-credit courses such as Extra Academic Programmes belong to this category. No grade points are associated with these grades and these courses are not taken into account in the calculation of the SGPA or CGPA. However, the award of the degree is subject to obtaining a 'P' grade in all such courses.

7.6 In the case of an audit course, the letters “AU” shall be written alongside the course name in the Grade Sheet. A student is not required to register again for passing failed audit courses.

8.0 Assessment of Performance

8.1. A student’s performance is evaluated through a continuous system of evaluation comprising tests, quizzes, assignments, seminars, minor projects, major projects and end-semester examinations.

8.2. **Theory Courses:** Theory courses shall have two components of evaluation – in- semester assessment of 40% weightage and an end-semester examination having 60% weightage.

8.2.1. The modalities of the conduct of in-semester assessment and weightages attached to its various components shall be as published by the School at the beginning of each semester.

8.3. **Lab Courses:** Lab courses (Laboratory, Drawing, Workshop, etc.) shall be evaluated on the basis of attendance, assessment of tasks assigned and end semester test/viva voce. The weightage assigned for these components of the evaluation is given in the following table:

Component	Weightage
Attendance	10
Assessment of Tasks Assigned	30
End-semester test / viva voce	60

8.3.1. The modalities of the conduct of evaluation under the heading “Assessment of tasks assigned”, its components and the weightages attached to its various components shall be published by the department concerned at the beginning of each semester.

8.3.2. The evaluation of the end-semester test for a lab course may be done on the basis of criteria and weightage to be specified in the question paper, among which are included

- Organisation of the experiment
- Actual conduct of the experiment assigned and accuracy of the result
- Extent of completion
- A comprehensive viva-voce which examines the overall grasp of the subject

8.4 End-Semester examinations

8.4.1 End-semester examinations for the theory courses, generally of three hours’ duration, shall be conducted by the University. The Director of the concerned school shall make the arrangements necessary for holding the examinations.

8.4.2 In the end-semester examinations, a student shall be examined on the entire syllabus of the courses.

8.4.3 A student shall not obtain a pass grade for a course without appearing for the end-semester examination in that course.

8.5 Industry Training/Internship Programme

8.5.1 Departments may require students to undergo industry training/internship programmes.

8.5.2 Departments are to notify the students at the beginning of their programmes about the details of industry training/internship.

- 8.5.3 After the Industry Training/Internship programme, the student shall furnish a certificate from the organisation where he/she underwent the programme as proof of successful completion.
- 8.5.4 The student shall submit a training/internship report to the department in a format to be laid down by the concerned department. He/she shall also give a seminar to present the learning outcomes of the programme in the presence of the faculty members and students of the department. The student shall be evaluated on the basis of the report, the seminar and interaction during the seminar and grades shall be assigned. These grades shall be given a weightage of two credits in the subsequent semester.

8.6 The Major Project

- 8.6.1 Students of the BTECH programme and BCA programme shall undertake a Major Project during the course of their graduate studies. The BTECH major project work is normally conducted in two phases during the seventh and eighth semesters of the programme and is to be done individually or in groups within the campus. A department may substitute this with two independent projects in the seventh and eighth semesters with prior permission from the statutory authority. The BCA major project work is conducted during the sixth semester of the programme, and is to be done individually or in groups within the campus.
- 8.6.2 Each department shall constitute a Departmental Project Evaluation Committee (DPEC) consisting of the Head of the Department, Project Co-ordinator and two senior teachers from the department, with the Project Co-ordinator as the convener. The DPEC shall co-ordinate the conduct and assessment of the project.
- 8.6.3 The DPEC shall notify the schedule and modalities for the following stages in the implementation of the project.
- Submission of the topic of the project.
 - Notification for assignment of project supervisors.
 - Submission of the synopsis.
 - Schedule and modality for the submission of weekly activity reports.
 - Schedule for the seminar presentation of synopsis.
 - Schedule for Progress Seminars, submission of progress reports and viva voce examination.
 - Date for the submission of the project report and a brief summary.
 - Dates for the external evaluation of the project.

In the case of the BTECH project, some of these activities may be performed during semester VII (Phase I) and others during Semester VIII (Phase II) as shall be notified by the DPEC.

- 8.6.4 The DPEC may ask a student to resubmit a synopsis if the same does not get its approval.
- 8.6.5 The Convener of the DPEC shall submit to the Controller of Examinations a panel of at least three names of external examiners at least three weeks before the external examination. The Controller of Examinations shall appoint the external examiner(s) from this panel. The project supervisor shall be the internal examiner.

- 8.6.6 Each student shall submit to the DPEC three bound, typed copies of the project report, prepared according to the prescribed format, after the pre-submission seminar, by the due date. The student shall also submit three copies of a brief summary of the project that shall be forwarded to the concerned examiners.
- 8.6.7 The DPEC shall make the arrangements necessary to conduct the external evaluation in consultation with the examiner(s) appointed by the University, during the dates notified.
- 8.6.8 Phase I of the project shall be evaluated through in-semester assessment only. The modality and components of the assessment and their weightages shall be determined by the School and the same shall be notified at the beginning of each semester.
- 8.6.9 Phase II of the project shall be evaluated through in-semester and end-semester assessments of equal weightage. The in-semester assessment shall be done by the DPEC and the project supervisor and the end-semester assessment shall be done by the external examiner(s) and the project supervisor, assisted by the DPEC. The modality and components of the in-semester assessment and their weightages shall be determined by the school and the same shall be notified at the beginning of each semester.
- 8.6.10 The DPEC shall forward the in-semester assessment marks to the Controller of Examinations by the date specified by the Examination Department.
- 8.6.11 The end-semester assessment shall have the following components:
- Project implementation: 40 marks
 - Seminar presentation: 20 marks
 - Viva voce examination: 20 marks
 - Project documentation: 20 marks
- 8.6.12 Independent projects as envisaged in clause 8.6.1 shall be evaluated in the same manner as Phase II of the major project.
- 8.6.13 Those who obtain an 'F' grade for the major project shall be required to re-enrol for it in the subsequent semesters.

8.7 Minor and Mini Projects

- 8.7.1 Students may be assigned minor and mini projects by the department from the fourth semester onwards to ensure that their learning becomes a hands-on experience. These projects shall be executed by the students individually or in groups under the guidance of faculty members appointed by the department.
- 8.7.1.1 BCOM students shall undertake a Project (phase 1 & 2) spread across 5th and 6th semesters.
- 8.7.2 The mode of evaluation of these projects shall follow the pattern of evaluation of Lab Courses (vide clause 8.3) and the modalities for the conduct of evaluation, its components and the weightages attached to these components shall be published by the department concerned at the beginning of each semester.
- 8.7.3 The students may be required to submit project reports in the format specified. The evaluation of the Minor and Mini Projects shall take into consideration these project reports.

8.8 The evaluation of performance in Extra Academic Programmes shall be done by the authorities conducting them and they shall communicate the grades to the Director of the concerned School who shall forward them to the Controller of Examinations.

8.9 The Director of the concerned School shall forward the marks obtained in the in-semester evaluation to the Controller of Examinations within the prescribed time as may be notified.

8.9.1 All evaluated work in a course except the end semester answer scripts shall be returned to the students promptly.

8.10 Eligibility for appearing in the end-semester examinations: A student shall be permitted to appear for the end-semester examinations, provided that

8.10.1 A student has not been debarred from appearing in the end semester examinations as disciplinary action for serious breach of conduct.

8.10.2 He/she has satisfactory attendance during the semester according to the norms laid out in section 6 of these regulations.

8.10.3 He/she has paid the prescribed fees or any other dues of the university within the date specified.

8.11 Registration for end-semester Examinations

8.11.1 The University shall, through a notification, invite applications from students to register for the end-semester examinations.

8.11.2 Students who have registered with the University (vide clause 5) and those who have applied for such registration may apply to appear for the end- semester examinations of the university, in response to the notification issued by the University, provided that they fulfil the eligibility norms as laid down in clause 8.10.

8.11.3 All eligible candidates shall be issued an admit card for the relevant examination and for specified courses. A student who does not have a valid admit card may not be permitted to write the end-semester examinations.

8.11.4 A student who secures an 'F' or 'X' grade in any course in a semester may register for the end-semester examination for that course in a subsequent semester when that course is offered again, within the maximum period of time allotted for the completion of the programme. The in-semester assessment marks obtained by him/her in the last semester in which the said course was attended by him/her shall be retained.

8.11.5 Similarly, in case of an 'NP' grade in Extra Academic Programmes the student shall have to re-register for it in the appropriate semester of the next academic session.

8.11.6 When a student re-registers for the end semester examination of a course, in accordance with clause 8.11.4 above, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.12 Conduct of Examinations: The University shall conduct the end-semester examinations in accordance with the applicable regulations on such dates as are set down in the Academic Calendar or as notified.

8.13 Declaration of Results: The University shall declare the results of a semester and make available to the students their grade sheets within the time-frame prescribed by the relevant regulations of the university and specified in the academic calendar.

8.14 The University may withhold the results of a student for any or all of the following reasons

- he/she has not paid his/her dues
- there is a disciplinary action pending against him/her
- he/she has not completed the formalities for University Registration according to the requirement of section 5 of these Regulations.

8.15 Re-examining of answer scripts

8.15.1 If a student feels that the grade awarded to him/her in a course is not correct, he/she may apply to the University for the re-examining of his/her answer script.

8.15.2 Re-examining of scripts may be of two different categories – scrutiny and re-evaluation.

8.15.3 Scrutiny: The activities under this category shall ordinarily be confined to checking

- correctness of the total marks awarded and its conversion into appropriate letter grades
- whether any part/whole of a question has been left unevaluated inadvertently
- correctness of transcription of marks on the tabulation sheet and the grade sheet issued in respect of the course under scrutiny.

8.15.4 Re-evaluation: Re-evaluation of the answer script by independent experts in the concerned subject(s).

8.15.5 Application for re-examining of answer scripts

- A student may apply for scrutiny or re-evaluation for one or more courses of the just-concluded end-semester examinations within seven calendar days from the date of publication of its results in the application form prescribed for this purpose.
- He/she shall pay the prescribed fee to the University as notified.
- A student applying for scrutiny/re-evaluation shall expressly state on the application form whether the application made is for Scrutiny or for Re-evaluation. In each case, the student may also request to see his/her answer script.
- All applications for scrutiny/re-evaluation must be routed through the Director of the concerned School.

8.15.6 If in the process of re-examining, the grade obtained in a course changes, the better of the two grades shall be assigned to the course. If there is a change, the new grade shall be recorded and a new grade sheet shall be issued to the student.

8.15.7 Without prejudice to any of the clauses of section 8.15, a student who has been found to have used unfair means during an examination shall not be eligible to apply for scrutiny or re-evaluation of answer scripts.

8.16. Improvement Examination

8.16.1 After the completion of the entire programme of study, a student may be allowed the provision of improvement examinations. These are to be availed of only once each in the Autumn and Spring semesters that immediately follow the completion of the programme, and within the maximum number of years permissible for a programme.

8.16.2 A student who has taken migration from the University shall not be eligible to appear for Improvement Examination.

8.16.3 A student may not choose more than the number of courses specified below for improvement examinations.

Programme	Number of Courses for Improvement Examinations		
	Autumn Semester	Spring Semester	Total
BTECH	6	6	12
BCA	4	4	8
BCOM	4	4	8
BBA	4	4	8
BA	4	4	8
BSc	4	4	8

8.16.4 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.16.5 If the student improves his/her grades through the improvement examination, new grade sheets and comprehensive transcripts shall be issued to the student.

8.17. Special Examination

8.17.1 The University shall conduct Special Examinations to benefit the following categories of students:

8.17.1.1 Students who, on the completion of the final semester, have some 'F' graded courses in the two final semesters, but no 'F' or 'X' graded courses in any of the previous semesters

8.17.1.2 Students who have only one 'F' graded course in a semester other than the two final semesters and do not have 'F' or 'X' graded courses in the two final semesters.

8.17.2 The Special Examinations shall ordinarily be conducted each year within a month of the declaration of the results of the Spring Semester.

8.17.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students will be governed by the provisions of clause 10.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of inner family circle (restricted to only father, mother, siblings).

8.17.4 Students who have 'X' graded courses only in the last two semesters may be offered the opportunity for participating in a Tutorial Programme which may be conducted during the semester break immediately following the end- semester examinations of the final semester and students who earn 85% attendance for the programme shall be permitted to appear for the Special Examinations. Separate fees shall be charged for the Tutorial Programme.

8.17.5 Students who do not obtain pass grades in any course at the special examinations shall have to apply in the prescribed format and appear for the end-semester examination of these courses when they are scheduled by the University during subsequent relevant end-semester examinations.

9.0 Change of Branch (only for BTECH)

9.1 Normally a student admitted to a particular branch of the BTECH programme shall continue studying in that branch till completion. However, in special cases the university

may permit a student to change from one branch of studies to another after the first two semesters.

- 9.2 Students shall be allowed a change in branch subject to the limitation that the strength of a branch should not fall below the existing strength by more than ten percent and should not go above the sanctioned strength by more than ten percent.
- 9.3 Only those students shall be eligible for consideration of a change of branch, who have completed all the credits required in the first two semesters of their studies, in their first attempt.
- 9.4 Applications for a change of branch must be made by intending eligible students in the prescribed form. The Office of the Registrar shall call for applications at the beginning of the third semester and the completed forms must be submitted by the last date specified in the notification.
- 9.5 Students may enlist up to two choices of branch, in order of preference, to which they wish to change over. It shall not be permissible to alter the choice after the application has been submitted.
- 9.6 Change of branch shall be made strictly in order of merit of the applicants. For this purpose the CGPA obtained at the end of the second semester shall be considered. In case of a tie, the following shall be considered in the given order: the SGPA of the second semester, the SGPA of the first semester, grades obtained by the applicants in the courses of the second semester in an order to be determined by the Office of the Registrar.
- 9.7 A committee consisting of the Director and heads of departments of the concerned School, chaired by the Registrar shall examine the applications and consider them on the basis of the criteria laid out above.
- 9.8 The details of branch changes effected shall be notified to the students by the Registrar, within 7 days of the submission of applications.
- 9.9 All changes of branch shall be final and binding on the applicants. No student shall be permitted, under any circumstance, to refuse the change of branch offered.
- 9.10 All changes of branch made in accordance with the above rules shall be effective from the third semester of the applicants concerned. No change of branch shall be permitted after this.

10.0 Enrolment (for semesters other than the first)

- 10.1 Every student is required to enrol for the relevant courses before the commencement of each semester within the dates fixed for such enrolment and notified by the Registrar.
- 10.2 Students who do not enrol within the dates announced for the purpose may be permitted late enrolment up to the notified date on payment of a late fee.
- 10.3 Only those students shall be permitted to enrol who have
 - cleared all University, Departmental, Hostel and Library dues and fines (if any) of the previous semester,
 - paid all required University, Departmental and Hostel fees for the current semester, and
 - not been debarred from enrolling on any specific ground.
- 10.4 No student may enrol for a semester if he/she has not appeared, for whatever reason, in the end semester examinations of the previous semester.
- 10.5 A student who fails to obtain 50% of the credits offered in the third and subsequent semesters shall not be permitted to enrol for the next semester and shall have to re-enrol for and attend all the courses of the said semester in the following academic year. Students

who due to X grade (lack of due attendance) have been debarred from exams in any semester (including first and second) will have to re-enrol for the same.

11.0 Eligibility for the Award of the Graduate Degree

- 11.1 A student shall be declared to be eligible for the award of the Graduate Degree for which he/she has enrolled if he/she has
- 11.1.1 completed all the credit requirements for the degree with grade 'C' or higher grade in each of the mandatory graded courses and grade 'P' in all mandatory non-graded courses;
 - 11.1.2 satisfactorily completed all the non-credit requirements for the degree viz., Extra Academic Activities, Industry Training, Field Work, Internship Programme, etc. (if any);
 - 11.1.3 obtained a CGPA of 5.00 or more at the end of the semester in which he/she completes all the requirements for the degree;
 - 11.1.4 owes no dues to the University, School, Department, Hostels; and
 - 11.1.5 has no disciplinary action pending against him/her.
- 11.2 The award of the Graduate Degree must be recommended by the Academic Council and approved by the Board of Management of the University.

12.0 Termination from the Programme

- 12.1 If more than the number of years permitted for the completion of a programme have elapsed since the student was admitted, and the student has not become eligible for the award of Degree, the student shall be removed from the programme.
- 12.2 A student may also be required to leave the Programme on disciplinary grounds on the recommendations of the Students' Disciplinary Committee of the concerned School.

ASSAM DON BOSCO UNIVERSITY REGULATIONS

POST GRADUATE DEGREE PROGRAMMES

SCIENCE AND TECHNOLOGY

The following are the regulations of the Assam Don Bosco University concerning the Post-Graduate Programmes leading to the award of the Master's Degree in the disciplines of Science and Technology made subject to the provisions of its Statutes and Ordinances.

1.0 Academic Calendar

- 1.1 Each academic year is divided into two semesters of approximately 18 weeks duration: an Autumn Semester (July – December) and a Spring Semester (January – June). The Autumn Semester shall ordinarily begin in July for students already on the rolls and the Spring Semester shall ordinarily begin in January. However, the first semester (Autumn, for newly admitted students) may begin later depending on the completion of admission formalities.
- 1.2 The schedule of academic activities approved by the Academic Council for each semester, inclusive of the schedule of continuing evaluation for the semester, dates for the conduct of end-semester examinations, the schedule of publication of results, etc., shall be laid down in the Academic Calendar for the semester.

2.0 Duration of the Programme

- 2.1 The normal duration of the Post Graduate Programme shall be as per the table given below:

Programme	Number of Semesters	Number of Years
Master of Technology (MTECH)	4	2
Master of Computer Applications (MCA)	6	3
Master of Science (MSc)	4	2

- 2.2 However, students who do not fulfill some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 4 more semesters (2 years) to complete all the requirements of the degree.
- 2.3 Under exceptional circumstances and depending on the merit of each case, a period of 2 more semesters (1 year) may be allowed for the completion of the programme

3.0 Course Structure

- 3.1 The choice based credit system shall be followed for the Post Graduate Degree Programmes. Credits are allotted to the various courses depending on the number of lecture/tutorial/laboratory hours per five-day cycle (one week) of classes assigned to them using the following general pattern:
 - 3.1.1 Lecture : One hour per cycle/week is assigned 1 credit.
 - 3.1.2 Tutorial : One hour per cycle/week is assigned 1 credit.
 - 3.1.3 Practical : Two hours per cycle/week is assigned 1 credit.
- 3.2 The courses offered for the Post Graduate Degree Programmes are divided into two baskets – core courses and elective courses. (Core courses will include “Core Courses” and “Ability Enhancement Courses” mentioned in CBCS guidelines. Elective Courses will include “Discipline Specific Electives”, “Generic Electives”, optional “Dissertation or Project”, and “Skill Enhancement Courses”).

3.3 **Core Courses:** Core courses are those in the curriculum, the knowledge of which is deemed Essential for students who are pursuing the said Degree Programme.

3.3.1 A student shall be required to take all the core courses offered for a particular programme.

3.3.2 The number of credits required from core courses shall be as prescribed by the competent academic authority.

3.4 **Elective Courses:** These are courses in the curriculum which give the student opportunities for specialisation and which cater to his/her interests and career goals. These courses may be selected by the student and/or offered by the department conducting the programme, from those listed in the curriculum according to the norms laid down by the competent academic authority.

3.4.1 The number of credits which may be acquired through elective courses shall be prescribed by the competent academic authority.

3.5 These categories of courses may further be subdivided into departmental, school or institutional, depending on the department which offers the course. The schema of categorisation of courses into baskets is as given below:

*Core Courses	
Departmental Core (DC)	Core courses which are offered by the department conducting the programme
School Core (SC)	Core courses which are offered by a department other than the department conducting the programme, from within the same School
Institutional Core (IC)	Core courses which are offered by departments of the University from Schools other than the parent School
*Elective Courses	
Departmental Elective (DE)	Elective courses which are offered by the department conducting the programme
School Elective (SE)	Elective courses which are offered by a department other than the department conducting the programme, from within the same School
Institutional Elective (IE)	Elective courses which are offered by departments of the University from Schools others than the parent School

***UGC Equivalent Courses-** Core Paper (DC), Ability Enhancement Compulsory Course (IC/SC), Skill Enhancement Course (IE), General Elective (IE/SE), Discipline Specific Elective (DE)

***AICTE Equivalent Courses -** Basic Science Course (IC), Engineering Science Course(IC), Open Elective Course (IC), Humanities and Social Science Courses (IC),Mandatory Course (IC), Professional Core Course (DC), Professional Elective Course (DE)

3.6 In order to qualify for a Post Graduate Degree, a student is required to complete the minimum credit requirements as prescribed by the competent academic authority.

3.7 In addition to the prescribed credit requirements a student shall have to complete the requirements of Extra Academic Programmes (EAP) as may be prescribed by the School. Students shall be awarded P/NP grades for the EAP, which shall be recorded in the Gradesheet but not taken into account for computing the SGPA and the CGPA.

- 3.8 Students who secure a CGPA of at least 8 at the end of the first semester (third semester, in the case of MCA) may opt to take one audit course per semester from any Department from the second semester onwards (fourth semester, in the case of MCA), provided the course teacher permits the auditing of the course. This shall be done under the guidance of the Departmental Faculty Advisor/mentor. The student is free to participate in the evaluation process for such courses. However, an attendance of 75% is necessary for obtaining a P grade for such courses. When auditing courses offered by other departments, it shall be the responsibility of the student to attend such courses without missing courses of one's own department and semester.
- 3.9 In addition, students may also opt for additional elective courses in consultation with their mentors. Students are required to participate in the evaluation process of such courses. The grades obtained for such courses shall be recorded in the gradesheet, but not taken into account for computing SGPA and CGPA.
- 3.10 It shall be the prerogative of the department to not offer an elective course which has less than 5 students opting for it.
- 3.11 The medium of instruction shall be English and examinations and project reports shall be in English.
- 3.12 The course structure and syllabi of the Post Graduate Degree Programmes shall be approved by the Academic Council of the University. Departmental Boards of Studies (DBOS) shall discuss and recommend the syllabi of all the courses offered by the department from time to time before forwarding the same to the School Board of Studies (SBOS). The SBOS shall consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.
- 3.13 The curriculum may include industry training and /or fieldwork for a specified time. This is to be satisfactorily completed before a student is declared eligible for the degree. There shall be credit allocation for such industrial training or fieldwork. Normally these activities shall be arranged during convenient semester breaks as shall be determined by the School Board of Studies.
- 3.14 Faculty Advisor/Mentor:** A faculty advisor/mentor (and a co-mentor to perform the duties of a mentor during the absence of the mentor) shall be assigned for groups of students. Faculty advisors/mentors shall help their mentees to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them.

4.0 Admission

- 4.1 All admissions to the Post Graduate Degree Programmes of the University shall be on the basis of merit. There may, however, be provision for direct admission for a limited number of NRI/FN students.
- 4.2 **Eligibility Criteria**
- 4.2.1 To be considered for admission to a Post Graduate Degree Programme a candidate should have passed a Bachelor's Degree (or equivalent) programme of a recognised university securing grades/marks as specified in the table below.
- 4.2.2 Admission will be on the basis of the performance of the candidate at the graduate level, the Post Graduate Entrance Test conducted by the university and/or a personal interview. Candidates for MTECH who have a valid GATE score may be exempted from the entrance test.

Programme	Grade /Marks requirement from qualifying examinations	Entrance Examinations / Personal Interview
MTECH	Completed a Bachelor's Degree programme in the appropriate stream of technology from a recognised university successfully with a minimum CGPA of 6.5 (or equivalent). The Academic Council may establish other eligibility criteria for M Tech in a particular discipline.	Post Graduate Entrance Test of Assam Don Bosco University
MCA	Completed a Bachelor's Degree programme in any stream of a recognised university successfully with a minimum of 50 % marks in the aggregate. In addition, the candidate must have passed Mathematics or equivalent at the higher secondary level or above.	Post Graduate Entrance Test of Assam Don Bosco University
MSc	Completed a Bachelor's Degree programme in Science of a recognised university successfully with a minimum aggregate specified by the competent academic body.	Satisfactory performance in the Personal Interview

- 4.3 Reservation of seats for the programme shall be as per the guidelines laid out in the Statutes of the University.
- 4.4 Admissions shall ordinarily close after a specified period from the date of commencement of the first semester, through a notification. However, in exceptional cases, admission of a candidate after the last date may be recommended to the University with justification, by the School / Departments concerned. Under such an event, this period shall not exceed four weeks from the date of commencement of the first semester.
- 4.4.1 The attendance of such students shall be computed from the date of admission.
- 4.4.2 Such students may be offered the opportunity of taking part in in-semester assessment modules which may have already been completed.
- 4.5 All candidates shall be required to satisfy the norms prescribed by the University for medical fitness prior to admission.
- 4.6 Candidates may be required to furnish a certificate of good conduct from the institution last attended.

4.7 Lateral Entry into the MCA Programme

Students who have completed the BCA programme of Assam Don Bosco University shall be eligible for admission into the third semester of the MCA programme. Students who have completed BCA with 50% marks in aggregate from other Universities may be admitted on successful completion of ADBU entrance test and interview.

5.0 University Registration

- 5.1 Candidates shall have to register as bona-fide students with the University as per the University regulations within a period specified by the University, by a formal application routed through the Director of the School concerned.
- 5.2 For registration the following category of students have to obtain Migration Certificates from the University/Board last attended:

All first Semester and third semester (Lateral Entry) students of Master's Degree Programmes
Students of Bachelor's Degree (First Semester) who completed their Higher Secondary Examination in Boards other than AHSEC

Students of BTECH (Third Semester – Lateral Entry) who completed their 3-year Diploma under the governments of States other than the Assam.

6.0 Attendance

- 6.1 To be permitted to appear for the end-semester examination of a particular course, a student is required to have a minimum attendance of 75% for that course.
- 6.2 Deficiency in attendance up to 10% may be condoned by the Director of the School in the case of leave taken for medical and other grievous reasons, which are supported by valid medical certificates and other requisite documents.
- 6.3 Some students, due to exceptional situations like their own serious sickness and hospitalization or death of members of inner family circle (restricted to only father, mother, siblings), may have attendance below 65%. Such students may be given bonus attendance percentage for a particular course based on his/her attendance for that course during the remaining days of the current semester, as given in the following table:

Attendance during the remaining days of the current semester	Bonus percentage available in the current semester
95% or more	5
90% or more but less than 95%	4
85% or more but less than 90%	3
80% or more but less than 85%	2
75% or more but less than 80%	1

They shall be permitted to appear for the end-semester examination of the course if, on the strength of this bonus attendance percentage, they obtain 65% attendance for that course.

- 6.4 If the sum of the credits of the courses for which a student is unable to appear at the end-semester examinations exceeds 50% of the total credits allotted for the semester, he/she shall not be permitted to appear for the entire end-semester examinations in view of clause 9.5 of these Regulations.
- 6.5 The School may propose to set aside a certain portion of the in-semester assessment marks for attendance. The number of marks and modalities of their allotment shall be made known to the students at the beginning of each semester.
- 6.6 **Leave**

- 6.6.1 Any absence from classes should be with prior sanctioned leave. The application for leave shall be submitted to the office of the Director of the concerned School on prescribed forms, through proper channels, stating fully the reasons for the leave requested along with supporting documents.
- 6.6.2 In case of emergency such as sickness, bereavement or any other unavoidable reason for which prior application could not be made, the parent or guardian must promptly inform the office of the Director of the concerned School.
- 6.6.3 If the period of absence is likely to exceed 10 days, a prior application for grant of leave shall have to be submitted through the Director of the concerned School to the Registrar of the University with supporting documents in each case; the decision to

grant leave shall be taken by the Registrar on the recommendation of the Director of the concerned School.

6.6.4 The Registrar may, on receipt of an application, also decide whether the student be asked to withdraw from the programme for that particular semester because of long absence.

6.7 It shall be the responsibility of the student to intimate the concerned teachers regarding his/her absence before availing the leave.

7.0 Grading System

7.1. Three types of courses are offered in the Post Graduate programmes:

- **Graded courses:** For the majority of the courses, students shall be assessed and given grades.
- **Pass/No-Pass courses:** There are some courses for which the students are expected to obtain a P grade to be eligible for the degree.
- **Audit Courses:** A third category of courses are audit courses. These are optional.

However, students who opt for these courses must have the required attendance to obtain a P grade in the course.

7.2 Based on the performance of a student, each student is awarded a final letter grade in each graded course at the end of the semester and the letter grade is converted into a grade point. The correspondence between percentage marks, letter grades and grade points is given in the table below:

Marks (x) obtained (%)	Grade	Description	Grade Points
$90 \leq x \leq 100$	O	Outstanding	10
$80 \leq x < 90$	E	Excellent	9
$70 \leq x < 80$	A+	Very Good	8
$60 \leq x < 70$	A	Good	7
$50 \leq x < 60$	B	Average	6
$40 \leq x < 50$	C	Below Average	5
$x < 40$	F	Failed	0

In addition, a student may be assigned the grades 'P' and 'NP' for pass marks and non-passing marks respectively, for Pass/No-pass courses, or the grade 'X' (not permitted).

7.2.1 A student shall be assigned the letter grade 'X' for a course if he/she is not permitted to appear for the end semester examination of that course due to lack of requisite attendance.

7.2.2 A letter grade 'F', 'NP' or 'X' in any course implies failure in that course.

7.2.3 A student is considered to have completed a course successfully and earned the credits if she/he secures a letter grade other than 'F', 'NP', or 'X'.

7.3. At the end of each semester, the following measures of the performance of a student in the semester and in the programme up to that semester shall be computed and made known to the student together with the grades obtained by the student in each course:

7.3.1. The Semester Grade Point Average (SGPA): From the grades obtained by a student in the courses of a semester, the SGPA shall be calculated using the following formula:

$$SGPA = \frac{\sum_{i=1}^n GP_i \times NC_i}{\sum_{i=1}^n NC_i}$$

Where GP_i = Grade points earned in the i^{th} course
 NC_i = Number of credits for the i^{th} course
 n = the number of courses in the semester

7.3.2 The Cumulative Grade Point Average (CGPA): From the SGPA's obtained by a student in the completed semesters, the CGPA shall be calculated using the following formula:

$$CGPA = \frac{\sum_{i=1}^n SGP_i \times NSC_i}{\sum_{i=1}^n NSC_i}$$

Where SGP_i = Semester Grade point average of i^{th} semester
 NSC_i = Number of credits for the i^{th} semester
 n = the number of semesters completed

7.3.3. The CGPA may be converted into a percentage by multiplying CGPA by 10.

- 7.4. Both the SGPA and CGPA shall be rounded off to the second place of decimal and recorded as such. Whenever these CGPA are to be used for official purposes, only the rounded off values shall be used.
- 7.5. There are academic and non-academic requirements for the Graduate programmes where a student shall be awarded the 'P' and 'NP' grades. Non-credit courses such as Extra Academic Programmes belong to this category. No grade points are associated with these grades and these courses are not taken into account in the calculation of the SGPA or CGPA. However, the award of the degree is subject to obtaining a 'P' grade in all such courses.
- 7.6. In the case of an audit course, the letters "AU" shall be written alongside the course name in the Grade Sheet. A student is not required to register again for passing failed audit courses.

8.0 Assessment of Performance

8.1. A student's performance is evaluated through a continuous system of evaluation comprising tests, quizzes, assignments, seminars, minor projects, major projects and end-semester examinations.

8.2. Theory Courses: Theory courses shall have two components of evaluation – in- semester assessment of 40% weightage and an end-semester examination having 60% weightage.

8.2.1. The modalities of the conduct of in-semester assessment and weightages attached to its various components shall be as published by the School/Department at the beginning of each semester.

8.3. Lab Courses: Lab courses (Laboratory, Drawing, Workshop, etc.) shall be evaluated on the basis of attendance, assessment of tasks assigned and end semester test/viva voce. The weightage assigned for these components of the evaluation is given in the following table:

Component	Weightage
Assessment of Tasks Assigned	40
End-semester test / Viva voce	60

8.3.1. The modalities of the conduct of evaluation under the heading “Assessment of tasks assigned”, its components and the weightages attached to its various components shall be published by the department concerned at the beginning of each semester.

8.3.2. The evaluation of the end-semester test for a lab course may be done on the basis of criteria and weightage to be specified in the question paper, among which are included

- Organisation of the program/experiment
- Coding, freedom from logical and syntactical errors, and accuracy of the result obtained / conduct of the experiment assigned and accuracy of the result
- Extent of completion
- A comprehensive viva-voce which examines the overall grasp of the subject

8.4. End-Semester examinations

8.4.1. End-semester examinations for the theory courses, generally of three hours’ duration, shall be conducted by the University. The Director of the concerned school shall make the arrangements necessary for holding the examinations.

8.4.2. In the end-semester examinations, a student shall be examined on the entire syllabus of the courses.

8.4.3. A student shall not obtain a pass grade for a course without appearing for the end-semester examination in that course.

8.5. Research Seminar

8.5.1. During the course of the Post Graduate programme students may be required to conduct research seminars on a regular basis. The purpose of these research seminars is to encourage the students to conduct literature survey on the recent trends and developments in a chosen area of the discipline.

8.5.2. The literature survey conducted in preparation for these seminars may lead the students to the development of a project model to be executed during the final semesters of the programme.

8.5.3. The Research Seminars shall be evaluated on the basis of a presentation, a report and a viva voce examination.

8.6. The Major Project / Research Project / Dissertation

8.6.1 Students of the Post Graduate Programme shall undertake a Major Project / Research Project / Dissertation during the course of their Post Graduate studies. The Major Project / Research Project / Dissertation (to be referred to as Major Project henceforth) is normally conducted in two phases during the last two semesters of the programme.

8.6.2 The Major Project may be a software project, a research oriented project or research work which leads to a dissertation, as may be relevant to the discipline in which the work is undertaken. If it is a research oriented work, it should expose the students to the current state of research in a chosen area of the discipline and lead to new developments in the area.

- 8.6.3 The Major Project is to be undertaken individually in the campus or outside as may be specified by the department.
- 8.6.4 Each department shall constitute a Departmental Project Evaluation Committee (DPEC) consisting of the Director of the School (Chairperson), Head of the Department (Vice Chairperson), Project Co-ordinator and two senior teachers from the department, with the Project Co-ordinator as the convenor. The DPEC shall co-ordinate the conduct and assessment of the project.
- 8.6.4. The DPEC will notify the schedule and modalities for the following stages in the implementation of the project.
- Submission of the topic of the project.
 - Notification for assignment of project supervisors.
 - Submission of the synopsis
 - Schedule for the seminar presentation of synopsis.
 - Schedule for Progress Seminars, submission of progress reports and viva voce examination.
 - Date for the submission of the project report and a brief summary.
 - Dates for the end semester evaluation of the project.
- 8.6.5. The DPEC may ask a student to resubmit a synopsis if the same does not get its approval.
- 8.6.6. The project supervisor may be from outside the department or university. Such a supervisor should be approved by the DPEC and jointly supervise a project with a faculty member of the department.
- 8.6.7. The minimum qualification of a project supervisor shall be laid down by the DPEC in consultation with the Director of the School and authorities of the University.
- 8.6.8. The Chairperson of the DPEC will submit to the Controller of Examinations a panel of at least three names of external examiners at least three weeks before the end semester examination. The Controller of Examinations will appoint the external examiner(s) from this panel.
- 8.6.9. Each student shall submit to the DPEC four bound, printed copies of the project report, prepared according to the prescribed format made available, by the due date. The student will submit also three copies of a brief summary of the project that will be forwarded to the concerned examiners.
- 8.6.10 The DPEC will make the arrangements necessary to conduct the end semester evaluation in consultation with the examiners appointed by the University, during the dates notified.
- 8.6.11 The project will be evaluated through in-semester and end-semester assessments of equal weightage. The in-semester assessment will be done by the DPEC and the project supervisor. The end-semester assessment will be done by the external examiner(s), the project supervisor and a member of the DPEC appointed by it for the purpose. The weightages attached to their respective evaluations shall be 60:20:20.
- 8.6.12 The DPEC will forward the in-semester assessment marks to the Controller of Examinations by the date specified by the Examination Department.

8.6.13 Given below are the suggested components of Internal assessment and respective marks assigned:

- Synopsis: 15 marks
- Seminar presentation of the synopsis: 15 marks
- Project implementation: 40 marks
- Pre-submission presentation: 15 marks
- Pre-submission viva voce: 15 marks

8.6.14 Given below are the suggested components of External assessment and respective marks assigned:

- Project implementation: 40 marks
- Seminar presentation: 25 marks
- Viva voce examination: 20 marks
- Project documentation: 15 marks

8.6.15 Publication of papers and registering of patents are encouraged during the Post Graduate programme. Papers published or patents obtained may be awarded extra weightage during the evaluation of the project.

8.6.16 Those who obtain an 'F' grade for the major project will be required to re-enrol for it in the subsequent semester and pay the prescribed fees.

8.7. The Director will forward the marks obtained in the in-semester evaluation to the Controller of Examinations within the prescribed time as may be notified.

8.8. All evaluated work in a subject except the end semester answer scripts will be returned to the students promptly.

8.9 Eligibility for appearing in the end-semester examinations: A student shall be permitted to appear for the end-semester examinations, provided that

8.9.1. A student has not been debarred from appearing in the end semester examinations as disciplinary action for serious breach of conduct.

8.9.2. He/she has satisfactory attendance during the semester according to the norms laid out in section 6 of these regulations.

8.9.3. He/she has paid the prescribed fees or any other dues of the university within the date specified.

8.10 Registration for end-semester Examinations

8.10.1 The University shall, through a notification, invite applications from students to register for the end-semester examinations.

8.10.2 Students who have registered with the University (vide clause 5) and those who have applied for such registration may apply to appear for the end- semester examinations of the university, in response to the notification issued by the University, provided that they fulfil the eligibility norms as laid down in clause 8.9.

8.10.3 All eligible candidates shall be issued an admit card for the relevant examination and for specified courses. A student who does not have a valid admit card may not be permitted to write the end-semester examinations.

8.10.4 A student who secures an 'F' or 'X' grade in any course in a semester may register for the end-semester examination for that course in a subsequent semester when

that course is offered again, within the maximum period of time allotted for the completion of the programme. The in-semester assessment marks obtained by him/her in the last semester in which the said course was attended by him/her shall be retained.

8.10.5 Similarly, in case of an 'NP' grade in Extra Academic Programmes the student shall have to re-register for it in the appropriate semester of the next academic session.

8.10.6 When a student re-registers for the end semester examination of a course, in accordance with clause 8.10.4 above, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.11 Conduct of Examinations: The University shall conduct the end-semester examinations in accordance with the applicable regulations on such dates as are set down in the Academic Calendar or as notified.

8.12 Declaration of Results: The University shall declare the results of a semester and make available to students their gradesheets within the time-frame prescribed by the relevant regulations of the university and specified in the academic calendar.

8.13 The University may withhold the results of a student for any or all of the following reasons

- he/she has not paid his/her dues
- there is a disciplinary action pending against him/her
- he/she has not completed the formalities for University Registration according to the requirement of section 5 of these Regulations.

8.14 Re-examining of answer scripts

8.14.1 If a student feels that the grade awarded to him/her in a course is not correct, he/she may apply to the University for the re-examining of his/her answer script.

8.14.2 Re-examining of scripts may be of two different categories – scrutiny and re- evaluation.

8.14.3 **Scrutiny:** The activities under this category shall ordinarily be confined to checking

- correctness of the total marks awarded and its conversion into appropriate letter grades
- whether any part/whole of a question has been left unevaluated inadvertently
- correctness of transcription of marks on the tabulation sheet and the gradesheet issued in respect of the course under scrutiny.

8.14.4 Re-evaluation: Re-evaluation of the answer script by independent experts in the concerned subject(s).

8.14.5 Application for re-examining of answer scripts

- A student may apply for scrutiny or re-evaluation for one or more courses of the just-concluded end-semester examinations within seven calendar days from the date of publication of its results in the application form prescribed for this purpose.
- He/she shall pay the prescribed fee to the University as notified.
- A student applying for scrutiny/re-evaluation shall expressly state on the application form whether the application made is for Scrutiny or for Re- evaluation. In each case, the student may also request to see his/her answer script.
- All applications for scrutiny/re-evaluation must be routed through the Director of the concerned School.

8.14.6 If in the process of re-examining, the grade obtained in a course changes, the better of the two grades shall be assigned to the course. If there is a change, the new grade shall be recorded and a new grade sheet shall be issued to the student.

8.14.7 Without prejudice to any of the clauses of section 8.14, a student who has been found to have used unfair means during an examination shall not be eligible to apply for scrutiny or re-evaluation of answer scripts.

8.15 Improvement Examination

8.15.1 After the completion of the entire programme of study, a student may be allowed the provision of improvement examinations. These are to be availed of only once each in the Autumn and Spring semesters that immediately follow the completion of the programme, and within the maximum number of years permissible for a programme.

8.15.2 A student who has taken migration from the University shall not be eligible to appear for Improvement Examination.

8.15.3 A student may not choose more than the number of courses specified in the table below for improvement examinations.

Programme	Number of Courses for Improvement Examinations		
	Autumn Semester	Spring Semester	Total
MCA	4	4	8
MSc	3	3	6
MTECH	2	2	4

8.15.4 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

8.15.5 If the student improves his/her grades through the improvement examination, new grade sheets and comprehensive transcripts shall be issued to the student.

8.16 Special Examination

8.16.1 The University shall conduct Special Examinations to benefit the following categories of students:

8.16.1.1 Students who, on the completion of the final semester, have some 'F' graded courses in the two final semesters, but no 'F' or 'X' graded courses in any of the previous semesters

8.16.1.2 Students who have only one 'F' graded course in a semester other than the two final semesters and do not have 'F' or 'X' graded courses in the two final semesters.

8.16.2 The Special Examinations shall ordinarily be conducted each year within a month of the declaration of the results of the Spring Semester.

8.16.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students will be governed by the provisions of clause 9.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of inner family circle (restricted to only father, mother, siblings).

8.16.4 Students who have 'X' graded courses only in the last two semesters may be offered the opportunity for participating in a Tutorial Programme which may be conducted during the semester break immediately following the end-semester examinations of

the final semester and students who earn 85% attendance for the programme shall be permitted to appear for the Special Examinations. Separate fees shall be charged for the Tutorial Programme.

8.16.5 Students who do not obtain pass grades in any course at the special examinations shall have to apply in the prescribed format and appear for the end-semester examination of these courses when they are scheduled by the University during subsequent relevant end-semester examinations.

9.0 Enrolment (for semesters other than the first)

9.1 Every student is required to enrol for the relevant courses before the commencement of each semester within the dates fixed for such enrolment and notified by the Registrar.

9.2 Students who do not enrol within the dates announced for the purpose may be permitted late enrolment up to the notified date on payment of a late fee.

9.3 Only those students shall be permitted to enrol who have

- cleared all University, Departmental, Hostel and Library dues and fines (if any) of the previous semester,
- paid all required University, Departmental and Hostel fees for the current semester, and
- not been debarred from enrolling on any specific ground.

9.4 No student may enrol for a semester if he/she has not appeared, for whatever reason, in the end semester examinations of the previous semester.

9.5 A student who fails to obtain 50% of the credits offered in the third and subsequent semesters shall not be permitted to enrol for the next semester and shall have to re-enrol for and attend all the courses of the said semester in the following academic year. Students who due to X grade (lack of due attendance) have been debarred from exams in any semester (including first and second) will have to re-enrol for the same.

10.0 Eligibility for the Award of the Post Graduate Degree

10.1 A student shall be declared to be eligible for the award of the Post Graduate Degree for which he/she has enrolled if he/she has

10.1.1 completed all the credit requirements for the degree with grade 'C' or higher grade in each of the mandatory graded courses and grade 'P' in all mandatory non-graded courses.

10.1.2 satisfactorily completed all the non-credit requirements for the degree viz., Extra Academic Activities, Industry Training, field work, internship programme, etc. (if any);

10.1.3 obtained a CGPA of 5.00 or more at the end of the semester in which he/she completes all the requirements for the degree;

10.1.4 owes no dues to the University, School, Department, Hostels; and

10.1.5 has no disciplinary action pending against him/her.

10.2 The award of the Post Graduate Degree must be recommended by the Academic Council and approved by the Board of Management of the University.

11.0 Termination from the Programme

- 11.1. If more than the number of years permitted for the completion of a programme have elapsed since the student was admitted, and the student has not become eligible for the award of Degree, the student shall be removed from the programme.
- 11.2. A student may also be required to leave the Programme on disciplinary grounds on the recommendations of the Students' Disciplinary Committee of the concerned School.

ASSAM DON BOSCO UNIVERSITY REGULATIONS

POST GRADUATE DEGREE PROGRAMMES

HUMANITIES AND SOCIAL SCIENCES

COMMERCE AND MANAGEMENT

The following are the regulations of the Assam Don Bosco University concerning the Post-Graduate Programmes leading to the award of the Master's Degree in the disciplines of Humanities and Social Sciences & Commerce and Management made subject to the provisions of its Statutes and Ordinances:

The Master's Degree Programmes of Assam Don Bosco University consist of theory and practicum components, taught and learned through a combination of lectures, field work/field visit and research projects.

1.0 Academic Calendar

- 1.1 Each academic year is divided into two semesters of approximately 18 weeks duration: an Autumn Semester (July – December) and a Spring Semester (January – June). The Autumn Semester shall ordinarily begin in July for students already on the rolls and the Spring Semester shall ordinarily begin in January. However, the first semester (Autumn, for newly admitted students) may begin later depending on the completion of admission formalities.
- 1.2 The schedule of academic activities approved by the Academic Council for each semester, inclusive of the schedule of continuing evaluation for the semester, dates for end-semester examinations, the schedule of publication of results, etc., shall be laid down in the Academic Calendar for the semester.

2.0 Duration of the Programme

- 2.1 The normal duration of the Post Graduate Programme in the disciplines of Humanities and Social Sciences & Commerce and Management shall be 4 semesters (2 years).
- 2.2 However, students who do not fulfil some of the requirements in their first attempt and have to repeat them in subsequent semesters may be permitted up to 4 more semesters (2 years) to complete all the requirements of the degree.
- 2.3 Under exceptional circumstances and depending on the merit of each case, a period of 2 more semesters (1 year) may be allowed for the completion of the programme

3.0 Course Structure

- 3.1 The choice based credit system shall be followed for the Masters Degree Programmes.
Credits are allotted to the various courses depending on the number of hours of lecture/practicum/Field work assigned to them using the following general pattern:
 - 3.1.1. Lecture : One hour per cycle/week is assigned 1 credit.
 - 3.1.2. Practicum/fieldwork : Two hours per cycle/week is assigned 1 credit.
- 3.2 The courses are divided into two baskets – core courses and elective courses. (Core courses will include “Core Courses” and “Ability Enhancement Courses” mentioned in CBCS guidelines. Elective Courses will include “Discipline Specific Electives”, “Generic Electives”, optional “Dissertation or Project”, and “Skill Enhancement Courses”)

3.3 **Core Courses:** Core courses are those in the curriculum, the knowledge of which is deemed essential for students who are pursuing the programme.

3.3.1 A student shall be required to take all the core courses offered for a particular programme.

3.3.2 The number of credits required from core courses shall be as prescribed by the competent academic authority.

3.4 **Elective Courses:** These are courses in the curriculum which give the student opportunities for specialisation and which cater to his/her interests and career goals. These courses may be selected by the student and/or offered by the department conducting the programme, from those listed in the curriculum according to the norms laid down by the competent academic authority.

3.4.1 The number of credits which may be acquired through elective courses shall be prescribed by the Board of studies pertaining to the programme.

3.5 These categories of courses may further be subdivided into departmental, school or institutional, depending on the department which offers the course. The schema of categorisation of courses into baskets is as given below:

*Core Courses	
Departmental Core (DC)	Core courses which are offered by the department which conducts the programme
School Core (SC)	Core courses which are offered by a department other than the department which conducts the programme, from within the same School
Institutional Core (IC)	Core courses which are offered by departments of the University from Schools other than the parent School
*Elective Courses	
Departmental Elective (DE)	Elective courses which are offered by the department which conducts the programme
School Elective (SE)	Elective courses which are offered by a department other than the department which conducts the programme, from within the same School
Institutional Elective (IE)	Elective courses which are offered by departments of the University from Schools others than the parent School

***UGC Equivalent Courses** - Core Paper (DC), Ability Enhancement Compulsory Course (IC/SC), Skill Enhancement Course (IE), General Elective (IE/SE), Discipline Specific Elective (DE)

***AICTE Equivalent Courses** - Basic Science Course (IC), Engineering Science Course(IC), Open Elective Course (IC), Humanities and Social Science Courses (IC),Mandatory Course (IC), Professional Core Course (DC), Professional Elective Course (DE)

3.6 In order to qualify for a Masters Degree, a student is required to complete the credit requirement as prescribed in the curriculum.

3.7 In addition to the prescribed credit requirement, a student shall have to complete the requirements of Extra Academic Programmes (EAP) as may be prescribed by the Department. Students shall be awarded P/NP grades for the EAP, which shall be recorded in the Gradesheet, but not taken into account for computing the SGPA and the CGPA.

- 3.8 Students who secure a CGPA of at least 7.5 at the end of the 2nd semester may opt to take one audit course per semester from any Department from the 3rd semester onwards, provided the course teacher permits the auditing of the course. This shall be done under the guidance of the Departmental Faculty Advisor/mentor. The student is free to participate in the evaluation process for such courses. However, an attendance of 75% percentage is necessary for obtaining a P grade for such courses. When auditing courses offered by other departments, it shall be the responsibility of the student to attend such courses without missing courses of one's own department and semester.
- 3.9 In addition, students may also opt for additional elective courses in consultation with their mentors. Students are required to participate in the evaluation process of such courses. The grades obtained for such courses shall be recorded in the gradesheet, but not taken into account for computing SGPA and CGPA.
- 3.10 It shall be the prerogative of the department to not offer an elective course which has less than 5 students opting for it.
- 3.11 The medium of instruction shall be English and examinations and project reports shall be in English.
- 3.12 The course structure and syllabi of the Post Graduate Degree Programmes shall be approved by the Academic Council of the University. Departmental Boards of Studies (DBOS) shall discuss and recommend the syllabi of all the courses offered by the department from time to time before forwarding the same to the School Board of Studies (SBOS). The SBOS shall consider the proposals from the departments and make recommendations to the Academic Council for consideration and approval.
- 3.13 The curriculum may include fieldwork / institutional visits / internship for a specified time. These are to be satisfactorily completed before a student is declared eligible for the degree. There shall be credit allocation for such activities. These activities may be arranged during the semester or during convenient semester breaks as shall be determined by the School Board of Studies.
- 3.14 **Faculty Advisor/Mentor:** A faculty advisor/mentor shall be assigned for groups of students. Faculty advisors/mentors shall help their mentees to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them.

PROGRAMME SPECIFIC CURRICULAR ASPECTS

4.0 MASTER OF SOCIAL WORK (MSW)

4.1 **Area of Concentration:** The third and fourth semesters shall have courses from a chosen Area of Concentration (AoC) from among those offered by the department. The AoC is to be opted for at the end of the second semester and will be confirmed by the department depending on the availability of seats and the aptitude and ability of the student. An AoC will be offered by the department only if a minimum of ten students opt for it. The fieldwork and research project of the third and fourth semesters will be based on the AoC.

4.2 Concurrent and Continuous Fieldwork

Fieldwork shall be an essential part of the course structure in all the semesters of the programme. The field work practice in the first semester shall consist of orientation visits, sessions for skills training and placement. In the first year, the focus of the field work shall be the community and in the second year the focus shall be based on the specialisation chosen by the students. In the first semester,, students shall be placed in communities, NGOs,

service organizations and government agencies working with communities, and in those settings where they can be exposed to the community and community issues. The students get a close feel of the community and community settings, understand the dynamics and issues in the community and become aware of the sensitivities of people while working with them. They also get a firsthand experience of the programmes and projects implemented in the communities by NGOs and government agencies and the impact that these have on the community. They shall also interact with the personnel from organisations and the community members to understand the tension between tradition and change that the communities in the region are likely to experience, and how it is handled. They shall, with the help of the organisation and the field work supervisor, identify an issue and work on it following the principles of community organization. The students are expected to be creative and innovative in assisting the agency and community in whatever way possible.

The field work practice in the second semester will consist of lab sessions for skills training and placement. The focus will be on the practice of social case work and Group works. The students shall be placed in NGOs, and government service organizations and government agencies working with individuals and families, and in those settings where they can be exposed to issues related to individuals and groups.

- 4.2.1 Normally a student shall spend fifteen hours over two days per week in field work. However, keeping in mind the peculiar situation of transport and communications in the region and the expenses involved, the field work practice may be arranged in other convenient ways as the institution deems fit.
- 4.2.2. The student is required to submit the report on the field work and the field work diary to the field work supervisor, before the commencement of classes on the first day of class following the field work days. The supervisor shall conduct regular field work conferences
- 4.2.3. A student is expected to have 100 percent attendance in field work. Any shortage shall be compensated by him/her.
- 4.2.4 At the end of the semester the student shall submit a summary report of the field work for the semester and a viva voce examination shall be conducted.
- 4.3.5 The field work practice in the Third and Fourth Semesters shall focus upon the Area of Concentration chosen by the students. The students shall be placed in the field for twenty five days of consecutive field work. The field work settings shall be communities, NGOs, service organizations, hospitals, clinics and governmental agencies. Those students who are specializing in Community Development will either be placed in an urban or rural community setting that is identified by the Department. Students who are specializing in Medical and Psychiatric Social Work will be exposed to either a Medical or a Psychiatric setting.

4.3 Rural Camp

Students shall organise and participate in a rural camp during the first / second semester. The duration of the rural camp shall generally be ten days excluding days of travel.

4.3.1 The objectives of the rural camp are:

- To apply the acquired skills of group work and community organisation in communities.
- To understand and assess the problems faced by the rural population.
- To involve oneself positively in the communities to help to remove some of these problems.

- 4.3.2 At the end of the camp each student shall submit a written report to the department in a specified format. Performance at the Rural Camp shall be considered for the evaluation of the Field Work during the second semester.
- 4.3.3 The Rural Camp shall be credited along with the fieldwork of the semester along with which it can be conveniently coupled.

4.4 Study Tour

During the programme the students shall undertake a study tour along with the assigned faculty members to a place approved by the department. The places are to be so chosen as to be of educational benefit to students. During the tour, the focus shall be on visiting and interacting with as many NGOs/ state/national/international organisations involved in developmental work as possible. A report of the learning outcomes shall be submitted to the department at the end of the tour. The Study Tour shall be a Pass/No Pass course.

4.5 Block Placement

After the examinations at the end of the fourth semester, the students shall be placed with an NGO or Agency for a period of not less than one month for practical experience and application of their skills. While the Block Fieldwork is not credited, it is mandatory for the completion of the MSW programme. The student shall contact an agency of his/her choice and get the choice of agency approved by the department. Students shall endeavour to choose an agency that is primarily in tune with their AoC and which has credentials in the concerned field. At the end of every week the student shall send a brief report to the supervisor and at the end of the Block Field Work period a summary report shall be submitted. The summary report shall contain a short description of the Agency, the social service skills applied in his/her work and the student's learning outcomes. The report shall be submitted in a format prescribed by the department and shall be submitted together with a certificate from the agency confirming his/her field work, in a prescribed format.

4.6 Research Project Work

Every student shall undertake a research project work which has bearing on his/her AoC and present a written thesis on the research work under the supervision and guidance of a faculty member. The preliminary work may begin at the end of the second semester. The students are expected to complete the data collection before the fourth semester. The thesis is to be submitted to the department before the date notified. The student shall write a dissertation of the research thesis and appear for a viva voce examination on the research done. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

4.7 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

5.0 MSC PSYCHOLOGY (PSYCHOLOGICAL COUNSELLING)

5.1 Field Work

Students shall take part in field work during the first three semesters in mental health agencies, medical institutions, educational institutions etc., under the supervision of professional counsellors and psychologists, where the student of psychological counselling can get a first-hand experience of the application of the learning derived from the classroom. The field work shall be credited and shall be evaluated using norms laid down by the department.

5.2 Study Tour

During the programme the students shall undertake a study tour, along with the faculty members, to a place approved by the department. The places are to be so chosen as to be of educational benefit to students. During the tour, the focus shall be to visit and interact with NGOs, hospitals, state/national/international organisations involved in psychological counselling. A report of the learning outcomes shall be submitted to the department at the end of the tour followed by a presentation. The Study Tour shall be a Pass/No Pass course.

5.3 Summer Internship

Students are required to undergo a summer internship of two weeks' during the semester break between the second and third semesters. It is a P/NP course and shall be recorded in the third semester. The Summer Internship gives students an opportunity to apply the theories and principles that they have learnt in class room courses to the "real world" of social service agencies, medical institutions, the criminal justice system, business, and industry. During the internship, students can explore career interests, develop professional skills, learn how community organizations work and expand their clinical and interpersonal skills. The summer internship enriches the students' academic experience while making a valuable contribution to the community and utilizing the vacation optimally.

5.4 Supervised Internship

Each student shall perform a supervised internship for a period of 90 days (spread across semester three and four with 45days in each semester) in two organizations which offers counselling help to clients. The supervised internship is a credited course and the report for each internship shall be submitted by the students at the end of each semester followed by a presentation on the same. It shall be the prerogative of the department to propose the number of institutions where a student is expected to perform supervised internship. Supervision shall be provided for by the university in collaboration with the organisation where the student performs the internship. Evaluation of the internship shall be based on the documentation, reports from the organisation, report of the supervisor and the presentation and the viva voce examination of the student at the end of the period of Internship.

5.5 Research Project Work

A research project shall be undertaken during the course of the third and the fourth semesters. The topic of the research shall be so chosen that it will be possible for the student to pursue and complete the research work in the institution/hospital where the student is placed for the supervised internship. The preliminary work may begin at the end of the second semester. The students are expected to complete the data collection before the fourth semester. The thesis is to be submitted to the department before the date notified. The student shall write a dissertation of the research thesis and appear for a viva voce examination on the research done. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/ Institute at the beginning of the semester.

5.6 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A Group assignment shall be accompanied by a common presentation.

6.0 MA EDUCATION

6.1 Specialisations

The Masters Degree Programme in Education offers a number of specialisations, of which a student shall be required to choose a specialization after the completion of the first semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

6.2 Educational Seminar

During the course of the programme, students are expected to present a series of seminars which will address fundamental intellectual, conceptual and practical issues in current educational philosophy and application. They may also deal with other relevant topics which may be suggested by the department. Students shall be assisted through guest lectures, discussions, field work in education related institutions and active engagement with faculty members. During these interactions students shall be provided with an opportunity to explore how best to bring new interdisciplinary scholarship, technology and critical thinking into the development of the chosen seminar area. They shall also consider alternative pedagogic strategies, teaching techniques and technologies. Students shall prepare and present a final paper based on these seminars. Students shall be evaluated on the basis of the seminars and the final paper.

6.3 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

6.4 Research Project Work

Every student shall undertake a research project work which has bearing on his/her field of specialisation and present a written thesis on the research work under the supervision and guidance of a faculty member. The Research Project shall be undertaken individually, in two phases during the third and fourth semesters. Students are expected to make presentations to the department at different stages of the research work. The student shall write a dissertation of the research thesis, submit it to the department and appear for a viva voce examination at times to be notified by the department. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

6.5 School Visits

The students of the Masters Programme in Education shall be engaged in regular school visits with the purpose of understanding and evaluating the process of teaching, learning and evaluation as well as the exigencies of administration of the school.

6.6 Internship

During the final semester of the programme, a student is required to undergo an internship for a period of one month. The internship provides an opportunity for students to experience the ground reality and connect it with the theoretical and methodological perspectives the student has studied and interiorized. During the internship the student will be monitored and guided by his/her supervisor and faculty members. The student will be required to maintain a journal and at the end of the period of internship, submit a written report and to make a presentation of his/her experiences and learnings at the internship. The student will be required also to submit a report from the head of the institution regarding his/her performance there.

The evaluation of the student shall be based on the level of his/her engagement during the internship in addition to his/her ability to communicate this engagement in the journal, the report and the presentation. The journal and the report are to be submitted within a month of the completion of the internship. The department shall specify the criteria for evaluating the journal, the report and the presentation.

6.7 Journaling

During the 1st semester, students shall maintain a reflective journal, to develop within them a reflection that can be described as an inner dialogue, using visible thinking routine (Harvard), as a critical structure for guiding their journal writing. Journaling has to be done six days a week. At the end, the student will be awarded grade/marks after assessing their learning.

7.0 MA MASS COMMUNICATION

7.1 Specialisations

The Master's Degree Programme in Mass Communication offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the first semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

7.2 Media House Visits

During the course of the programme, students shall be required to visit a variety of Media Houses in small groups constituted by the department. The purpose of these Media House Visits shall be to gain exposure to the best practices among the day-to-day activities of the media house. A report of the visit is to be submitted in the format specified within two days of the visit. The Media House visit shall be a graded course and grades shall be awarded on the basis of the written reports of the media house visits.

7.3 Research Project Work

Every student shall undertake a research project work which has a bearing on his/her field of specialisation and present a written thesis on the research work under the supervision and guidance of a faculty member. The Research Project shall be undertaken individually, in two phases during the course of two semesters as shall be laid down in the course structure of the programme. Students are expected to make presentations to the department at different stages of the research work. The student shall write a dissertation of the research thesis, submit it to the department and appear for a viva voce examination at times to be notified by the department. The mode and components of evaluation of the research work and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

7.4 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

7.5 Internship

All students shall undergo an internship involving media related activities of four weeks' duration. The purpose of the internship is to give the students an opportunity to have a hands-on field experience to effectively put into practice the theoretical and practical learning from the programme in an area of interest. Students may undergo their internship in a media house of their choice. The student shall be required to discuss the choice of media house with the department and obtain its

consent. Before going for the internship, a Letter of Consent from the concerned media house, in the prescribed format, shall be submitted by the student to the Department. After returning from the internship each student shall have to submit a detailed report in a prescribed format. Each student shall also make a presentation of the internship experience and learning in the Department and submit a certificate of successful completion of the internship from the designated authority of the concerned media house. The schedule of the conduct, report submission and evaluation of the internship shall be as notified by the Department. The components of evaluation of the Internship and their weightages shall be as notified by the department at the beginning of the semester.

7.6 Final Project

As a Final Project the students are required to create a Social Awareness and Community Development oriented multi-media project which shall culminate in a Media Event. The purpose of the final project is to showcase all the skills that the students have acquired during the course of the programme as well as demonstrate their Media and Event Management, and Media Entrepreneurship abilities and at the same time use these skills for the service and upliftment of the community. The Final Project shall essentially be a group project and the number of groups shall be specified by the department. The groups shall perform their activities under the guidance of faculty members who shall be assigned to guide each group. The last dates for the submission of the project proposal and the conduct of the event shall be notified by the Department well in advance. The components of evaluation of the Final Project and their weightages shall be as notified by the department at the beginning of the semester.

8.0 MASTER OF ARTS (MA) ENGLISH

8.1 Specialisations

The Master's Degree Programme in English offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the second semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

8.2 Educational Seminar

During the course of the programme, students are expected to present a series of seminars related to English literature. They may also deal with other relevant topics which may be suggested by the department. Students shall prepare and present a final paper based on these seminars. Students shall be evaluated on the basis of the seminars and the final paper.

8.3 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

8.4 Dissertation

Students will be required to write a dissertation in the 4th semester.

9.0 MASTER OF COMMERCE (MCOM)

9.1 Specialisations

The Master's Degree Programme in Commerce offers a number of specialisations, of which a student shall be required to choose a specialisation after the completion of the second semester. The department shall have the prerogative of not offering a specialisation if a sufficient number of students do not opt for it.

9.2 Project Work/Dissertation

The Master's Degree Programme in Commerce will require students to do Project work in the 3rd and 4th semesters. The mode and components of evaluation of the project work and the weightages attached to them shall be published by the department at the beginning of the semester.

9.3 Assignments

Assignments are an essential part of learning. The faculty shall engage students in a minimum of one individual and one group assignment per course, per semester. A group assignment shall be accompanied by a common presentation.

10.0 Admission

10.1 All admissions to the Post Graduate Degree Programmes of the University shall be on the basis of merit. There may, however, be provision for direct admission for a limited number of NRI/FN students.

10.2 Eligibility Criteria

10.2.1. To be considered for admission to a Post Graduate Degree Programme a candidate should have passed a Bachelor's Degree (or equivalent) programme of a recognised university securing 50% of the grades/marks.

10.2.2. Admission will be on the basis of the academic records of the candidate, and taking into consideration his/her performance in any or all of the following:

- Written test
- Group Discussion
- Personal Interview

10.3 Candidates whose results for the qualifying examination are not yet declared may be provisionally admitted provided she/he submits proof of fulfilment of the eligibility criteria by 31 October of the year of provisional admission.

11.0 University Registration

11.1 Candidates shall have to register as bona-fide students with the University as per the University regulations within a period specified by the University, by a formal application routed through the Director.

11.2 For registration the following category of students have to obtain Migration Certificates from the University/Board last attended:

1.1.1 All first Semester and third semester (Lateral Entry) students of Master's Degree Programmes

1.1.2 Students of Bachelor's Degree (First Semester) who completed their Higher Secondary Examination in Boards other than AHSEC

1.1.3 Students of BTECH (Third Semester – Lateral Entry) who completed their 3-year Diploma under the governments of States other than the Assam.

12.0 Attendance

12.1 To be permitted to appear for the end-semester examination of a particular course, a student is required to have a minimum attendance of 75% for that course.

- 12.2 Deficiency in attendance up to 10% may be condoned by the Director in the case of leave taken for medical and other grievous reasons, which are supported by valid medical certificates and other requisite documents.
- 12.3 Some students, due to exceptional situations like their own serious sickness and hospitalization or death of members of inner family circle, may have attendance below 65%. Such students may be given bonus attendance percentage for a particular course based on his/her attendance for that course during the remaining days of the current semester, as given in the following table:

Attendance during the remaining days of the current semester	Bonus percentage available in the current semester
95% or more	5
90% or more but less than 95%	4
85% or more but less than 90%	3
80% or more but less than 85%	2
75% or more but less than 80%	1

They shall be permitted to appear for the end-semester examination of the course if on the strength of this bonus attendance percentage, they obtain 65% attendance for that course.

- 12.4 If the sum of the credits of the courses for which a student is unable to appear at the end-semester examinations exceeds 50% of the total credits allotted for the semester, he/she shall not be permitted to appear for the entire end-semester examinations in view of clause 13.5 of these Regulations.
- 12.5 The School may decide to set aside a certain portion of the in-semester assessment marks for attendance. The number of marks and modalities of their allotment shall be made known to the students at the beginning of each semester.

12.6 Leave

- 12.6.1 Any absence from classes should be with prior sanctioned leave. The application for leave shall be submitted to the Office of the Director of the School on prescribed forms, through the Head of the Department, stating fully the reasons for the leave requested along with supporting documents.
- 12.6.2 In case of emergency such as sickness, bereavement or any other unavoidable reason for which prior application could not be made, the parent or guardian must inform the office of the Director promptly.
- 12.6.3 If the period of absence is likely to exceed 10 days, a prior application for grant of leave shall have to be submitted through the Director to the Registrar with supporting documents in each case; the decision to grant leave shall be taken by the Registrar on the recommendation of the Director.
- 12.6.4 The Registrar may, on receipt of an application, also decide whether the student be asked to withdraw from the programme for that particular semester because of long absence.
- 12.6.5 It shall be the responsibility of the student to intimate the concerned teachers regarding his/her absence before availing of the leave.

13.0 Grading System

13.1 Based on the performance of a student, each student is awarded a final letter grade in each graded course at the end of the semester and the letter grade is converted into a grade point. The correspondence between percentage marks, letter grades and grade points is given in the table below:

Marks (x) obtained (%)	Grade	Description	Grade Points
$90 \leq x \leq 100$	O	Outstanding	10
$80 \leq x < 90$	E	Excellent	9
$70 \leq x < 80$	A+	Very Good	8
$60 \leq x < 70$	A	Good	7
$50 \leq x < 60$	B	Average	6
$40 \leq x < 50$	C	Below Average	5
$x < 40$	F	Failed	0

In addition, a student may be assigned the grades 'P' and 'NP' for pass marks and non-passing marks respectively, for Pass/No-pass courses, or the grade 'X' (not permitted).

13.1.1 A student shall be assigned the letter grade 'X' for a course if he/she is not permitted to appear for the end semester examination of that course due to lack of requisite attendance.

13.1.2 A letter grade 'F', 'NP' or 'X' in any course implies a failure in that course.

13.1.3 A student is considered to have completed a course successfully and earned the credits if she/he secures a letter grade other than 'F', 'NP', or 'X'.

13.2 At the end of each semester, the following measures of the performance of a student in the semester and in the programme up to that semester shall be computed and made known to the student together with the grades obtained by the student in each course:

13.2.1 **The Semester Grade Point Average (SGPA):** From the grades obtained by a student in the courses of a semester, the SGPA shall be calculated using the following formula:

$$SGPA = \frac{\sum_{i=1}^n GP_i \times NC_i}{\sum_{i=1}^n NC_i}$$

Where GP_i = Grade points earned in the i^{th} course

NC_i = Number of credits for the i^{th} course

n = the number of courses in the semester

13.2.2 **The Cumulative Grade Point Average (CGPA) :** From the SGPA's obtained by a student in the completed semesters, the CGPA will be calculated using the following formula:

$$CGPA = \frac{\sum_{i=1}^n SGP_i \times NSC_i}{\sum_{i=1}^n NSC_i}$$

Where SGP_i = Semester Grade point average of i^{th} semester

NSC_i = Number of credits for the i^{th} semester

n = the number of semesters completed

- 13.3 Both the SGPA and CGPA will be rounded off to the second place of decimal and recorded as such. Whenever these CGPA are to be used for official purposes, only the rounded off values will be used.
- 13.4 There are academic and non-academic requirements for the programme where a student will be awarded the 'P' and 'NP' grades. All non-credit courses (such as Study Tour and Extra Academic Activities) belong to this category. No grade points are associated with these grades and these courses are not taken into account in the calculation of the SGPA or CGPA. However, the award of the degree is subject to obtaining a 'P' grade in all such courses.

14.0 Assessment of Performance

- 14.1 A student's performance is evaluated through a continuous system of evaluation comprising tests, quizzes, assignments, seminars, projects, research work, concurrent and block field work performance and end-semester examinations.
- 14.2 **Theory Courses:** Theory courses will have two components of evaluation – in-semester assessment of 40% weightage and an end-semester examination having 60% weightage.
- 12.2.1 The modalities of conduct of in-semester evaluation, its components and the weightages attached to its various components shall be published by the department concerned at the beginning of each semester.
- 14.3 **Practicum/Field Work/Lab:** These courses shall be evaluated on the basis of attendance, performance of tasks assigned and an end semester test/viva voce examination. The weightage assigned to these components of the evaluation is given in the following table:

Component	Weightage
Attendance	10
Performance of tasks assigned	30
end-semester test / viva voce examination	60

14.4 End-Semester examinations

- 14.4.1. End-semester examinations, generally of three hours' duration, shall be conducted by the University for the theory courses. However, the Director of the Institute shall make the arrangements necessary for holding the examinations.
- 14.4.2 In the end-semester examinations, a student shall be examined on the entire syllabus of the courses.
- 14.4.3 A student shall not obtain a pass grade for a course without appearing for the end-semester examination in that course.
- 14.5 The evaluation of performance in Co-curricular Activities will be done by the authorities conducting them and they will communicate the grades to the Director who will forward them to the Controller of Examinations of the University.
- 14.6 The Director will forward the marks obtained in the in-semester evaluation to the Controller of Examinations within the prescribed time as may be notified.
- 14.7 All evaluated work in a subject except the end semester answer scripts will be returned to the students promptly. They should be collected back after the students have examined them, and preserved for a period of one semester.
- 14.8 **Eligibility for appearing in the end-semester examinations:** A student will be permitted to appear for the end-semester examinations, provided that

- 12.8.1 A student has not been debarred from appearing in the end semester examinations as disciplinary action for serious breach of conduct.
- 12.8.2 He/she has satisfactory attendance during the semester according to the norms laid out in section 9 of these regulations.
- 12.8.3 He/she has paid the prescribed fees or any other dues of the university, institute and department within the date specified.

14.9 Registration for end-semester Examinations

- 14.9.1 The University shall, through a notification, invite applications from students to register for the end-semester examinations.
- 14.9.2 Students who have registered with the University and those who have applied for such registration may apply to appear for the end-semester examinations of the university, in response to the notification issued by the University, provided that they fulfil the eligibility norms as laid down in clause 14.8.
- 14.9.3 All eligible candidates shall be issued an admit card for the relevant examination and for the specified courses. A student who does not have a valid admit card may not be permitted to write the end-semester examinations.
- 14.9.4 A student who secures an 'F' or 'X' grade in any course in a semester may register for the end-semester examination for that course in a subsequent semester when that course is offered again, within the maximum period of time allotted for the completion of the programme. The in-semester assessment marks obtained by him/her in the last semester in which the said course was attended by him/her shall be retained.
- 14.9.5 Similarly, in case of an 'NP' grade in Extra Academic Programmes the student shall have to re-register for it in the appropriate semester of the next academic session.
- 14.9.6 When a student re-registers for the end semester examination of a course, in accordance with clause 14.9.4 above, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

14.10 Conduct of Examinations: The University shall conduct the end-semester examinations in accordance with the applicable regulations on such dates as are set down in the Academic Calendar or as notified.

14.11 Declaration of Results: The University shall declare the results of a semester and make available to the students their gradesheets within the time-frame prescribed by the relevant regulations of the university and specified in the academic calendar.

- 14.11.1 The University may withhold the results of a student for any or all of the following reasons
- he/she has not paid his/her dues
 - there is a disciplinary action pending against him/her
 - he/she has not completed the formalities for University Registration according to the requirement of section 6 of these Regulations.

14.12 Re-examining of answer scripts

- 14.12.1 If a student feels that the grade awarded to him/her in a course is not correct, he/she may apply to the University for the re-examining of his/her answer script.
- 14.12.2 Re-examining of scripts may be of two different categories – scrutiny and re-evaluation.

14.12.3 **Scrutiny:** The activities under this category shall ordinarily be confined to checking

- correctness of the total marks awarded and its conversion into appropriate letter grades
- whether any part/whole of a question has been left unevaluated inadvertently
- correctness of transcription of marks on the tabulation sheet and the gradesheet issued in respect of the course under scrutiny.

14.12.4 **e-evaluation:** Re-evaluation of the answer script by independent experts in the concerned subject(s).

14.12.5 Application for re-examining of answer scripts

- A student may apply for scrutiny or re-evaluation for one or more courses of the just-concluded end-semester examinations within seven calendar days from the date of publication of its results in the application form prescribed for this purpose.
- He/she shall pay the prescribed fee to the University as notified.
- A student applying for scrutiny/re-evaluation shall expressly state on the application form whether the application made is for Scrutiny or for Re- evaluation. In each case, the student may also request to see his/her answer script.
- All applications for scrutiny/re-evaluation must be routed through the Director of the Institute.

14.12.6 If in the process of re-examining, the grade obtained in a course changes, the better of the two grades shall be assigned to the course. If there is a change, the new grade shall be recorded and a new grade sheet shall be issued to the student.

14.12.7 Without prejudice to any of the clauses of section 14.12, a student who has been found to have used unfair means during an examination shall not be eligible to apply for scrutiny or re-evaluation of answer scripts.

14.13 Improvement Examination

14.13.1 After the completion of the entire programme of study, a student may be allowed the provision of improvement examinations. These are to be availed of only once each in the Autumn and Spring semesters that immediately follow the completion of the programme, and within the maximum number of years permissible for the programme.

14.13.2 A student may choose no more than six courses (three in the Autumn semester and three in the Spring semester) for improvement examinations.

14.13.3 After the improvement examination, the better of the two grades obtained (the old and the new) shall be considered for the calculation of SGPA and CGPA.

14.13.4 If the student improves his/her grades through the improvement examination, new gradesheets and comprehensive transcripts shall be issued to the student.

14.14 Special Examination

14.14.1 The University shall conduct Special Examinations to benefit the following categories of students:

- 14.14.1.1 Students who, on the completion of the final semester, have some 'F' graded courses in the two final semesters, but no 'F' or 'X' graded courses in any of the previous semesters

- 14.14.1.2 Students who have only one 'F' graded course in a semester other than the two final semesters and do not have 'F' or 'X' graded courses in the two final semesters.
- 14.14.2 The Special Examinations shall ordinarily be conducted each year within a month of the declaration of the results of the Spring Semester.
- 14.14.3 Students who fail to secure 50% of the credits offered in the final semester shall not be eligible to appear for the special examinations. Such students will be governed by the provisions of clause 15.5 of these regulations. However, this restriction shall not apply in the case of students who are unable to appear in the end semester examinations due to exceptional situations like their own serious illness and hospitalisation or death of members of inner family circle (restricted to only father, mother, siblings).
- 14.14.4 Students who have 'X' graded courses only in the last two semesters may be offered the opportunity for participating in a Tutorial Programme which may be conducted during the semester break immediately following the end- semester examinations of the final semester and students who earn 85% attendance for the programme shall be permitted to appear for the Special Examinations. Separate fees shall be charged for the Tutorial Programme.
- 14.14.5 Students who do not obtain pass grades in any course at the special examinations shall have to apply in the prescribed format and appear for the end-semester examination of these courses when they are scheduled by the University during subsequent relevant end-semester examinations.

15.0 Enrolment (for semesters other than the first)

- 15.1 Every student is required to enrol for the programme through the designated officer at the commencement of each semester on the days fixed for such enrolment and notified in the Academic Calendar.
- 15.2 Students who do not enrol on the days announced for the purpose may be permitted late enrolment up to the notified day in the Academic Calendar on payment of a late fee.
- 15.3 Only those students will be permitted to enrol who have
- 15.3.1 cleared all University, Institute, Department, Hostel and Library dues and fines (if any) of the previous semester,
 - 15.3.2 paid all required University, Institute, Department and Hostel fees for the current semester, and
 - 15.3.3 not been debarred from enrolling on any specific ground.
- 15.4 No student may enrol for a semester if he/she has not appeared, for whatever reason, in the end semester examinations of the previous semester.
- 15.5 A student who fails to obtain 50% of the credits offered in the third and subsequent semesters shall not be permitted to enrol for the next semester and shall have to re-enrol for and attend all the courses of the said semester in the following academic year. Students who due to X grade (lack of due attendance) have been debarred from exams in any semester (including first and second) will have to re-enrol for the same.

16.0 Eligibility for the Award of Degree

- 16.1 A student shall be declared to be eligible for the award of the degree if he/she has
- 16.1.1 completed all the credit requirements for the degree with grade 'C' or higher grade in each of the graded courses and grade 'P' in all the non-graded courses.
 - 16.1.2 satisfactorily completed all the non-credit requirements for the degree (if any);
 - 16.1.3 obtained a CGPA of 5.00 or more at the end of the semester in which he/she completes all the requirements for the degree;
 - 16.1.4 owes no dues to the University, Institute, Department, Hostels; and
 - 16.1.5 has no disciplinary action pending against him/her.
- 16.2 The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

17.0 Termination from the Programme

- 17.1 If more than the number of years permitted for the completion of a programme have elapsed since the student was admitted, and the student has not become eligible for the award of Degree, the student shall be removed from the programme.
- 17.2 A student may also be required to leave the Programme on disciplinary grounds on the recommendations of the Students' Disciplinary Committee of the concerned School.

SCHEME OF IN-SEMESTER ASSESSMENT:**GRADUATE DEGREE PROGRAMMES****Theory Courses**

For theory courses, in-semester assessment carries 40% weightage. Different components along with the weightage of each are given in the table below:

Component	Weightage	Remarks
Class Test (Two Class tests of one and a half hour duration)	20	Average of the two marks shall be considered
Assignment (Individual and Group)	10	Group assignments for two courses and individual assignments for the remaining courses
Non-formal evaluation	5	Based on response and interaction in class, quizzes, open book tests, etc.
Attendance	5	For norms regarding attendance cfr. clause 6 of the Regulations for Undergraduate Programmes

There shall be no re-test for In-semester assessment under any circumstance. The original marks of all the In-semester assessment components shall be retained for all further repeat examinations.

Attendance

Marks for attendance will be given according to the following scheme:

Attendance Percent (x)	Marks Allotted	
	Theory	Lab
75 <= x < 80	2	4
80 <= x < 90	3	6
90 <= x < 95	4	8
95 <= x 100	5	10

EVALUATION OF LABORATORY COURSES, DRAWING AND WORKSHOP

All Laboratory courses are evaluated on the basis of attendance, performance of tasks assigned and end semester test/viva voce examination. The distribution of marks within these components will be specified by individual departments along the lines of the break-up given below:

Component	Weightage
Attendance	10
assessment of tasks assigned	30
End Semester Test and/or Viva-Voce Examination	60
Total	100

In-Semester Evaluation of Minor and Mini Projects

The guidelines for the conduct and evaluation of Minor and Mini Projects shall be laid down by the Department. The components of evaluation and allotment of marks may be as follows:

In Semester Evaluation	Marks	End Semester Evaluation (weightage 40)	Marks
Synopsis	10	Project Implementation	16
Seminar presentation of synopsis (Analysis and Design)	15	Seminar Presentation	8
Progress Seminar (Implementation)	15	Viva Voce Examination	16
Project Documentation	10		
Attendance	10		
Total	60		40

In-Semester Evaluation of BTECH Major Project Phase I and Phase II

The in-semester evaluation of Major Project Phase I and Phase II shall have 60% weightage. The modality and conduct of the in-semester evaluation of the Major Project Phase I, and their weightages shall be declared by the DPEC of each department at the beginning of the semester. The following aspects are to be assessed, among others:

Synopsis presentation Progress seminars Progress reports Weekly activity reports

In-Semester BCOM Project Evaluation

The scheme of in-semester evaluation and the modalities along with the weightages will be specified by the department at the beginning of the semester.

SCHEME OF IN-SEMESTER EVALUATION

POST GRADUATE DEGREE PROGRAMMES

MCA, MSW, MSC (Psychology), MA English, MA Education, MCOM

Theory Courses

The different components of the scheme of in-semester for the theory courses are given in the table below:

Component	Weightage
Class Test (Two class tests of equal weightage)	20
Assignments, Group Presentations/Seminar	10
Non-formal evaluation	5
Attendance	5
Total	40

Non-formal Evaluation

Non-formal evaluation may be done using a combination of quizzes, unannounced tests, open book tests, library work reports, class room interaction and participation, etc. The scheme of non-formal evaluation shall be announced by every teacher in the beginning of the semester.

Attendance

Marks for attendance will be given according to the following scheme:

Attendance Percent (x)	Marks Allotted
75 ≤ x < 80	2
80 ≤ x < 90	3
90 ≤ x < 95	4
95 ≤ x 100	5

NB: There shall be no re-test for in-semester Assessment under any circumstance. The original marks of all the in-semester Assessment components shall be retained for all further repeat examinations.

MCA Minor Project

The guidelines for the conduct and evaluation of the MCA Minor Project shall be laid down by the Department . The components of evaluation and allotment of marks will be as follows:

In Semester Evaluation	Marks	End Semester Evaluation (weightage 40)	Marks
Synopsis	10	Project Implementation	16
Seminar presentation of synopsis (Analysis and Design)	15	Seminar Presentation	8
Progress Seminar (Implementation)	15	Viva Voce Examination	16
Project Documentation	10		
Attendance	10		
Total	60		40

In-Semester Evaluation of MCA Major Project

The in-semester evaluation of the MCA Major Project shall have 60% weightage. The Internal Evaluation of the Major project will be done through two seminar sessions:

Synopsis	: 20
Seminar Presentation of Synopsis (Analysis and Design)	: 30
Progress Seminar (Implementation)	: 30
Project Documentation	: 20

External Evaluation of all Major projects will follow the guidelines laid down in the Regulations.

MSW, MSc Psychology Field Work

The components of evaluation and their weightages for the concurrent/continuous fieldwork are as follows:

Component	Weightage
Field Work Diary	10
Agency Evaluation	15
Faculty Evaluation	20
Attendance	5
Viva Voce Examination	50
Total	100

Practicum

Field Report	: 15
Presentation	: 15
Administration of tests	: 10
Faculty Evaluation	: 10
Viva Voce Examination	: 50

MSW, MSc Psychology Research Project

Phase I

Literature Survey Presentation	: 40
Synopsis Presentation	: 60

Phase II

Examination of Thesis	: 50
Presentation and Viva Voce Exam	: 50

MTECH, MSC (Physics, Chemistry, Mathematics, Biochemistry, Biotechnology, Microbiology, Botany, Zoology)

Theory Courses

For theory courses, in-semester assessment carries 40% weightage. Different components along with the weightage of each are given in the table below:

Component	Weightage	Remarks
Class Test (Two Class tests of one and a half hour duration)	20	Average of the two marks shall be considered
Assignments	15	Written Assignments/Seminar on course Topics/ Technical Paper Review
Non-formal evaluation	5	Based on response and interaction in class, quizzes, open book tests, etc.
Total	40	

There shall be no re-test for In-semester assessment under any circumstance. The original marks of all the In-semester assessment components shall be retained for all further repeat examinations.

In-Semester Evaluation of Project (Phase I) / Research Project (Phase I) / Dissertation (Phase I)

The in-semester evaluation of Project Phase I / Research Project (Phase I) / Dissertation (Phase I) shall have 60% weightage. It shall be evaluated in the following seminar sessions having equal weightage:

Seminar 1: Presentation of the synopsis

Synopsis	:	30%
Seminar presentation of the synopsis	:	50%
Viva voce examination	:	20%

Seminar 2: Progress Seminar

Progress report	:	30%
Progress seminar	:	50%
Viva voce Examination	:	20%

In-Semester Evaluation of Project (Phase II) / Research Project (Phase II) / Dissertation (Phase II)

The in-semester evaluation of Project Phase II / Research Project (Phase II) / Dissertation (Phase II) shall have 60% weightage. The in-semester evaluation will be done through two seminar sessions having equal weightage. Each seminar will be evaluated using the following components.

Progress Report	:	30
Progress Seminar	:	50
Viva Voce Examination	:	20

External Evaluation of the project / Research Project / Dissertation shall follow the guidelines laid down in the Regulations.

RULES, PROCEDURES AND BEHAVIOURAL GUIDELINES

1. Dress Code and Identity Card

- 1.1 The dress code of the University consists of shirt / top (of the prescribed colour and material), trousers (of the prescribed colour and material), shoes (black) and socks (dark grey), a belt (black/dark brown, if required) and a tie (blue, with diagonal stripes). Students are required to come to the University following this dress code. The tie will be required to be worn only on formal occasions. An apron (of the prescribed colour) is to be worn in the Chemistry Lab and during Workshop Practice. During winter, students may wear only a blazer and/or a sweater (full sleeve or sleeveless) of the prescribed colour and material.
- 1.2 The Student Identity Card is to be brought to the University every day and is to be produced whenever asked for. Entry to the University campus shall be only on production of the Identity Card. The Identity Card is also the Library Card.
- 1.3 All students should wear the ID card around the neck from entry in the morning to exit in the evening.

2. Morning Assembly

- 2.1 The morning assembly is a daily programme in the university on all class days during which all members, i.e., students, faculty, staff and management meet together. The assembly starts at the prescribed time. During the assembly, important announcements are made and a thought or insight is shared. The assembly is concluded with an invocation to God to bless the activities of the day. Note that any announcement made at the morning assembly is considered as being equivalent to notifying the same in the notice boards. All students should reach the assembly venue before prescribed time. Immediately after assembly all should proceed to the classroom to start class. Any change in procedures will be notified by the concerned School at the beginning of the Semester.
- 2.2 One of the following prayers may be used to conclude the Morning Assembly:

The Our Father

*Our Father, who art in heaven,
Hallowed be thy name, Thy kingdom come,
Thy will be done on earth as it is in heaven.
Give us this day, our daily bread
And forgive us our trespasses
As we forgive those who trespass against us.
And lead us not into temptation,
But deliver us from all evil, Amen.*

Or

Prayer for Peace

*Lord, make me an instrument of your peace, Where there is hatred, let me sow love; where
there is injury, pardon;
where there is doubt, faith;
where there is despair, hope;*

where there is darkness, light;

where there is sadness, joy;

O Divine Master, grant that I may not so much seek to be consoled as to console;

to be understood as to understand;

to be loved as to love.

For it is in giving that we receive;

it is in pardoning that we are pardoned;

and it is in dying that we are born to eternal life. Amen

3. Punctuality in Attending Classes

- 3.1 All are expected to be at their respective assembly venues five minutes before assembly time.
- 3.2 Normally no student shall leave the University before all the classes are over. In case of an emergency, a student may leave with proper written permission from the HOD of the concerned department.
- 3.3 While all students are encouraged to have their lunch in the University Canteens, students are permitted to take lunch outside the University.

4. Make-up Classes, Leave of Absence and Earned Attendance

- 4.1 If any student misses any laboratory class due to illness or other grievous problems, he/she is required to meet the concerned teacher for completing the experiments as soon as possible. Such make-up attendance will be taken into consideration at the end of the semester if attendance is less than 75%. At most two make-up attendances may thus be earned by any student.
- 4.2 Any student who is required to be engaged in a University activity or a pre-planned training and placement activity during class hours, may apply for the grant of an 'earned attendance' from the concerned HODs in the prescribed form available at the Reception. Such applications must be forwarded by the Activity In-Charge. For club related activities, Faculty Advisor of the concerned club will be the Activity In-Charge. In all other cases, Faculty In-Charge or Assistant Faculty In-Charge of Student Affairs will be the Activity In-Charge. Filled up forms shall be submitted preferably before or in case of emergency, immediately after the activity for which earned attendance is to be granted.
- 4.3 Any student going to participate in any activity or competition outside the University must apply to the Faculty In-Charge of student Affairs using the prescribed form which must be forwarded by the Assistant Faculty In-Charge of Student Affairs in consultation with respective Club Advisers. On return, these students must report back to the Assistant Faculty In-Charge of Student Affairs for recording the outcome.
- 4.4 Any student who is not able to attend classes due to medical or other grievous reasons are required to apply for leave in the prescribed form along with valid medical certificates and other requisite documents, to the Faculty In-charge, students' affairs within seven days of joining back. Such applications must be signed by a parent of the student and forwarded by the mentor of the concerned student and the HOD of the concerned department. Only these students will be considered for condonement of deficiency in attendance.

5. Discipline

- 5.1 Personal, academic and professional integrity, honesty and discipline, a sense of responsibility and a high degree of maturity is expected of all students inside and outside the campus. Integrity calls for being honest in examinations and assignments, avoiding plagiarism and misrepresentation of facts.
- 5.2 Indulging in acts of violence, riotous or disorderly behaviour directed towards fellow students, faculty members or other employees of the institution/hostel in the campus or outside is considered to be a serious breach of discipline and will attract penalty.
- 5.3 **Respect for Common Facilities:** Care and respect for common facilities and utilities are an essential component of social responsibility. Any willful damage to University property must be made good by the persons concerned. Further, maintaining cleanliness of the classrooms and the entire campus is everyone's responsibility.
- 5.4 **Substance Abuse:** Chewing of tobacco, betel nut and the likes, smoking and the use of other addictive substances and alcoholic drinks are strictly prohibited. These should not be brought into or used within the campus of the University. Violation of this norm will lead to stern action.
- 5.5 **Use of Cell Phones:** Cell phones may be used in the University lawns, canteens and other open areas. However, the use of cell phones in classrooms and labs are strictly prohibited except when used for teaching/learning purposes with the explicit permission of the teacher concerned. The cell phone of anyone found violating this rule shall be confiscated and his/her SIM card shall be taken away and retained in the University office for 7 days. If a person violates the norm for a second time, his/her mobile will be confiscated and retained in the University office till the end of the semester.
- 5.6 **Use of Internet:** The entire campus is wi-fi enabled and the students may use the Internet freely for educational purposes. Students may also use the Computing Centre for browsing the Net. However, the use of Internet to access unauthorized and objectionable websites is strictly prohibited.
- 5.7 All cases of indiscipline will be brought before the Students' Disciplinary Committee and the decisions made by the Committee for dealing with such cases shall be final.

6. Class Tests and Examinations

- 6.1 The conduct of examinations will be governed by the norms of the University.
- 6.2 The Student Identity Card shall be the Admit Card for the class tests
- 6.3 During class tests, all students are expected to enter the venue of the class test 15 minutes before the scheduled time of commencement. However, no one will be permitted into the examination hall after 15 minutes of the commencement of the class test and No one will be allowed to leave the examination hall until an hour has elapsed from the commencement of the class test.
- 6.4 No one is to leave the hall during examination for any purpose, except in case of an emergency.
- 6.5 Malpractices during class tests and examinations will not be tolerated and will attract stern action.

7 Ragging

Ragging and eve-teasing are activities which violate the dignity of a person and they will be met with zero tolerance. Anti-ragging norms have been given to each student at the time of admission and all students and parents have signed the anti-ragging affidavit. Any case of ragging and eve-teasing must be reported to the anti-ragging squad. All cases of violation of anti-ragging norms will be taken up by the anti-ragging Committee and punished according to the norms.

8 Grievance Redressal

The University has constituted a Grievance Redressal Cell to redress any genuine grievance students may have. Any student having a genuine grievance may make a representation to the Grievance Redressal Cell through his/her mentor. The representation should be accompanied by all relevant documents in support of the genuineness of the grievance.

9. School Association

9.1 The School Association is an association of the representatives of the various stake holders of the School – students, staff, faculty and management. It is the responsibility of the School Association to take charge of organizing most of the co- curricular activities such as the annual festivals, quizzes, debates, competitions and social events.

9.2 A male and a female student are elected by the students of each class as “class representatives” to represent them in the School Association. Class representatives are expected to be outstanding students who are academically competent and having qualities of leadership.

10 Participation in University Activities

10.1 In order to provide opportunities for the holistic development of the human person, a large number of co-curricular and extra-curricular activities are designed and implemented under the banner of the University Association and student clubs. Some of the most important activities are D'VERVE & BOSCOIADE (intra- University sports and cultural festival during University Week), PRAJYUKTTAM (the inter-University technical festival). All students are expected to take part actively in such activities to showcase their talents, to develop leadership qualities and to gain the experience of working in groups.

10.2 **Training and Placement Activities:** The training and Placement Cell of DBCET has been incorporated with the objective of minimizing the gap between industry and academia and giving the students training and exposure so that they can capitalize on every opportunity for placement. It is the prime responsibility of the cell to look after all matters concerning 'Training to enhance employability' and 'guiding students for placement'. In the first two semesters, students are trained for communication skills development under the department of Humanities and Social Sciences, and personal development programmes under the department of campus ministry. From the third semester onwards, in every semester, students are given systematic training in aptitude tests, communication skills, group discussion, etc. They are also made to undergo mock HR and Technical Interviews. These activities of the training and placement cell find a place in the curriculum as Extra Academic Programmes (EAP) and all students are required to get a P grade for these activities by taking active part in these activities regularly.

Other departments of the University offer customised services in training and placement of their students.

11. Free Time

Some hours without class may be available for some students during the day. Students are expected to use such 'free time' for visiting the library, meeting teachers and mentors, self-study, carrying out lab or project related activities, etc.

12. Faculty Performance Feedback

In order to improve the teaching and learning process in the University, students will be required to give feedback about the performance of their teachers from time-to-time. All students are expected to participate in the online feedback sessions concerning their teachers with sincerity and responsibility.

13. Mentoring

All students are assigned mentors from among the faculty members for their guidance. Directors of Schools in collaboration with the Heads of Departments will take care of assigning mentors. Mentors shall help the students to plan their courses of study, advise them on matters relating to academic performance and personality development, and help them to overcome various problems and difficulties faced by them. Although students should meet their mentors on a regular basis to get timely help, specific days have been set aside in the calendar for meeting mentors to ensure proper documentation of achievements, activities, shortcomings and problems faced by the students. Every student must meet the mentor during these days.

14. Interaction Meet With Parents

The University organises interaction meetings with parents once a year in which the parents are invited to interact with teachers and management to appraise themselves about the performance of their ward and also to offer their suggestions for the betterment of the institution. It is the responsibility of the students too to invite their parents to come and participate in the event and make the event meaningful.

SCHOOL OF FUNDAMENTAL AND APPLIED SCIENCES

DEPARTMENT OF PHYSICS

BACHELOR OF SCIENCE- HONOURS IN PHYSICS

Type of Course/Category	Course Code	Course Name	Credits	Page
Semester I				
Core Paper1 (Theory)/DC	PSMY0101	Mathematical Physics-I	4-0-0	106
Core Paper2 (Theory)/DC	PSMC0102	Mechanics	4-0-0	107
Core Paper1 (Lab)/DC	PSMY6101	Mathematical Physics-I Laboratory	0-0-2	133
Core Paper2 (Lab)/DC	PSMA6102	Mechanics Laboratory	0-0-2	134
Ability Enhancement compulsory Course -1/IC	LSEC0018	English Communication	2-0-0	657
General Elective –I (Maths)/SE	MACD0105	Calculus and Differential Equations	4-2-0	289
	MALG0106	Algebra		291
Total Credits			20	
Semester II				
Core Paper3 (Theory)/DC	PSEM0103	Electricity and Magnetism	4-0-0	108
Core Paper4 (Theory)/DC	PSWO0104	Waves and Optics	4-0-0	110
Core Paper3 (Lab)/DC	PSEM6103	Electricity and Magnetism Laboratory	0-0-2	135
Core Paper4 (Lab)/DC	PSWO6104	Waves and Optics Laboratory	0-0-2	135
Ability Enhancement compulsory Course –2/IC	CHES0002	Environmental Studies	2-0-0	143
General Elective –II (Maths)/SE	MAAL0107	Algebra and Numerical Methods	4-2-0	292
	MADV0108	Differential Equations, Vector Calculus and Geometry		293
Total Credits			20	
Semester III				
Core Paper5 (Theory)/DC	PSMS0105	Mathematical Physics–II	4-0-0	111
Core Paper6 (Theory)/DC	PSPT0106	Thermal Physics	4-0-0	112
Core Paper7 (Theory)/DC	PSDA0107	Digital Systems and Applications	4-0-0	114
Core Paper5 (Lab)/DC	PSMS6105	Mathematical Physics–II Laboratory	0-0-2	136
Core Paper6 (Lab)/DC	PSPT6106	Thermal Physics Laboratory	0-0-2	137
Core Paper7 (Lab)/DC	PSDA6107	Digital Systems and Applications Laboratory	0-0-2	138
Skill Enhancement Course 1 (Elective)/IE/SE/DE	PSCP0111	Computational Physics Skills	2-0-0	119
	PSEN0112	Electrical circuits and Network Skills		120
General Elective –III (Chemistry)/SE	CHAH0105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	3-1-0	189
	CHCK0120	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics		209

General Elective –III (Chemistry) Lab/SE	CHAH6105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons Lab	0-0-2	220
	CHCK6114	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics Lab	0-0-2	228
Total Credits			26	

Semester IV				
Core Paper8 (Theory)/DC	PSMP0108	Mathematical Physics III	4-0-0	115
Core Paper9 (Theory)/DC	PSEP0109	Elements of Modern Physics	4-0-0	116
Core Paper10 (Theory)/DC	PSAS0110	Analog Systems and Applications	4-0-0	117
Core Paper8 (Lab)/DC	PSMP6108	Mathematical Physics III Laboratory	0-0-2	138
Core Paper9 (Lab)/DC	PSEP6109	Elements of Modern Physics Laboratory	0-0-2	139
Core Paper10 (Lab)/DC	PSAS6110	Analog Systems and Applications Laboratory	0-0-2	140
Skill Enhancement Course 2 (Elective)/IE/SE/DE	PSBI0113	Basic Instrumentation Skills	2-0-0	121
	PSRS0114	Radiation Safety		123
General Elective –IV (Chemistry)/SE	CHCF0106	Chemical Energetics, Equilibria & Functional Organic Chemistry	3-1-0	191
	CHOS0119	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy		207
General Elective –IV (Chemistry) – Lab/SE	CHCF6106	Chemical Energetics, Equilibria & Functional Organic Chemistry - Lab	0-0-2	221
	CHOS6113	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy - Lab		227
Total Credits			26	

Semester V				
Core Paper11 (Theory)/DC		Quantum Mechanics and Applications	4-0-0	
Core Paper12 (Theory)/DC		Solid State Physics	4-0-0	
Core Paper11 (Lab)/DC		Quantum Mechanics and Applications Laboratory	0-0-2	
Core Paper12 (Lab)/DC		Solid State Physics Laboratory	0-0-2	
Discipline Specific Elective I /DE		Embedded systems- Introduction to Microcontroller	4-0-0	
		Physics of Devices and Communication		
		Advanced Mathematical Physics-I		
		Embedded systems- Introduction to Microcontroller Laboratory	0-0-2	
		Physics of Devices and Communication Laboratory		
		Advanced Mathematical Physics-I Laboratory		

Discipline Specific Elective II/DE		Advanced Mathematical Physics-II	5-1-0	
		Classical Dynamics	5-1-0	
		Communication System	4-0-0	
		Communication System Lab	0-0-2	
Total Credits			24	
Semester VI				
Core Paper13 (Theory)/DC		Electromagnetic Theory	4-0-0	
Core Paper14 (Theory)/DC		Statistical Mechanics	4-0-0	
Core Paper13 (Lab)/DC		Electromagnetic Theory Laboratory	0-0-2	
Core Paper14 (Lab)/DC		Statistical Mechanics Laboratory	0-0-2	
Discipline Specific Elective III/DE		Nuclear and Particle Physics	5-1-0	
		Astronomy and Astrophysics	5-1-0	
		Nano Materials and Applications	4-0-0	
		Nano Materials and Applications Laboratory	0-0-2	
Discipline Specific Elective IV/DE		Digital Signal Processing	4-0-0	
		Digital Signal Processing Laboratory	0-0-0	
		Medical Physics	4-0-0	
		Medical Physics Laboratory	0-0-2	
		Plasma Physics	5-1-0	
		Dissertation	6-0-0	
Total Credits			24	
Total Programme Credits			140	

MASTER OF SCIENCE – PHYSICS

Semester	Category	Course Name	Course Code	Credits	Page
I	DC	Classical Mechanics	PSCM0020	4	78
	DC	Quantum Mechanics I	PSQM0021	4	79
	DC	Mathematical Physics	PSMP0022	4	80
	DC	Electronics I	PSEL0049	4	103
	DC	Physics Laboratory I	PSPL6009	4	127
Total Credits				20	
II	DC	Quantum Mechanics II	PSQM0024	4	81
	DC	Condensed Matter Physics	PSCP0025	4	82
	DC	Electrodynamics	PSED0026	4	83
	DC	Nanophysics I	PSNP0050	4	104
	DC	Physics Laboratory II	PSPL6003	4	127
Total Credits				20	

III	DC	Atomic and Molecular Physics	PSAM0028	4	84
	DC	Nuclear Physics	PSNA0029	4	85
	DC	Computer Oriented Numerical Methods	PSCN0030	2	86
	DC	Computer Oriented Numerical Methods Laboratory	PSCN6010	4	128
	DC	Project Phase I	PSPP6011	4	130
	Specialisation: High Energy Physics				
	DE	Particle Physics	PSPA0035	4	88
	Specialisation: Astrophysics				
	DE	Plasma Physics I	PSPL0036	4	89
	Specialisation: Plasma Physics				
	DE	Plasma Physics I	PSPL0036	4	89
	Specialisation: Electronics				
	DE	Electronics II	PSEC0037	4	90
	Specialisation: Nanophysics				
DE	Nanophysics II	PSNS0041	4	95	
Total Credits				22	
IV	DC	Statistical Mechanics	PSSM0034	4	87
	DC	Project Phase II	PSPR6012	6	130
	DC	Study Tour	PSST6016	P/NP	131
	Specialisation: High Energy Physics				
	DE	Gauge Theories	PSGT0043	4	96
	DE	General Theory of Relativity and Cosmology	PSGR0044	4	97
	Specialisation: Astrophysics				
	DE	Astrophysics	PSAR0045	4	98
	DE	General Theory of Relativity and Cosmology	PSGR0044	4	97
	Specialisation: Plasma Physics				
	DE	Plasma Physics II	PSPM0046	4	99
	DE	Plasma Physics Laboratory	PSPM6013	4	130
	Specialisation: Electronics				
	DE	Electronics III	PSE0047	4	100
	DE	Electronics Laboratory	PSEL6014	4	131
	Specialisation: Nanophysics				
	DE	Nanophysics III	PSNY0048	4	102
	DE	Nanophysics Laboratory	PSNY6015	4	131
Total Credits				18	
Total Programme Credits				80	

DEPARTMENT OF CHEMISTRY

BACHELOR OF SCIENCE- HONOURS IN CHEMISTRY

Type of Course/Category	Course Code	Course Name	Credits	Page
Semester I				
Core Paper1 (Theory)/DC	CHAB0101	Inorganic Chemistry-I: Atomic Structure & Chemical Bonding	4-0-0	182
Core Paper2 (Theory)/DC	CHSI0102	Physical Chemistry-I: States of matter & Ionic equilibrium	4-0-0	184
Core Paper1 (Lab)/DC	CHAB6101	Inorganic Chemistry-I: Atomic Structure & Chemical Bonding - Lab	0-0-2	216
Core Paper2 (Lab)/DC	CHIS6102	Physical Chemistry-I: States of matter & Ionic equilibrium - Lab	0-0-2	217
Ability Enhancement compulsory Course -1/IC	LSEC0018	English Communication	2-0-0	657
General Elective –I (Maths)/SE	MACD0105	Calculus and Differential Equations	4-2-0	289
	MALG0106	Algebra		291
Total Credits			20	
Semester II				
Core Paper3 (Theory)/DC	CHBH0103	Organic Chemistry-I: Basics & Hydrocarbons	4-0-0	185
Core Paper4 (Theory)/DC	CHCT0104	Physical Chemistry-II: Chemical Thermodynamics & its applications	4-0-0	187
Core Paper3 (Lab)/DC	CHBH6103	Organic Chemistry-I: Basics & Hydrocarbons	0-0-2	218
Core Paper4 (Lab)/DC	CHCT6104	Physical Chemistry-II: Chemical Thermodynamics & its applications - Lab	0-0-2	219
Ability Enhancement compulsory Course –2/IC	CHES0002	Environmental Studies	0-0-2	143
General Elective –II (Maths)/SE	MAAL0107	Algebra and Numerical Methods	4-2-0	292
	MADV0108	Differential Equations, Vector Calculus and Geometry		293
Total Credits			20	
Semester III				
Core Paper5 (Theory)	CHSP0107	Inorganic Chemistry II: s- and p-Block Elements	4-0-0	193
Core Paper6 (Theory)	CHOG0108	Organic Chemistry II: Oxygen Containing Functional Groups	4-0-0	195
Core Paper7 (Theory)	CHPC0109	Physical Chemistry III: Phase Equilibria & Chemical Kinetics	4-0-0	196
Core Paper5 (Lab)	CHSP6107	Inorganic Chemistry II: s- and p-Block Elements - Lab	0-0-2	222
Core Paper6 (Lab)	CHOG6108	Organic Chemistry II: Oxygen Containing Functional Groups - Lab	0-0-2	223

Core Paper7 (Lab)	CHPC6109	Physical Chemistry III: Phase Equilibria & Chemical Kinetics - Lab	0-0-2	224
Skill Enhancement Course 1 (Elective)	CHBA0113	Basic Analytical Chemistry	0-0-2	201
	CHCI0114	Chemo informatics		203
	CHCP0115	Chemistry of cosmetics and perfumes		204
General Elective - III (Physics)	PSGP0115	General Thermal Physics	4-0-0	124
	PSDA0107	Digital Systems and Applications		114
General Elective –III (Physics) Lab	PSGP6111	General Thermal Physics Lab	0-0-2	140
	PSDA6107	Digital Systems and Applications Lab		138
Total Credits			26	
Semester IV				
Core Paper8 (Theory)	CHCC0110	Inorganic Chemistry III: Coordination Chemistry	3-1-0	197
Core Paper9 (Theory)	CHHC0111	Organic Chemistry III: Heterocyclic Chemistry	3-1-0	199
Core Paper10 (Theory)	CHEC0112	Physical Chemistry IV: Electrochemistry	3-1-0	200
Core Paper8 (Lab)	CHCC6110	Inorganic Chemistry III: Coordination Chemistry - Lab	0-0-2	225
Core Paper9 (Lab)	CHHC6111	Organic Chemistry III: Heterocyclic Chemistry - Lab	0-0-2	226
Core Paper10 (Lab)	CHEC6112	Physical Chemistry I IV: Electrochemistry - Lab	0-0-2	226
Skill Enhancement Course 2 (Elective)	CHPY0116	Pesticide Chemistry	2-0-0	204
	CHFC0117	Fuel Chemistry		205
	CHIP0118	Intellectual Property Rights		206
General Elective –IV (Physics)	PSGM0116	General Elements of Modern Physics	4-0-0	125
	PSAS0110	Analog Systems and Applications		117
General Elective –IV (Physics) - Lab	PSGM6112	General Elements of Modern Physics Lab	0-0-2	141
	PSAS6110	Analog Systems and Applications Lab		140
Total Credits			26	
Semester V				
Core Paper11 (Theory)		Organic Chemistry IV: Biomolecules	4-0-0	
Core Paper12 (Theory)		Physical Chemistry V: Quantum Chemistry & Spectroscopy	4-0-0	
Core Paper11 (Lab)		Organic Chemistry IV: Biomolecules - Lab	0-0-2	
Core Paper12 (Lab)		Physical Chemistry V: Quantum Chemistry & Spectroscopy - Lab	0-0-2	

Discipline Specific Elective I		Applications of computers in Chemistry	4-0-0	
		Analytical methods in Chemistry		
		Applications of computers in Chemistry Lab	0-0-2	
		Analytical methods in Chemistry Lab		
Discipline Specific Elective II		Novel Inorganic Solid	4-0-0	
		Polymer Chemistry		
		Novel Inorganic Solid Lab	0-0-2	
		Polymer Chemistry Lab		
Total Credits			24	

Semester VI				
Core Paper13 (Theory)		Inorganic Chemistry IV: Organometallic Chemistry	4-0-0	
Core Paper14 (Theory)		Organic Chemistry V: Spectroscopy	4-0-0	
Core Paper13 (Lab)		Inorganic Chemistry IV: Organometallic Chemistry - Lab	0-0-2	
Core Paper14 (Lab)		Organic Chemistry V: Spectroscopy - Lab	0-0-2	
Discipline Specific Elective III		Green Chemistry	4-0-0	
		Inorganic materials & Industrial Importance	4-0-0	
		Green Chemistry Lab	0-0-2	
		Inorganic materials & Industrial Importance Lab	0-0-2	
Discipline Specific Elective IV		Industrial Chemicals & Environment	4-0-0	
		Research methodology for Chemistry	4-0-0	
		Industrial Chemicals & Environment Lab	0-0-2	
		Research methodology for Chemistry Lab	0-0-2	
Total Credits			24	
Total Programme Credits			140	

MASTER OF SCIENCE – CHEMISTRY (2019-2021 Batch)

Semester	Category	Course Name	Course Code	Credits	Page
I	DC	Fundamentals of Inorganic Chemistry	CHIC0003	4	144
	DC	Fundamentals of Organic Chemistry	CHOC0004	4	146
	DC	Fundamentals of Physical Chemistry	CHPC0005	4	147
	DC	Introduction to Quantum Chemistry and Group Theory	CHQT0029	4	178

	DC	Inorganic Qualitative and Quantitative Analyses and Preparations - Lab	CHIQ6002	3	210
Total Credits				19	
II	DC	Advanced Inorganic Chemistry I	CHIR0007	4	150
	DC	Advanced Organic Chemistry I	CHOG0008	4	151
	DC	Advanced Physical Chemistry I	CHAP0009	4	153
	DC	Fundamentals of Spectroscopy	CHFYO030	4	180
	DC	Introduction to Green and Environmental Chemistry	CHGC0011	3	155
	DC	Experimental Physical Chemistry - Lab	CHEQ6003	3	211
Total Credits				22	
III	DC	Advanced Inorganic Chemistry II	CHAI0012	4	156
	DC	Advanced Organic Chemistry II	CHAO0013	4	158
	DC	Advanced Physical Chemistry II	CHAP0014	4	159
	DC	Special Topics in Biochemistry	CHSP0015	3	161
	DC	Applied Spectroscopy	CHAP0031	3	181
	DC	Research Methodology for Chemistry	CHRM0017	3	163
	DC	Organic Qualitative Analysis and Synthesis Lab	CHQA6004	3	212
Total Credits				24	
IV	<i>One Elective Course (of the five offered) and two Specialisation Courses (either Physical or Organic Chemistry courses) to be selected</i>				
	Electives				
	DE	Materials Chemistry	CHCM0018	3	164
	DE	Computational Chemistry	CHCC0019		165
	DE	Food Chemistry	CHFC0020		167
	DE	Industrial Chemistry	CHIC0021		168
	DE	Medicinal Chemistry	CHMD0022		169
	Specialisation I - Physical Chemistry				
	DE	Recent Advances in Catalysis	CHRC0023	3	170
	DE	Biophysical Chemistry	CHBC0024	3	171
	Specialisation II - Organic Chemistry				
	DE	Heterocyclic Chemistry	CHHC0025	3	172
	DE	Natural Products Chemistry	CHNP0026		174
	Specialisation III - Inorganic Chemistry				
	DE	Organometallic Chemistry	CHOC0027	3	176
	DE	Inorganic Rings, Clusters and Polymers	CHIP0028		177
	DC	Research Project	CHRP6008		12
Total Credits				21	
Total Programme Credits				86	

MASTER OF SCIENCE – CHEMISTRY (2018-2020 Batch)

Semester	Category	Course Name	Course Code	Credits	Page
III	DC	Advanced Inorganic Chemistry II	CHAI0012	4	156
	DC	Advanced Organic Chemistry II	CHAO0013	4	158
	DC	Advanced Physical Chemistry II	CHAP0014	4	159
	DC	Special Topics in Biochemistry	CHSP0015	3	161
	DC	Applied Spectroscopy	CHAS0016	2	162
	DC	Research Methodology for Chemistry	CHRM0017	3	163
	DC	Organic Qualitative Analysis and Synthesis Lab	CHQA6004	3	212
Total Credits				23	
IV	<i>One Elective Course (of the five offered) and two Specialisation Courses (either Physical or Organic Chemistry courses) to be selected</i>				
	Electives				
	DE	Materials Chemistry	CHMC0018	3	164
	DE	Computational Chemistry	CHCC0019		165
	DE	Food Chemistry	CHFC0020		167
	DE	Industrial Chemistry	CHIC0021		168
	DE	Medicinal Chemistry	CHMD0022		169
	Specialisation I - Physical Chemistry				
	DE	Recent Advances in Catalysis	CHRC0023	3	170
	DE	Biophysical Chemistry	CHBC0024		171
	Specialisation II - Organic Chemistry				
	DE	Heterocyclic Chemistry	CHHC0025	3	172
	DE	Natural Products Chemistry	CHNP0026		174
	Specialisation III - Inorganic Chemistry				
	DE	Organometallic Chemistry	CHOC0027	3	176
	DE	Inorganic Rings, Clusters and Polymers	CHIP0028		177
DC	Research Project	CHRP6005	9	213	
Total Credits				18	
Total Programme Credits				80	

DEPARTMENT OF MATHEMATICS

BACHELOR OF SCIENCE- HONOURS IN MATHEMATICS (2019 Batch)

Type of Course/Category	Course Code	Course Name	Credits (L-T-P)	Page
Semester I				
Core Paper1/DC	MACS0101	Calculus	4-2-0	285
Core Paper2/DC	MAAG0102	Algebra	4-2-0	286
Ability Enhancement compulsory Course -1/IC	LSEC0018	English Communication	2-0-0	657
General Elective -I//IE/ SE/DE (Chemistry)	CHAH0105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	3-1-0	189
	CHCK0120	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics		209
	CHAH6105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons Lab	0-0-2	220
	CHCK6114	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics Lab		228
Total Credits			20	
Semester II				
Core Paper3/DC	MAER0103	Elementary Real Analysis	4-2-0	287
Core Paper4/DC	MADQ0104	Differential Equations	4-2-0	288
Ability Enhancement compulsory Course -1/IC	CHES0002	Environmental Studies	2-0-0	143
General Elective -II/IE/ SE/ DE (Chemistry)	CHCF0106	Chemical Energetics, Equilibria & Functional Organic Chemistry	3-1-0	191
	CHOS0119	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy		207
	CHCF6106	Chemical Energetics, Equilibria & Functional Organic Chemistry - Lab	0-0-2	221
	CHOS6113	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy - Lab		227
Total Credits			20	
Semester III				
Core Paper5/DC	MARF0109	Theory of Real Functions	4-2-0	293
Core Paper6/DC	MAGT0110	Group Theory I	4-2-0	294
Core Paper7/DC	MAMC0111	Multivariable Calculus	4-2-0	295
Skill Enhancement Course 1/IE	MAPC0112	Programming in C	2-0-0	298
	MALS0113	Logic and sets	2-0-0	297

General Elective -III/IE/ SE/ DE(Physics)	PSGP0115	General Thermal Physics	3-1-0	124
	PSDA0107	Digital Systems and Applications		114
	PSGP6111	General Thermal Physics Lab	0-0-2	140
	PSDA6107	Digital Systems and Applications Lab		138
Total Credits			26	
Semester IV				
Core Paper8/DC	MAPE0114	Partial Differential Equations	4-2-0	299
Core Paper9/DC	MANM0115	Numerical Methods	4-2-0	300
Core Paper10/DC	MAMC0116	Mechanics i	4-2-0	301
Skill Enhancement Course 2/IE	MACG0117	Computer Graphics	2-0-0	303
	MAGY0118	Graph Theory	2-0-0	303
General Elective –IV/IE/ SE/ DE (Physics)	PSGM0116	General Elements of Modern Physics	3-1-0	125
	PSAS0110	Analog Systems and Applications		117
	PSGM6112	General Elements of Modern Physics Lab	0-0-2	141
	PSAS6110	Analog Systems and Applications Lab		140
Total Credits			26	
Semester V				
Core Paper11/DC		Metric Space and Complex Analysis	4-2-0	
Core Paper12/DC		Ring Theory and Linear Algebra I	4-2-0	
Discipline Specific Elective I/DE		Number Theory	4-2-0	
		Portfolio Optimization		
		Analytical Geometry		
Discipline Specific Elective II/DC		Probability and Statistics	4-2-0	
		Linear Programming		
		Industrial Mathematics		
Total Credits			24	
Semester VI				
Core Paper13/DC		Riemann Integration and Series of Functions	4-2-0	
Core Paper14/DC		Ring Theory and Linear Algebra II	4-2-0	
Discipline Specific Elective III/DE		Theory of Equations	4-2-0	
		Group Theory II		
		Mechanics I		
Discipline Specific Elective IV/DE		Bio-Mathematics	4-2-0	
		Differential Geometry		
		Mathematical Modelling		
Optional Dissertation or Project Work in place of one Discipline Elective (DSE) Course				
Project Work		Project Work	6	
Total Credits			24	
Total Programme Credits			140	

BACHELOR OF SCIENCE- HONOURS IN MATHEMATICS (2018 Batch)

Type of Course/Category	Course Code	Course Name	Credits (L-T-P)	Page
Semester III				
Core Paper5/DC	MARF0109	Theory of Real Functions	4-2-0	293
Core Paper6/DC	MAGT0110	Group Theory I	4-2-0	294
Core Paper7/DC	MAMC0111	Multivariable Calculus	4-2-0	295
Skill Enhancement Course 1/IE	MAPC0112	Programming in C	4-2-0	298
General Elective -III/IE/ SE/ DE(Chemistry)	MALS0113	Logic and sets	2-0-0	297
General Elective -III/IE/ SE/ DE(Chemistry)	CHAH0105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	3-1-0	189
	CHCK0120	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics		209
	CHAH6105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons Lab	0-0-2	220
	CHCK6114	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics Lab		228
Total Credits			26	
Semester IV				
Core Paper8/DC	MAPE0114	Partial Differential Equations		299
Core Paper9/DC	MANM0115	Numerical Methods	4-2-0	300
Core Paper10/DC	MAMC0116	Mechanics	4-2-0	301
Skill Enhancement Course 2/IE	MAGY0118	Graph Theory	2-0-0	303
	MACG0117	Computer Graphics		303
General Elective –IV/IE/ SE/ DE (Chemistry)	CHCF0106	Chemical Energetics, Equilibria & Functional Organic Chemistry	3-1-0	191
	CHOS0119	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy		207
	CHCF6106	Chemical Energetics, Equilibria & Functional Organic Chemistry - Lab	0-0-2	221
CHOS6113	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy - Lab	227		
Total Credits			26	
Semester V				
Core Paper11/DC		Metric Space and Complex Analysis	4-2-0	
Core Paper12/DC		Ring Theory and Linear Algebra I	4-2-0	
Discipline Specific Elective I/DE		Number Theory	4-2-0	
		Group Theory II		

Discipline Specific Elective II/DC		Probability and Statistics	4-2-0	
		Linear Programming		
Total Credits			24	
Semester VI				
Core Paper13/DC		Riemann Integration and Series of Functions	4-2-0	
Core Paper14/DC		Ring Theory and Linear Algebra II	4-2-0	
Discipline Specific Elective III/DE		Industrial Mathematics	4-2-0	
		Mathematical Finance		
Discipline Specific Elective IV/DE		Bio-Mathematics	4-2-0	
		Differential Geometry		
Total Credits			24	
Total Programme Credits			140	

MASTER OF SCIENCE – MATHEMATICS (2019-2021 Batch)

Semester I						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	DC	MARA0014	Real Analysis	4-0-0	4	235
	DC	MALA0015	Linear Algebra	4-0-0	4	237
	DC	MAAB0016	Abstract Algebra	4-0-0	4	238
	DC	MADE0017	Differential Equations	4-0-0	4	238
	DC	MAMT0018	Mathematical Methods I	4-0-0	4	239
Total Credits					20	

Semester II						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	DC	MATF 0019	Topology and Functional Analysis	4-0-0	4	241
	DC	MACA 0020	Complex Analysis	4-0-0	4	242
	DC	MAMP 0021	Measure Theory and Probability Theory	4-0-0	4	243
	DC	MAMD 0022	Mathematical Methods II	4-0-0	4	244
	DC	MACL 0023	Classical Mechanics	4-0-0	4	245
Total Credits					20	

Semester III						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
	DC	MADS0030	Discrete Mathematics	4-0-0	4	254
	DC	MACP0031	Computer Programming in C	2-0-1	3	255
	DC	MARM0032	Research Methodology for Mathematical Sciences	3-0-0	3	256
	DC	MARS6001	Research Seminar	2-0-0	2	304

Specialization I: Theoretical						
	DE	MAFA0033	Field theory & commutative Algebra	4-0-0	4	257
	DE	MANT0034	Number Theory	4-0-0		258
	DE	MAML0035	Mathematical Logic	4-0-0		259
	DE	MAFS0036	Fuzzy sets and Applications	4-0-0		260
Specialization II: Applicable						
	DE	MAFD0037	Fluid Dynamics I	4-0-0	4	261
	DE	MARC0038	Riemannian Geometry & Tensor Calculus	4-0-0		262
	DE	MANS0039	Numerical solution of PDE	4-0-0		263
Specialization III: Computational						
	DE	MACN0040	Computational Number Theory	4-0-0	4	264
	DE	MASC0041	Scientific Computing	4-0-0		266
	DE	MASF0042	Special Functions	4-0-0		267
Total Credits					20	
Semester IV						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Specialization I: Theoretical						
	DE	MAAS0046	Advance Analysis	4-0-0	4	271
	DE	MAGY0047	Graph Theory	4-0-0	4	272
	DE	MACA0048	Multivariable calculus	4-0-0	4	273
	DE	MAAY0049	Algebraic Number Theory	4-0-0	4	274
Specialization II: Applicable						
	DE	MAFL0050	Fluid Dynamics II	4-0-0	4	275
	DE	MACM0051	Continuum Mechanics	4-0-0		276
	DE	MATR0052	Theory of Relativity	4-0-0		277
	DE	MAFE0053	Finite element Methods	4-0-0		278
Specialization III: Computational						
	DE	MADN0054	Design and Algorithms Analysis	4-0-0	4	279
	DE	MAFE0053	Finite Elements Methods	4-0-0		278
	DE	MAIC0055	Introduction to Cryptography	4-0-0		281
Project	DC	MARP6003	Research Project		8	305
Total Credits					20	
Total Programme Credits					80	

MASTER OF SCIENCE – MATHEMATICS (2018-2020 Batch)

Semester III						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
	DC	MADS0030	Discrete Mathematics	4-0-0	4	254
	DC	MACP0031	Computer Programming in C	2-0-0	2	255
	DC	MARM0032	Research Methodology for Mathematical Sciences	3-0-0	3	256
	DC	MARS6001	Research Seminar	2-0-0	2	304
	DC	MACP6002	Computer Programming in C Lab	0-0-1	1	305
Specialization I: Theoretical						
	DE	MAFA0033	Field theory & commutative Algebra	4-0-0	4	257
	DE	MANT0034	Number Theory	4-0-0	4	258
		MAML0035	Mathematical Logic	4-0-0	4	259
		MAFS0036	Fuzzy sets and Applications	4-0-0	4	260
Specialization II: Applicable						
	DE	MAFD0037	Fluid Dynamics I	4-0-0	4	261
	DE	MARC0038	Riemannian Geometry & Tensor Calculus	4-0-0	4	262
	DE	MANS0039	Numerical solution of PDE	4-0-0	4	263
Specialization III: Computational						
	DE	MACN0040	Computational Number Theory	4-0-0	4	264
	DE	MASC0041	Scientific Computing	4-0-0	4	266
	DE	MASF0042	Special Functions	4-0-0	4	267
Specialization IV: Interdisciplinary						
	DE	MABM0043	Bio-Mathematics	4-0-0	4	268
	DE	MAMP0044	Mathematical Physics	4-0-0	4	269
	DE	MAMF0045	Mathematical Finance	4-0-0	4	270
Total Credits					20	
Semester IV						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Specialization I: Theoretical						
	DE	MAAS0046	Advance Analysis	4-0-0	4	271
	DE	MAGY0047	Graph Theory	4-0-0	4	272
	DE	MACA0048	Multivariable calculus	4-0-0	4	273
	DE	MAAY0049	Algebraic Number Theory	4-0-0	4	274

Specialization II: Applicable						
	DE	MAFL0050	Fluid Dynamics II	4-0-0	4	275
	DE	MACM0051	Continuum Mechanics	4-0-0	4	276
	DE	MATR0052	Theory of Relativity	4-0-0	4	277
	DE	MAFE0053	Finite element Methods	4-0-0	4	278
Specialization III: Computational						
	DE	MADN0054	Design and Algorithms Analysis	4-0-0	4	279
	DE	MAFE0053	Finite Elements Methods	4-0-0	4	278
	DE	MAIC0055	Introduction to Cryptography	4-0-0	4	281
Specialization IV: Interdisciplinary						
	DE	MAMM0056	Mathematical Modelling	4-0-0	4	282
	DE	MAMY0057	Mathematics in Economics and Game Theory	4-0-0	4	282
	DE	MASI0058	Statistical Inference	4-0-0		284
Project	DC	MARP6003	Research Project		8	305
Total Credits						20
Total Programme Credits						80

SCHOOL OF FUNDAMENTAL AND APPLIED SCIENCES

DEPARTMENT OF PHYSICS

Vision:

To endow the students with profound understanding of physics, the foundation for all natural sciences, and drive them towards critical thought for further study and research, to pave the way for suitable career opportunities and enable them to be of service to the society as responsible human beings.

Mission:

1. To strengthen the fundamental concepts of physics and provide advanced understanding of physical phenomena by emphasizing on the correlation between theory and observation.
2. To spark creative interest towards the pursuit of innovative research in fundamental and applied physics.

M.Sc. (Physics) Programme Outcomes

The students will be able to

- Get a profound understanding of physics, the foundation for all natural sciences, to explain different physical phenomena.
- Understand virtually every theme in the world - from elementary particles to the largest super clusters of galaxies.
- Comprehend all the advanced disciplines of physics from classical mechanics to quantum field theory and general theory of relativity.
- Get expertise in theoretical physics as well as experimental physics in sophisticated laboratories.
- Develop numerical techniques for solving different problems in physics.
- Have a good pedagogy to teach different topics of physics.
- Have good communication skills in discussing and presenting physics-related topics.
- Face with confidence all competitive examinations, like, NET, SLET, JEST, etc.
- Move towards critical thought for further study and research
- Be of service to the society as responsible human beings.

B.Sc. (Physics) Programme Outcomes

The students will be able to

- Get basic, but, very extensive knowledge of different theories of physics.
- Have vast hands on experience of an enormous number of experiments.
- Have a basic idea of computer programming.
- Enhance their skills through skill enhancement courses.
- Enhance their mathematical ability.
- Retain confidence while appearing for civil services or other such examinations.
- Take up master's degree programme and subsequently, Ph.D. programme with full confidence.
- Be of service to the society as responsible human beings.

DETAILED SYLLABUS

THEORY COURSES

PSCM0020: CLASSICAL MECHANICS

(4 credits-60 hours)

Objective: The objective of the course in classical mechanics or Newtonian mechanics is to make the students familiar to the set of physical laws describing the motion of bodies under the action of a system of forces. Classical mechanics describes the motion of macroscopic objects, from projectiles to parts of machinery, as well as astronomical objects, such as spacecraft, planets, stars, and galaxies. Besides this, many specializations within the subject deal with solids, liquids and gases and other specific sub-topics. Emphasis shall be laid upon the solution of numerical problems.

Module I (12 hours)

Hamilton's variational principle; derivation of Lagrange's equations; velocity dependent forces; dissipation. Charged particles in an electromagnetic field. Space time symmetries and conservation Laws. Variational theorem. Space transformation.

Module II (12 hours)

Two-body problem; central forces; classification of orbits; differential equation for orbits. Kepler problem; scattering in laboratory and centre of mass frames, transformation of cross sections, energies. Rutherford scattering. Kinematics of decay of particles (into two particles).

Module III (12 hours)

Rigid body motion: fixed and moving coordinate systems; orthogonal transformations. Euler angles; angular momentum; rotational kinetic energy. Principal axes transformation; Euler equations; force free motion of a rigid body symmetric top.

Module IV (12 hours)

Legendre transformation; Hamiltonian equations; Significance of the Hamilton function. Cyclic coordinates and conservation theorems. Poisson Brackets – Poisson Bracket of Angular momentum with coordinates. Canonical Transformation Theory. Contact transformation; integral invariants.

Module V (12 hours)

Special theory of relativity: Lorentz transformations. Four dimensional formulation. Force momentum and energy in relativistic mechanics. Properties of space-time in relativity. Two body decay of a particle.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain Hamilton's and Lagrange's equations and use them for solving problems in physics (Understanding)
- CO2:** Solve rigid body problems (Applying)
- CO3:** Analyse two body problem (Analysing)
- CO4:** Develop the concept of modern physics from Einstein's special theory of relativity (Creating)
- CO5:** Build the concept of frame of references (Creating)

Suggested Readings

1. H. Goldstein, C. Poole and J. Safko, Classical Mechanics, Pearson Education Asia.
2. N. C. Rana and P. S. Joag, Classical Mechanics, Tata McGraw Hills.

3. K. C. Gupta, Classical Mechanics of Particles and Rigid bodies, Wiley Eastern.
4. D. T. Greenwood, Principles of Dynamics, Prentice Hall.

PSQM0021: QUANTUM MECHANICS I

(4 credits-60 hours)

Objective: *The objective of this course in quantum mechanics is to make the students competent to understand the science of microscopic objects. It will help them to perceive the scientific principles that explain the behaviour of matter and its interactions with energy on the scale of atomic and subatomic particles. Emphasis shall be laid upon the solution of numerical problems.*

Module I (10 hours)

Introduction and revision: inadequacy of classical mechanics; basic postulates of quantum mechanics; ensemble and Copenhagen interpretation. Schrödinger equation; continuity equation; Ehrenfest theorem; admissible wave functions; stationary states. One dimensional problems; potential well and barriers; harmonic oscillator.

Module II (10 hours)

Equation of motion: Schrodinger, Heisenberg and Dirac representations; equation of motion in the respective representations. Application to linear harmonic oscillator.

Module III (10 hours)

Three dimensional problems: Separation of variables; orbital angular momentum; spherical harmonics. Harmonic oscillator in Cartesian and polar coordinates. A free particle and a particle in 3-D box in Cartesian and polar coordinates, Coulomb problem in spherical and parabolic coordinates - regular and irregular solutions.

Module IV (11 hours)

Spinors and their transformation properties. Pauli spin matrices. Identical particles and statistics. Addition of angular momenta. Clebsch-Gorden coefficients. Winger-Eckart Theorem.

Module V (8 hours)

Symmetry in quantum mechanics. Reflections, time reversal, space inversion, particle exchange. Displacement in space and time, space translation and rotational symmetry. Selection rule and conservation laws.

Module VI (11 hours)

Variational methods for bound states; lower and upper limits in simple cases. WKB approximation; connection with classical limits, validity of WKB approximation. Connection formulae; application to bound states, tunneling in one dimension. Application to radial Schrodinger equation.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Conceptualise different interpretations of quantum mechanics (Understanding)
- CO2:** Apply the concepts of quantum mechanics to different problems in physics (Applying)
- CO3:** Make use of variational method and WKB approximation (Applying)
- CO4:** Inspect how to encounter spin (Analysing)
- CO5:** Comprehend the idea of symmetry in quantum mechanics (Analysing)

Suggested Readings

1. E. Merzbacher, Quantum Mechanics, John Wiley.
2. G. Ahruddhas, Quantum Mechanics, Prentice Hall.
3. L. I. Schiff, Quantum Mechanics, McGraw Hill.

4. V. K. Thankappan, Quantum Mechanics, New Age Int. Pub.
5. P. T. Mathews and Venkatesan, Quantum Mechanics, Tata McGraw Hill.
6. K. D. Krori, Principles of Non-Relativistics and Relativistic Quantum Mechanics, PHI.
7. L. D. Landau and E. M. Lifshitz Quantum Mechanics (3 volumes), Pergamon Press.
8. Albert Messiah, Quantum Mechanics, Dover Publications.

PSMP0022: MATHEMATICAL PHYSICS

(4 credits–60 hours)

Objective: *The objective of the course in mathematical physics is to make students familiar with mathematical methods for application to problems in physics and the formulation of physical theories in different disciplines of physics. Emphasis shall be laid upon the solution of numerical problems.*

Module I (15 hours)

Functions of complex variable: Analytic functions; derivatives of an analytic function. Series of analytic functions: Taylor series, Laurent series; zeros and isolated singular points of analytic functions; the calculus of residues: theorem of residues; evaluation of integrals; Jordan's lemma; Principal value of an integral; multi-valued functions; Riemann surfaces; evaluation of an integral involving a multi-valued function; analytic continuation; dispersion relations.

Module II (13 hours)

Vectors and matrices: linear vector spaces; linear operators; matrices; coordinate transformations; eigenvalue problems; diagonalisation of matrices; spaces of infinite dimensionality.

Module III (16 hours)

Special functions: associated Legendre differential equation and functions; generating functions; spherical harmonics; orthonormality. Bessel's equation; Bessel function; Spherical Bessel function, Neumann and Hankel functions; expansion of a plane wave into partial waves. Laguerre and associated Laguerre differential equation and functions; generating functions; recurrence relations; orthonormality. Hypergeometric and confluent hypergeometric functions.

Module IV (8 hours)

Integral transforms: general properties of Laplace transforms; inverse Laplace transform; application of Laplace transforms; convolution theorem; solution of differential equations using Laplace transform.

Module V (8 hours)

Probability and statistics: fundamental laws of probability; binomial, Poisson and Gaussian distributions; general properties of probability distributions.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain the concept and applications of the function of complex variables (Understanding)
- CO2:** Make use of some advanced topics in vectors and matrices (Applying)
- CO3:** Utilize the concept and applications of some special functions (Applying)
- CO4:** Apply the concept of probability and statistics (Applying)
- CO5:** Analyse the concept and applications of Laplace and inverse Laplace transform (Analysing)

Suggested Readings

1. G. Arfken, H. Weber and F. Harris, Mathematical Methods for Physicists, Elsevier.

2. J. Mathews and R. L. Walker, Mathematical Methods of Physics, The Benjamin-Cumminngs Publishing Company.
3. P. Dennery and A. Krzywicki, Mathematics for Physicists, Harper and Row.

PSQM0024: QUANTUM MECHANICS II

(4 credits – 60 hours)

Objective: *The objective of the course in quantum mechanics II is to provide a deeper knowledge in the subject. This will be extremely helpful for students intending to go for higher studies in theoretical physics, e.g., theoretical nuclear physics, theoretical condensed matter physics, theoretical high energy physics, etc. Emphasis will be laid on solution of numerical problems.*

Module I (11 hours)

Stationary perturbation theory: Non Degenerate case; first and second order of energy and wave functions, perturbation of one dimensional harmonic oscillator by potentials of the bx^2 and cx^3 . Degenerate case; first order Stark effect in hydrogen; Zeeman effect without electron spin.

Module II (9 hours)

Time dependent perturbation theory; first order transition probabilities; constant perturbation. Transition to continuum; Harmonic perturbation; Fermi's golden rule; Sudden and adiabatic approximations.

Module III (10 hours)

Many Electron Atoms: Indistinguishable particles; Pauli's Principle; inclusion of spin; spin functions for two and three electrons; the Helium atom; central field approximation, Thomas-Fermi model of the atom; Hartree equation, Hartree- Fock equation.

Module IV (13 hours)

Scattering theory: asymptotic behaviour of scattering wave function; relation to cross sections, Green's function for scattering problem; Green's function with different boundary conditions; scattering integral equations; Born approximation and its validity criteria; scattering by screened Coulomb potential; Born series. Partial waves and phase shifts. Scattering amplitude; optical theorem; low energy scattering. Effective range; scattering length; resonance.

Module V (12 hours)

Relative wave equations: Klein-Gordon equation. Difficulty with probability interpretation. Dirac equation; four component solutions for free particle; negative energy solutions – particles and antiparticles. Covariant form of Dirac equation; 4-current density. Properties of γ -matrices. Dirac equation in the presence of electromagnetic field; non-relativistic reduction; spin and magnetic moment.

Module VI (5 hours)

Path integral approach to quantum mechanics: Feynman's Path Integral method, equivalence of Feynman and Schrödinger equations, Dirac-Feynman Action Principle.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain relativistic quantum mechanics (Understanding)
- CO2:** Interpret path integral approach to quantum mechanics (Understanding)
- CO3:** Apply the concept of quantum mechanics to the problems of scattering (Applying)
- CO4:** Build concept about perturbation theory (Applying)
- CO5:** Develop concepts on advanced topics like Hartree- Fock equation (Applying)

Suggested Readings

1. E. Merzbacher, Quantum Mechanics, John Wiley.
2. G. Aruldhas, Quantum Mechanics, Prentice Hall.
3. L. I. Schiff, Quantum Mechanics, McGraw Hill.
4. V. K. Thankappan, Quantum Mechanics, New Age Int. Pub.
5. P. T. Mathews and Venkatesan, Quantum Mechanics, Tata McGraw Hill.
6. Ghatak and Lokanathan, Quantum Mechanics Theory and Applications, Laxmi Publications.
7. K. D. Krori, Principles of Non-Relativistics and Relativistic Quantum Mechanics, PHI.

PSCP0025: CONDENSED MATTER PHYSICS

(4 credits – 60 hours)

Objective: *The objective of the course in condensed matter physics is to equip the students to deal with the physical properties of condensed phases of matter. Condensed matter physicists seek to understand the behaviour of these phases by using physical laws. Knowledge of condensed matter physics is required to pursue studies on specialised topic like electronics, nano-sciences, etc. Emphasis shall be laid upon the solution of numerical problems.*

Module I (11 hours)

Crystal structure. Diffraction of waves by crystal. Scattered wave amplitudes, Brillion zones. Fourier analysis of the basis. Crystal binding and elastic constants.

Module II (9 hours)

Phonons: quantisation of lattice vibrations, dispersion relation for acoustic and optical phonon, energy gap, density of states, heat capacity, thermal conductivity and thermal expansion.

Module III (8 hours)

Free electron Fermi gas: Fermi energy, density of states, heat capacity, thermal conductivity and electrical conductivity. Wiedemann-Franz law.

Module IV (10 hours)

Nearly free electron gas: Schrodinger equation of an electron in a periodic potential, Bloch theorem, energy gaps at the zone boundary, approximation solution near a zone boundary, energy bands and their role in properties of metals, insulators and semiconductors. Holes on energy bands. Hall effect.

Module V (12 hours)

Shape of fermi surfaces in the free electron and nearly free electron models. Tight binding approximations. Electron orbits, hole orbits and open orbits. Quantization of orbits in a magnetic field. De Hass-van Alphen effect and its role in experimental determination of Fermi surfaces.

Module VI (10 hours)

Plasmons, polaritons and polarons: dielectric functions of the electron gas, plasmons, electrostatic screening, Mott metal-insulator transition, polaritons, polarons. Peierls instability of linear metals.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain about crystal structure in details (Understanding)
- CO2:** Illustrate physics of phonons (Understanding)
- CO3:** Identify free electron and nearly free electron models (Applying)
- CO4:** Discuss about advanced topics like plasmons, polaritons, polarons, etc. (Creating)

Suggested Readings

1. C. Kittel, Introduction to Solid State Physics, John Wiley and Sons, Inc.

2. C. Kittel, Quantum Theory of Solids, John Wiley and Sons, Inc.
3. J. Callaway, Quantum Theory of the Solid State, Academic Press, New York.
4. H. Ibach and H. Luth, Solid State Physics, Narosa Pub. House.

PSED0026: ELECTRODYNAMICS

(4 credits – 60 hours)

Objective: *The objective of the course in electrodynamics (the science of charge and of the forces and fields associated with charge) to get an advanced understanding of electric charges, currents and magnetism. The curriculum provides an excellent description of electrodynamic phenomena which is also required in other disciplines of Physics. Emphasis shall be laid upon the solution of numerical problems.*

Module I (7 hours)

Maxwell's equations: review of Maxwell's equations; boundary conditions at interface between different media; Poisson's and Laplace's equations

Module II (8 hours)

Magnetostatics: introduction; Biot and Savart Law; Ampere's Law; vector potential; vector potential and magnetic induction for a circular current loop.

Module III (8 hours)

Electromagnetic waves: linear and circular polarisation; Stoke's parameters; Poynting theorem of complex field vectors; frequency dispersion (normal and anomalous); characteristics of dielectrics, conductors and plasma and their interaction with electromagnetic waves.

Module IV (15 hours)

- a) Simple radiating systems: Gauge invariance; Green's function for the wave equation; concept of retarded potential, radiation from an oscillating dipole and its polarisation. Electric dipole fields, magnetic dipole and electric quadrupole fields; centre fed linear antenna, scattering at long wavelengths – viz. by dipoles induced in a small scatterer, scattering by a small dielectric sphere.
- b) Diffraction: Scalar diffraction theory; vectorial diffraction theory, Scattering in a short wavelength limit.
- c) Guided waves: waveguides, TE waves in a rectangular waveguide, coaxial transmission lines.

Module V (13 hours)

Radiation from accelerated charge: Lienard-Wiechart potentials; radiated power from accelerated charge at low velocities. Larmor's power formula. The fields of a point charge in arbitrary and uniform motion. Radiation from an ultra relativistic particle. Angular and frequency distribution of radiation from moving charges.

Module VI (9 hours)

Special theory of relativity: matrix representation of Lorentz transformation; infinitesimal generators; Thomas precession; invariance of electric charge; covariance of electrodynamics; transformation of electromagnetic fields

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the electromagnetic theory (Remembering)
- CO2:** Explain various phenomena from the standpoint of electrodynamics (Understanding)

CO3: Infer the extension of classical electrodynamics to the generalized 4-dimensional case (Understanding)

CO4: Apply the laws of electrodynamics to solve various physical problems (Applying)

Suggested Readings

1. J. D. Jackson, Classical Electrodynamics, John Wiley and Sons.
2. S. P. Puri, Classical Electrodynamics, Tata McGraw Hill Publishing Company Ltd..
3. S. L. Gupta, V. Kumar and S. P. Singh, Electrodynamics, Pragati Prakashan.
4. D. J. Griffiths, Introduction to Electrodynamics, Prentice Hall of India.

PSAM0028: ATOMIC AND MOLECULAR PHYSICS

(4 credits – 60 hours)

Objective: *The course intends to give a widespread knowledge of the physics of atoms and molecules and the spectroscopy to the students. The knowledge of this subject is indispensable to understand matter- matter and light-matter interactions. Its applications are wide. Typically, the theory and applications of emission, absorption, scattering of electromagnetic radiation (light) from excited atoms and molecules, analysis of spectroscopy, generation of lasers and masers in general, fall into these categories. Emphasis shall be laid upon the solution of numerical problems.*

Module I (15 hours)

Introduction of atomic spectrum; fine structure and hyperfine structure of energy levels. Angular momentum and magnetic moment. Doublet structure energy levels and single electron atom. Term symbols and fine structure of energy levels of two electron atoms using L-S coupling and j-j coupling schemes; identification of ground state. Interaction of nuclear and electronic magnetic moments and hyperfine structure with examples.

Module II (10 hours)

Interaction of radiation with atoms; spontaneous and stimulated emission; absorption; transition. Einstein's A and B coefficients. Working principles of He-Ne laser.

Module III (12 hours)

Theories of molecular bond formation; van der Waals bonding, ionic bonding, valence bond and molecular orbital models of covalent bonding. Homonuclear diatomic molecules and the term symbols and their ground states.

Module IV (8 hours)

Vibronic states of molecules and nature of vibronic spectra; harmonic and anharmonic vibrations and potential constants; rotational spectrum and moment of inertia of molecules.

Module V (15 hours)

Symmetry of molecules; symmetry elements and points group; proper and improper rotations and their matrix representation. Introduction to character table of point group; reducible and irreducible representation for simple molecules such as H₂O, NH₃, etc. Normal coordinates and normal modes of vibrations. Infrared absorption and Raman scattering from molecular vibrations and rotations, and selection rules.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

CO1: Explain atomic and molecular spectroscopy in details (Understanding)

CO2: Understand interaction of radiation with atoms (Understanding)

CO3: Analyse bond formation (Analysing)

CO4: Apply the concept of symmetry to molecules (Application)

Suggested Readings

1. H. E. White, Introduction to Atomic Spectra, Mc-Graw Hill.
2. Martin Karplus and Richard N. Porter; Atoms and Molecules, W. A. Benjamin.
3. G. Herzberg, Spectra of Diatomic Molecules, Van Vostrand.
4. O. Svelto, Principles of Lasers, Plenum Press.

PSNA0029: NUCLEAR PHYSICS

(4 credits–60 hours)

Objective: This course is mainly the study of the physics of elementary particles of the nature. The main objective of the course is to give the students a comprehensive knowledge of the constituents and interactions of atomic nuclei which will find its applicability in nuclear power generation. Further, many fields, including magnetic resonance imaging, are the direct applications of the knowledge of nuclear physics. Elementary knowledge of particle physics and detectors is also provided in the course. Emphasis shall be laid upon the solution of numerical problems.

Module I: Conventional Units to be Adopted in Nuclear Physics (8 hours)

Properties of nucleons and pion, elements of nucleon and pion structure in terms of quark model. Basic properties of nuclei-charge, mass, binding energy, binding energy curve, size, spin and statistics, parity, magnetic dipole moment, electric dipole moment with illustration examples.

Module II: Nuclear Two Body Problem and Nuclear Force (12 hours)

Properties of deuteron bound state and low energy n-p scattering in terms of scattering length and effective range, spin dependence, charge independence of nucleon force. Non-central part of nucleon force, isospin concept, exchange forces, magnetic moment and electric quadrupole moment of deuteron. Yukawa theory of nuclear force.

Module III: Nuclear Models (8 hours)

Magnetic number and single shell model using oscillator well, and spin orbit interaction, Schmidt lines, spin parity assignment, rotational model, vibrational model with examples.

Module IV: Nuclear Reactions (15 hours)

Conservation laws: Kinematics governing nuclear reactions, Q-value, cross section of nuclear reactions, neutron reactions at low energies, Coulomb effects in nuclear reactions, neutron reactions at low energies, Coulomb effects in nuclear reactions, neutron reactions, compound nucleus hypothesis, Breit Wigner one level formula for resonance reactions. Elements of direct reactions (qualitative), energies of fission and fusion, neutron induced fission, chain reaction, hydrogen burning in the sun.

Module V: Nuclear Decay (8 hours)

Fermi theory of decay, selection rules, non-conservative of parity. Gamma decay, electric and magnetic multipole transitions, selection rules, examples of beta and gamma decay.

Module VI: Interactions of Charged Particles and Gamma Radiation with Matter (9 hours)

Linear attenuation coefficients, Compton scattering, photoelectric absorption, and pair production. Stopping power and range energy relations. Semiconductor detectors for charged particles and scintillation detectors.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain nucleus and nuclear forces in details (Understanding)
CO2: Expound nuclear models (Understanding)

CO3: Understand nuclear reaction and origin of nuclear energy (Understanding)

CO4: Describe interactions of charged particles and gamma radiation with matter (Analysing)

Suggested Readings

1. S. N. Ghosal, Atomic and Nuclear Physics, Vol-II, S. Chand and company Ltd.
2. S. M. Wong, Introductory Nuclear Physics, Prentice Hall Inc.
3. B. L. Cohen, Concepts of Nuclear Physics, Tata McGraw Hill Publishing Company Ltd.
4. R. D. Evans, The Atomic Nucleus, Tata McGraw Hill Publishing Company Ltd.
5. S. S. Kapoor and V. S. Ramamurthy, Nuclear Radiation Detectors, Wiley Eastern Ltd.
6. W. N. Cottingham and D. A. Greenwood, An introduction to nuclear Physics, Cambridge University Press.

PSCN0030: COMPUTER ORIENTED NUMERICAL METHODS

(2 Credits – 30 hours)

Objective: Most problems in physics benefit from numerical methods, and many of them resist analytical solution altogether. The objective of this course is to learn the principles of numerical techniques and apply them to problems of Physics. Knowledge of computer programming is given with FORTRAN language. Emphasis will be laid on the solution of numerical problems.

Module I: Numerical Analysis (10 hours)

- a) Introduction to numerical methods: approximate and significant figures, absolute and relative errors, general formula for errors, application of the error formula to the fundamental operations of arithmetic and to logarithms. The error of a sum, the error of a difference, the error of a product and number of correct digits, the error of quotients and number of correct digits, the relative error of a power, the relative error of a root, successive approximation, Taylor's series, principle of least square, law of error of residuals.
- b) Matrices and linear equations: addition, subtraction and multiplication of matrices, inversion of matrices, Jacobi transformation of a symmetric matrix, determinant of a matrix, transpose of a matrix, solution of equations by matrix method, Gauss-Jordan elimination Method, eigenvalues and eigenvectors.
- c) The solution of numerical, algebraic and transcendental equations: Equations in one unknown: Finding approximate values of the roots, finding roots by repeated application of location theorem, bisection method, the Newton-Raphson method; their convergence and geometric significance.

Module II: Solutions of Ordinary Differential Equations (9 hours)

- a) Equations of the first order: Euler's method and its modification, the Runge-Kutta method, checks, errors and accuracy.
- b) Equations of the second order and systems of simultaneous equations: Milne's-predictor and corrector methods, boundary value problems, conditions for convergence.
- c) Minimization or maximization of functions: golden selection search in 1-D, parabolic interpolation and Brent's method in 1-D, 1-D search with 1 derivatives, Downhill simplex method in multidimensions, Direction set (Powell's method in Multidimensions)

Module III (5 hours)

- a) Numerical Integration: Classical formulae for equispaced abscissae: Simpson's rule, trapezoidal rule, Gaussian quadrature formula.
- b) Computation of factorials, computation of square roots, recurrence relations.

Module IV: Review of FORTRAN Language I (6 hours)

- a) Introduction to computing
- b) Constants, variables, expressions, operations, statements, functions and built in functions.
- c) Conditional and looping structures, arrays, subprograms and subroutines.
- d) File operations.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain the concept of numerical methods (Understanding)
CO2: Apply numerical techniques to solve different problems in Physics (Applying)
CO3: Understand high level language through Fortran (Understanding)

Suggested Readings

1. Seymour Lipschutz and Arthur Poe, Theory and problems of Programming with FORTRAN, McGraw-Hill.
2. C. Xavier and R. Rajaraman, FORTRAN 77 and numerical methods, New Age International Publishers
3. V. Rajaraman, FORTRAN 77 Programming, Prentice Hall of India.
4. V. Rajaraman, Numerical Analysis, Wiley Eastern.
5. W. H. Press, S. S. Tenkulsky, W. T. Wattering and B. P. Flannery, Numerical Receptions in FORTRAN, Cambridge University Press.
6. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India.
7. M. K. Jain et al., Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
8. F. B. Hildebrand, Introduction to Numerical Analysis, McGraw-Hill Book Company Inc.

PSSM0034: STATISTICAL MECHANICS**(4 credits – 60 hours)**

Objective: The course intends to describe physical phenomena in terms of a statistical treatment of the behaviour of large numbers of atoms or molecules, especially as regards the distribution of energy among them. Emphasis will be laid on the solution of numerical problems.

Module I: Essentials (17 hours)

- a) Probability theory: the random walk problem, binomial, Poisson and Gaussian distributions, central limit theorem.
- b) Classical equilibrium statistical mechanics: concept of equilibrium; Ergodic hypothesis; microcanonical, canonical and grand canonical Ensembles; partition functions and their relation to thermodynamics.
- c) Classical nonequilibrium statistical mechanics: approach to equilibrium, Liouville's theorem, Boltzmann's H theorem

Module II: Quantum Statistics (15 hours)

- a) Quantum statistical mechanics: Schrödinger and Heisenberg Picture; pure and mixed states, the density matrix, quantum mechanical Liouville's theorem; the fundamental postulates.
- b) Quantum statistics: quantum gases of independent particles; partition functions; Bose Einstein's and Fermi Dirac's distributions; electrons in metals; black body radiation; Bose Einstein's Condensation

Module III: Phase Transitions (15 hours)

- a) Phenomenology: first and second order phase transitions; elementary ideas of critical phenomena; universality of critical exponents; scaling of thermodynamic functions.
- b) Theory: the Landau theory of phase transition with examples. c) Exact solutions: Ising model in one dimension.

Module IV: Non Equilibrium Phenomena and Irreversible Processes (13 hours)

- a) Non equilibrium phenomena: transport theory; Boltzmann equation; Maxwell-Boltzmann distribution.
- b) Irreversible processes: fluctuations; Brownian motion; Langevin's equation; Wiener Khintchine relations, Nyquist theorem, Fluctuation-Dissipation theorem; Fokker Planck equation.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Appreciate the connection between statistical mechanics and thermodynamics (Analysing)
- CO2:** Conceptualise quantum statistical mechanics (Understanding)
- CO3:** Understand the physics of phase transition (Understanding)

Suggested Readings

1. Federick Reif, Fundamental of Statistical and Thermal Physics, McGraw Hill, Singapore.
2. Shang-Keng Ma, Statistical Mechanics, World Scientific, Singapore.
3. Richard E. Wilde, and Surjit Singh, Statistical Mechanics: Fundamental and Modern Applications, Wiley-Interscience, John Wiley and Sons Inc., New York.
4. Leo P Kadanoff, Statistical Physics: Statics, Dynamics and Renormalisation, World Scientific, River Edge, New Jersey.
5. K. Huang, Statistical Mechanics, John Wiley and Sons Inc., New York.
6. D. J. Amit and J. Verbin, Statistical Physics, World Scientific, Singapore.
7. L D Landau, E.M. Lifshitz, Statistical Physics, Butterworth-Heinemann.
8. R. K. Pathria, Statistical Mechanics, Academic Press.

PSPA0035: PARTICLE PHYSICS

(4 credits – 60 hours)

***Objective:** The objective of the course in particle physics is to make the students learn about the most primitive, primordial, unchanging and indestructible forms of matter and the rules by which they combine to compose all the things of the physical world. Thus, it is the branch of physics that studies the nature of the particles that constitute matter (particles with mass) and radiation (massless particles). In principle, all physics (and practical applications developed there from) can be derived from the study of fundamental particles. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Relativistic Kinematics (5 hours)

Lorentz transformation, four vectors, relativistic collisions and their application.

Module II: Group theory and Tensors (10 hours)

Introduction to group theory, representation theory, Lie group and Lie Algebra, direct product group, Young tableau. Basics of tensors, covariant and contravariant tensors, covariant derivative.

Module III: Introduction to Elementary Particles and their Interactions (13 hours)

Classification of elementary particles, fundamental forces, interactions and Feynman diagram, particle

exchange, leptons and weak interactions, quarks and hadrons, quark model, space time symmetry, C, P, CP conservation, time reversal, conservation law in different interactions.

Module IV: Quantum Field Theory (17 hours)

Concept of field, canonical quantisation of classical system, second quantisation, Fock space quantisation of scalar, Dirac and electromagnetic fields, Noether theorem - conservation of energy, momentum and charge of the field, the vacuum in field theory; C, P, T transformation of scalar and E. M. fields.

Module V: Quantum Electrodynamics (15 hours)

Covariant perturbation theory, Wick's theorem, Green's function, Feynman rule, Compton scattering, Mott's scattering, basics of renormalisation.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Summarize the mathematical skills like group theory, tensors, kinematics, etc. (Understanding)
- CO2:** Explain different groups like Lorentz group, Lie group and their algebra (Understanding)
- CO3:** Categorize SU(2) and SU(3) algebra (Analysing)
- CO4:** Explain quantum field theory and hence identify quantum electrodynamics (Applying)

Suggested Readings

1. D. Griffiths, Introduction of Elementary Particle, Wiley-vch Verlag GmbH.
2. F. Halzen and A. D. Martin, Quarks and Leptons : An Introductory Course in Modern Particle Physics, Wiley India.
3. L. H. Ryder, Quantum Field Theory, Cambridge University Press.
4. D. H. Perkins, Introduction to High Energy Physics, Addison-Wesley.
5. Brian R. Martin and Graham Shaw, Particle Physics, Wiley.
6. Michael E. Peskin and Daniel V. Schroeder, An introduction to Quantum Field Theory, Westview Press Inc.

PSPL0036: PLASMA PHYSICS I

(4 Credits – 60 hours)

Objective: *The objective of this course is to give a basic understanding of plasma physics. The course dealing with the knowledge of the fourth state of matter is not only important for taking up advanced studies in plasma physics but also in other branches of physics. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Introduction to Plasma Physics (12 hours)

Role of temperature in occurrence of plasma; definition of plasma: quasineutrality and collective behaviour of plasma; concept of temperature; Debye shielding; criteria for plasma; classification of plasma; occurrence of plasma in nature

Module II: Single Particle Motion (12 hours)

Uniform electric and magnetic fields; non-uniform magnetic field: grad-B drift, curvature drift, magnetic mirrors, the loss cone; non-uniform electric field; time-varying electric field; time-varying magnetic field; adiabatic invariants.

Module III: Plasma Diagnostics (14 hours)

Langmuir probe: I-V characteristics, measurement of plasma potential, floating potential, electron temperature and electron density; double probe; optical emission spectroscopy: radiation

from plasma, plasma models, temperature measurement by Boltzmann plot and line intensity ratio method, line broadening in plasma, Doppler broadening and Stark broadening, applications; absorption spectroscopy; calorimetric methods; laser and microwave interferometer.

Module IV: Laboratory and Space Plasma (10 hours)

Glow discharge plasma; production and stabilization of thermal plasma, principle of DC, AC and high frequency discharges, RF and ECR plasmas, dielectric barrier discharge plasma, laser produced plasmas; sun and solar winds, Van Allen belts, the ionosphere, formation of, accretion disks, dusty plasmas.

Module V: Applications of Plasma (12 hours)

Thermal plasma: nanoparticle synthesis, plasma spraying, waste management; plasma sputtering; plasma nitriding; plasma processing; plasma enhanced vapour deposition; plasma assisted surface engineering; biomedical applications; the magneto-hydrodynamic generator; plasma propulsion.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Understand and explain the basic theoretical concepts of plasma physics (Remembering)
- CO2:** Describe plasma diagnostic. (Analysing)
- CO3:** Understand some of the laboratory and naturally occurring plasma. (R, U, A)
- CO4:** Know various applications of plasma. (Analysing)

PSEC0037: ELECTRONICS II

(4 credits–60 hours)

Objective: *The course provides basic analog electronic circuit design techniques and analytical skills using diodes, op-amps, FETs, and BJTs. The student will develop ability to apply basic engineering sciences to the design, analyses and operation of electronics devices and circuits and problem solving skills of electronic circuits. Emphasis will be laid on the solution of numerical problems.*

Module I (20 hours)

- a) Bipolar junction transistor: BJT biasing: fixed bias, emitter bias, voltage divider bias, D.C. collector feedback bias; DC and AC load line, Q- point, stability considerations. BJT modeling: two port representation of BJT with z , y , h -parameters; re and hybrid models of C-E, C-B, C-C configuration.

Hybrid- π model of C-E amplifier in voltage divider bias configuration, frequency response in low, mid and high frequency conditions, respective voltage gain, current gain, input and output impedances.

- b) Field effect transistors: FET biasing: self bias, fixed bias, voltage divider bias, stabilization of Q-point. Small signal AC equivalent circuit of FET as amplifier, hybrid parameters. JFET amplifiers: CS, CD amplifiers; enhancement mode MOSFET amplifier, depletion mode MOSFET amplifiers; Introduction to CMOS, characteristics, structure of MOSFET, CMOS.

Module II (25 hours)

- a) Thyristors: four layer diode, SCR, Photo SCR, gate controlled switch, silicon controlled switch, Diac, Triac, UJT;
- b) Op-Amp - ideal operational amplifiers: Input impedance. DC offset parameters, frequency parameters, gain-bandwidth, CMRR, SVRR, SR. Op-Amp applications in constant gain multiplier, voltage summing, log - antilog amplifier, subtractor, comparator – zero crossing detector,

Schmitt trigger, integrator, differentiator and controlled sources. instrumentation amplifier. Active filters: low, high and bandpass filters; ADC and DAC.

- c) 555 timer: block diagram, monostable operation, astable operation, bistable operation, voltage controlled oscillator, ramp generator.

Module III (15 hours)

- a) Feedback configurations: voltage series, voltage shunt, current series, current shunt.
- b) Oscillators: introduction and classification, general form of LC oscillator, e.g. Hartley oscillator, Colpitts oscillator, RC phase shift oscillator, Wein Bridge oscillator, crystal oscillator.
- c) Regulated power supply: voltage feedback regulation, current limiting characteristics, power supply characteristics, 3 terminal IC regulators, current boosters, switching regulators.
- d) Characteristic of instruments: static characteristics, span, accuracy and precision, linearity, tolerance, error, repeatability, sensitivity, calibration, hysteresis, input impedance, resolution, bias and drift.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

CO1: Know about different types of transistors (R, U)

CO2: Utilize Describe devices like thyristors, operational amplifiers, oscillators, etc. (R, A)

Suggested Readings

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, New Delhi.
2. Jacob Millman, Christos C Halkias and Satyabrata Jit, Millman's Electronic Devices and Circuits, 2nd Edition, Tata McGraw Hill, New Delhi.
3. S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, Electronic Devices and Circuits, Tata McGraw- Hill.
4. Streetman and Banerjee, Solid State Electronic Devices, Prentice Hall, New Delhi.
5. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, New Delhi.
6. Jacob Millman, Christos C Halkias, Integrated Electronics, McGraw Hill Int. students Edition.
7. Ramakant A. Gayakwad, Op-amps and Linear Integrated Circuits, PHI.

PSPT0038: PHYSICS FOR TECHNOLOGISTS

(4 Credits – 60 Hours) (L-T-P: 3-1-0)

Objective: This course is intended to strengthen the understanding of the basic physical concepts which are essential to the branches of electrical, electronics and computer science engineering. The course is divided into four modules which deal with optics, electromagnetic theory, relativity, quantum physics and semiconductor physics and their applications. Emphasis shall be laid upon the solution of numerical problems.

Module I: Wave Optics (10 hours)

- a) Interference and diffraction: Huygen's principle, superposition of two waves, coherent sources, Young's double slit experiment, intensity distribution; Newton's rings and applications. Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to a single slit, plane transmission grating; zone plates. Polarization of transverse waves, plane, circular, and elliptically polarized light; polarization by reflection, refraction and scattering.
- b) Photonics: spontaneous and stimulated emission, fundamentals of laser action, ruby Laser, He-Ne laser, applications of lasers. Elements of fibre optics, types of optical fibres, numerical aperture. Principles of holography.

Module II: Electromagnetic Theory (18 hours)

- a) Electromagnetism: basic idea of divergence and stokes theorems, Gauss's law and its applications, electrostatic potential, Poisson's and Laplace's equation, work and energy, dielectric polarization bound charges, electric displacement (D); magnetic induction (B), magnetic intensity (H), Biot-Savart's Law, Ampere's circuital law; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Faraday's law of electromagnetic induction, displacement current, Maxwell's equations in differential and integral forms.
- b) Electromagnetic waves: Electromagnetic energy densities, Electromagnetic wave equations for E and B, transverse nature and speed of electromagnetic waves, Poynting vector, Poynting theorem.

Module III: Quantum Physics and Applications (14 hours)

- a) Quantum physics: historical overview; particle aspect of radiation – blackbody radiation, photoelectric effect, Compton scattering; wave aspect of particles – de Broglie's hypothesis, matter waves; Heisenberg's uncertainty principle; transition from deterministic to probabilistic states of a system – wave functions, probability density, superposition principle; observables and operators, expectation values. Schrodinger wave equation.
- b) Application of quantum mechanics: solutions of one dimensional problem, infinite deep potential well – energy eigenvalues, eigenfunctions, potential barrier – tunneling.

Module IV: Semiconductor Physics (18 hours)

- a) Free electron theory, density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), energy bands in solids, E-k diagram, direct and indirect bandgaps, types of electronic materials: metals, semiconductors, and insulators, density of states, occupation probability, Fermi level, effective mass, phonons.
- b) Intrinsic and extrinsic semiconductors, dependence of Fermi level on carrier- concentration and temperature (equilibrium carrier statistics), carrier generation and recombination, carrier transport: diffusion and drift, p-n junction, metal- semiconductor junction.
- c) Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; joint density of states, density of states for photons, transition rates (Fermi's golden rule), optical loss and gain; photovoltaic effect, exciton, drude model.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Outline about photonics and wave optics (Understanding)
- CO2:** Explain electromagnetic theory and electromagnetic waves (Understanding)
- CO3:** Apply the concept of quantum mechanics in technology (Applying)
- CO4:** Examine the physics of semiconductors and their possible applications (Analysing)

Suggested Readings

1. S. Dey, Physics for Engineers and Technologists, Eastern Book House.
2. Halliday, Resnick and Walker, Fundamentals of Physics (Extended), Wiley.
3. H. D. Young and R. A. Freedman, Sears and Zemansky's University Physics, Pearson Education.
4. A. Ghatak, Optics, Tata Mcgraw Hill.
5. D. J. Griffiths, Introduction to Electrodynamics, Pearson, Prentice Hall.
6. A. Beiser, Concepts of Modern Physics, McGraw Hill.
7. L. I. Schiff, Quantum Mechanics, McGraw Hills.
8. E. Merzbacher, Quantum Mechanics, Wiley.
9. G. Aruldas, Quantum Mechanics, PHI learning.

10. H. Goldstein, Classical Mechanics, Addison-Wesley.
11. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw Hill.
12. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley.
13. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India.

PSEP0039: ENGINEERING PHYSICS: MECHANICS

(4 Credits – 60 Hours) (L-T-P: 3-1-0)

Objective: *The objective of this syllabus is to impart the knowledge of mechanics, an important segment of physics, to the students of civil engineering. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Vector Mechanics of Particles (20 hours)

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates; Potential energy function; $F = -\text{Grad } V$; Conservative and non-conservative forces; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Application: Satellite manoeuvres; Non- inertial frames of reference; Rotating coordinate system: Five-term acceleration formula — Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance.

Module II: Planar Rigid Body Mechanics (10 hours)

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples; Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two- dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

Module III: Statics (10 hours)

Free body diagrams with examples on modelling of typical supports and joints; Condition for equilibrium in three- and two- dimensions; Friction: limiting and non- limiting cases; Force-displacement relationship; Geometric compatibility for small deformations; Illustrations through simple problems on axially loaded members like trusses.

Module IV: Mechanics of solids (20 hours)

Concept of stress at a point; Planar stress: transformation of stresses at a point, principal stresses and Mohr's circle; Displacement field; Concept of strain at a point; Plane strain: transformation of strain at a point, principal strains and Mohr's circle; Strain Energy; Discussion of experimental results on one- dimensional material behaviour; Concepts of elasticity, plasticity, strain hardening, failure (fracture / yielding); Idealization of one- dimensional stress-strain curve; Generalized Hooke's law with and without thermal strains for isotropic materials; Complete equations of elasticity; Force analysis — axial force, shear force, bending moment and twisting moment diagrams of slender members (without using singularity functions); Torsion of circular shafts and thin-walled tubes (plastic analysis and rectangular shafts not to be discussed)

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain about vector algebra and its application (Understanding)
- CO2:** Illustrate the mechanics of solids and apply the concepts in engineering problems (Understanding)
- CO3:** Apply the concepts of statics (Applying)
- CO4:** Analyse rigid body problem (Analysing)

Suggested Readings

1. M. K. Harbola, Engineering Mechanics.
2. M. K. Verma, Introduction to Mechanics.
3. D. Kleppner and R. Kolenkow, An Introduction to Mechanics.
4. J. L. Synge and B. A. Griths, Principles of Mechanics.
5. J. P. Den Hartog, Mechanics.
6. J. L. Meriam, Engineering Mechanics – Dynamics.
7. J. P. Den Hartog, Mechanical Vibrations.
8. W. T. Thomson Theory of Vibrations with Applications.
9. S. H. Crandall, N. C. Dahl & T. J. Lardner, An Introduction to the Mechanics of Solids.
10. J. L. Meriam, Engineering Mechanics: Statics.
11. E. P. Popov, Engineering Mechanics of Solids.

PSET0040: ENGINEERING PHYSICS: ELECTROMAGNETIC THEORY

(4 Credits – 60 Hours) (L-T-P: 3-1-0)

***Objective:** The objective of the course is to impart the knowledge electromagnetism including electromagnetic waves to the students of mechanical engineering. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Electrostatics in Vacuum (10 hours)

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Module II: Electrostatics in a Linear Dielectric Medium (8 hours)

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Module III: Magnetostatics (9 hours)

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Module IV: Magnetostatics in a Linear Magnetic Medium (7 hours)

Magnetization and associated bound currents; auxiliary magnetic field; Boundary conditions on and Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Module V: Faraday's law (8 hours)

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic braking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Module VI: Maxwell's equations (9 hours)

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Module VII: Electromagnetic Waves (9 hours)

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a nonconducting medium-vacuum interface for normal incidence.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall basic laws of electricity and Magnetism (Remembering)
- CO2:** Recall the electromagnetic theory (Remembering)
- CO3:** Explain various phenomena from the standpoint of electrodynamics (Understanding)
- CO4:** Apply the laws of electrodynamics to solve various physical problems (Applying)

Suggested Readings

1. David Griffiths, Introduction to Electrodynamics.
2. Halliday and Resnick, Physics.
3. W. Saslow, Electricity, Magnetism and Light.

PSNS0041: NANOPHYSICS II

(4 credits – 60 hours)

Objectives: *The aim of the course is to introduce the students to the world of nanomaterials and their synthesis and characterization process. Students will learn various kinds of nanomaterials and their potential use in the field of science and technology. The course will give scope of knowing about various methods of formation of nanostructures, surfaces and interfaces of nanostructures, natural nanomaterials and toxicology of nanomaterials. The common synthesis methods are also given emphasis as well as the characterization tools such as SEM, TEM, etc. will be discussed in detail. This course will help the students to take up practical work on nanotechnology. Emphasis will be laid on the solution of numerical problems.*

Module I (15 Hours)

Surfaces and interfaces in nanostructures; ceramic interfaces, superhydrophobic surfaces, grain boundaries in nanocrystalline materials, defects associated with interfaces; thermodynamics of nanomaterials, natural nanomaterials; toxicology of nanomaterials.

Module II (25 Hours)

Chemical routes for synthesis of nanomaterials: electrochemical synthesis, photochemical synthesis; synthesis in supercritical fluids. hydrothermal growth of nanoparticles and different nano structures. Ostwald ripening; zeta potential; fabrication of nanomaterials by physical methods: -inert gas condensation, arc discharge, plasma arc technique, RF plasma, MW plasma, ion sputtering, laser ablation, laser pyrolysis, ball milling, molecular beam epitaxy, physical and chemical vapour deposition method; electrodeposition. Core-shell quantum dots.

Module III (20 Hours)

Nanostructures: zero-, one-, two- and three- dimensional structure, size control of metal nanoparticles; properties: optical, electronic, magnetic properties; surface plasmon resonance, structural characterization X-ray diffraction, small angle x-ray scattering, optical microscope and their description, scanning electron microscopy (SEM), scanning probe microscopy (SPM), TEM and EDAX, SAED analysis, scanning tunneling microscopy (STM), atomic force microscopy (AFM). Spectroscopic characterizations: basic concepts of spectroscopy, operational principle and application for analysis of nanomaterials, UV-VIS-IR spectrophotometers, principle of operation and application for band gap measurement (T_{auc} plot).

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain different properties of nanomaterials (Understanding)
- CO2:** Know about different methods for the synthesis of nanomaterials (Applying)
- CO3:** Appreciate the technology associated with characterization of nanomaterials (Applying)

Suggested Readings

1. G. L. Hornyak, J. Dutta and H. F. Tibbals, A. Rao Introduction to nanoscience, CRC Press.
2. T. Pradeep, Nano: The Essentials, McGraw Hill.
3. D. Maclurcan and N. Radywyl (Eds.) Nanotechnology and Global Sustainability, CRC Press.
4. G. W. Hanson Fundamentals of Nanoelectronics, Pearson.
5. R. Vajtai (Ed.), Springer Handbook of Nanomaterials, Springer.
6. B. Bhushan (Ed.), Springer Handbook of Nanotechnology, Springer.

PSGT0043: GAUGE THEORIES

(4 credits – 60 hours)

Objective: The objective of this advanced course in physics is to use the knowledge of the earlier course in particle physics to understand the recent developments in high energy physics. The course mainly deals with Gauge theories which are fundamental for the understand of standard model and physics beyond standard model. Emphasis shall be laid upon the solution of numerical problems.

Module I: Introduction (10 hours)

Introduction to Gauge symmetries – global and local gauge transformations, abelian group $U(1)$ (QED), Yang-Mills (Non-Abelian) groups – $SU(2)$ (isospin), $SU(3)_C$ (QCD).

Module II: Spontaneous Symmetry Breaking (SSB) (12 hours)

Ground state with spontaneous symmetry breaking, some examples; global symmetry breaking and Goldstone bosons, proof of Goldstone theorem, local symmetry breaking and Higgs mechanism for giving masses to vector bosons, examples $U(1)$, $SU(2)$.

Module III: Standard Model (SM) (12 hours)

Standard model of electroweak unification, gauge bosons W^+ , W^- , Z^0 , charged weak current and neutral current, Higgs particle, experimental status.

Module IV: Beyond Standard Model (12 hours)

- a) Introduction to Grand Unified Theories (GUTs) – SU(5) and SO(10), and proton decay predictions;
- b) Minimal Supersymmetric Standard Model (MSSM) and its extension, its predictions;
- c) Introduction to String Theories and Planck scale physics.

Module V: Neutrino Physics (14 hours)

Solar and atmospheric neutrino puzzles, theory of neutrino oscillations in vacuum and medium (MSW mechanism), neutrino masses and leptonic mixings, survey of various neutrino oscillation experiments, seesaw mechanism for small neutrino masses.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain gauge theories (Understanding)
- CO2:** Familiarise with physics of spontaneous symmetry breaking and Higg's mechanism (Analysing)
- CO3:** Explain standard model and physics beyond standard model (Understanding)
- CO4:** Build the theory of neutrino physics (Analysing)
- CO5:** Recall group theory and learn how to apply it to gauge theory (Applying)

Suggested Readings

1. Ta-Pei Cheng and Ling-Fong Li, Gauge Theory of elementary particle physics, Oxford University Press.
2. Francis Halzen and Alan D. Martin, Quarks and leptons: An introductory Course in Modern Particle Physics, John Wiley & Sons.
3. David Griffiths, Introduction to Elementary Particles, John Wiley & Sons.
4. Barton Zwiebach, A First Course in String theory, Cambridge Univ. Press.
5. Graham G Ross, Grand Unified theories, Oxford University Press.
6. R. N. Mohapatra and P. B. Pal, Massive Neutrinos in Physics and Astrophysics, World Scientific, Singapore.

PSGR0044: GENERAL THEORY OF RELATIVITY AND COSMOLOGY**(4 credits – 60 hours)**

Objective: *The course aims to provide the theoretical foundations of the general theory of relativity, and bring the student to the frontier of elementary cosmology, which would then enable the pursuit of future research in this area. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Theoretical Background of Relativity (15 hours)

- a) Foundations of relativity: postulates of relativity, GR units, space-time intervals, proper time; special Lorentz transformations in Minkowski space-time; four-vectors.
- b) Review of tensor calculus in Euclidean space; tensor calculus in Riemannian space: generalized N-dimensional spaces, covariant and contravariant tensors; Riemann-Christoffel curvature tensor, Christoffel symbols, Einstein's tensor, geodesics; metric tensor, covariant differentiation, Bianchi Identities, Ricci tensor.

Module II: General Theory of Relativity (30 hours)

- a) Motion of a free particle in a gravitational field, equations of electrodynamics in the presence of a gravitational field; gravitational field equations – action for gravitational field, energy-momentum tensor, extremum principle, Einstein field equations, energy-momentum pseudotensor.
- b) Field of gravitating bodies – Schwarzschild solution, Birkhoff's theorem, motion in a centrally symmetric gravitational field, precession of perihelion of Mercury, deflection of light,

gravitational lensing; black holes – Schwarzschild black holes, Kruskal space, black hole thermodynamics; gravitational waves – plane waves, weak field approximation, gravitational radiation, transverse-traceless gauge.

Module III: Fundamentals of Cosmology (15 hours)

- a) Cosmological principle, cosmological time; spaces of constant curvature, Hubble's constant, Hubble's Law, red-shift of galaxies, big bang, age and density of universe; cosmological constant – Einstein space, de Sitter space, anti-de Sitter space; Robertson-Walker metric, introduction to Friedmann-Robertson-Walker (FRW) universe.
- b) The observed universe and its dynamics, Friedmann-Lemaître-Robertson-Walker (FLRW) metric, Friedmann equation and its solutions; composition of the universe – origin of matter, big bang nucleosynthesis, abundance of light elements, dark matter and dark energy, cosmological constant as dark energy, origin of matter-antimatter asymmetry, baryogenesis.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Relate the concepts from special theory of relativity with generalized tensor calculus (Remembering)
- CO2:** Explain Einstein's field equation from basic principles (Understanding)
- CO3:** Illustrate the implications of the general theory of relativity (Understanding)
- CO4:** Infer theoretical predictions based on the general theory of relativity (Understanding)
- CO5:** Extend Einstein's gravity to the cosmological scale (Understanding)
- CO6:** Apply general relativity to various physical phenomena (Applying)
- CO7:** Identify Newtonian gravity as a special case of general relativity (Applying)

Suggested Readings

1. D. F. Lawden, Introduction to Tensor Calculus, Relativity and Cosmology, Dover Publications.
2. B. Schutz, A First Course in General Relativity, Cambridge University Press.
3. B. Ryden, Introduction to Cosmology, Cambridge University Press.
4. C. W. Misner, K. S. Thorne and J. A. Wheeler, Gravitation, Princeton University Press.
5. L. D. Landau and E. M. Lifshitz, The Classical Theory of Fields, Butterworth-Heinemann.
6. A. Einstein, The Meaning of Relativity, Oxford & IBH.
7. P. A. M. Dirac, General Theory of Relativity, Prentice-Hall of India.
8. R. P. Feynman, F. B. Moronigo and W. G. Wagner, Feynman Lectures on Gravitation, Addison-Wesley.
9. S. Weinberg, Gravitation and Cosmology, Wiley.
10. J. V. Narliker, Introduction to Cosmology, Cambridge University Press.
11. S. Dodelson, Modern Cosmology, Academic Press.
12. V. Mukhanov, Physical Foundations of Cosmology, Cambridge University Press.

PSAR0045: ASTROPHYSICS

(4 credits - 60 hours)

Objective: The objective of this course is to enable the students to apply basic physical principles from a wide spectrum of topics in physics to astronomical situations and formulate astrophysical problems and thereby, apply analytical and numerical methods towards its solution. This course seeks to develop competence in areas of astrophysical theory and experiment. Emphasis shall be laid upon the solution of numerical problems.

Module I: Fundamentals of Astronomy (12 hours)

Astronomy fundamentals: celestial coordinate systems, telescope and its operational principles and mounting, atmospheric extinctions, magnitude systems. Radiation mechanism, flux density

and luminosity, specific intensity, (emission/absorption coefficients, source functions), basics of radiative transfer and radiative processes.

Module II: Stellar Parameters (18 hours)

Magnitudes, motions and distances of stars: absolute stellar magnitude and distance modulus, bolometric and radiometric magnitudes, colour-index and luminosities of stars, stellar positions and motions, velocity dispersion, statistical and moving cluster parallax, extinction, stellar temperature, effective temperature, brightness temperature, color temperature, kinetic temperature, excitation temperature, ionization temperature, spectral classification of stars, utility of stellar spectrum, stellar atmospheres. Binaries, variable stars, clusters, open and globular clusters, compact objects, shape, size and contents of our galaxy, normal and active galaxies.

Module III: Interstellar Medium (10 hours)

Neutral and ionized gas, gaseous nebulae, HII regions, supernova remnants, photo-dissociation regions, different phases of the interstellar medium: cold neutral medium, warm neutral and ionized medium, hot medium, diffuse clouds, dense clouds.

Module IV: Stellar Physics (20 hours)

Introduction to stars: HR diagram, a discussion on the variety of stellar phenomena, stellar structure, stellar opacities, stellar polytropes, energy generation in stars: calculation of thermonuclear reaction rates for non-resonant and beta-decay reactions, various reaction chains: pp-I, II, III, CNO, He-burning, C-burning, Si-burning, stellar degeneracy and equations of state: stellar degeneracy, Chandrasekhar mass, EoS of matter at near-nuclear and nuclear densities, final stages of stellar evolution: supernovae and neutron stars.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to: At the end of this course students will be able to:

- CO1:** Define and spell out fundamental concepts of Astronomy (Remembering)
- CO2:** Outline the various parameters describing the behaviour of stars and their evolution (Understanding)
- CO3:** Classify the various types of interstellar media (Understanding)
- CO4:** Explain the physical processes underlying the energy generation in stars (Understanding)
- CO5:** Develop theoretical models for various celestial systems (Applying)

Suggested Readings

1. P. Jain, An Introduction to Astronomy and Astrophysics, CRC Press.
2. B. Basu, An Introduction to Astrophysics, PHI Learning Pvt. Ltd.
3. K. D. Abhayankar, Astrophysics: Stars and Galaxies, Universities Press.
4. Erika Böhm-Vitense, Introduction to Stellar Astrophysics, Cambridge University Press.
5. J. B. Hartle, Gravity: Introduction to Einstein's General Relativity, Pearson Education.
6. P. J. E. Peebles, Physical Cosmology, Princeton University Press.

PSPM0046: PLASMA PHYSICS II

(4 Credit – 60 hours)

Objective: *This advanced course in plasma physics provides a detailed description of physics of plasma. It further discusses various applications of plasma physics. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Plasma as fluids and Plasma Kinetic Theory (20 hours)

Introduction to fluid model; equation of motion; continuity equation; fluids drifts perpendicular to \mathbf{B} ; fluids drifts parallel to \mathbf{B} ; the plasma approximation; Introduction to kinetic theory; equations

of kinetic theory; derivation of the fluid equation; plasma oscillation; Landua damping: meaning and physical derivation.

Module II: Waves in Plasma (10 hours)

Representation of waves; group velocity; plasma oscillation; electron plasma waves; sound waves; ion waves; validity of plasma approximation; ion acoustic waves; Alfven waves.

Module III: Diffusion and Resistivity (10 hours)

Diffusion and mobility; plasma decay by diffusion; steady state solution; recombination; diffusion across a magnetic field; the single MHD diffusion equation; solutions of the diffusion equation.

Module IV: Instability and Non-linear Effects (10 hours)

Hydro-magnetic equilibrium; diffusion of magnetic field into a plasma; classifications of instability; two stream instability; plasma sheaths; ion acoustic shock waves; the ponderomotive force; parametric instabilities; plasma echoes; non-linear Landua Damping.

Module V: Controlled Fusion (10 hours)

Controlled fusion and problems; magnetic confinement: toruses, mirrors, pinches; laser fusion; plasma heating; fusion technology; tokamaks; ITER.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to: At the end of this course students will be able to:

- CO1:** Explain fluid model and kinetic model of plasma (Understanding)
- CO2:** Explain the theory of waves, diffusion, resistivity, instability and non-linear effects in plasma (Understanding)
- CO3:** Identify the technology and problems associated with plasma fusion for energy production (Applying)

Suggested Readings

- 1. F. F. Chen, Introduction to Plasma Physics and Controlled Fusion, Plenum.
- 2. J. A. Bittencourt, Fundamentals of plasma physics, Springer.

PSER0047: ELECTRONICS III

(4 credits - 60 hours)

Objectives: *The objectives of this course are to introduce the concept of digital systems and give students the concept of digital electronics. The course also provides an in-depth understanding of the operation of microprocessors and basics of microcontrollers, assembly language programming and microprocessor interfacing techniques. The students will be able to design and implement microprocessor-based systems in both hardware and software and can apply this knowledge to more advanced structures. Emphasis shall be laid upon the solution of numerical problems.*

Module I (15 hours)

- a) Number system: representation of signed integers, binary arithmetic on signed and unsigned integers and detection of overflow and underflow, weighted binary Codes: BCD, 2421, non-weighted codes: excess-3 codes, gray codes, error detecting codes, error correcting codes, alphanumeric codes: ASCII code, EBCDIC codes.
- b) Boolean algebra and logic gates:, rules (postulates and basic theorems) of Boolean algebra, dual and complement of a Boolean expression, sum of products and product of sums forms. canonical forms. Conversion between different forms, conversion between Boolean expression and truth table, implementing logic expressions with logic gates (logic circuits).
- c) Digital logic families: designing of basic logic gates with diode and transistor; elementary idea of DTL, TTL, RTL, ECL, I²L logic family and characteristics.

Module II (15 hours)

- a) Combinational circuit: Simplification of Boolean expressions using algebraic method, Karnaugh map method and Quine-McCluskey method, Don't Care conditions. Multiplexer, demultiplexer, encoder, decoder, half-adder, full-adder, magnitude comparator, parity checkers: basic concepts, design of parity checkers, parity generation, code converters, binary-to-gray and gray-to-binary code converter; concept of magnitude comparator.
- b) Sequential circuit: simple R-S flip-flop or Latch, clocked R-S Flip-flop, D flip-flop. J-K flip-flop, T flip-flop, master-slave flip-flop, J-K Master-Slave flip-flop. Asynchronous preset and clear, edge triggering and level triggering. Registers: shift registers, parallel/serial in, parallel/serial out. Buffer counter design: different types of counters like asynchronous and synchronous, up and down, ring, Johnson etc. counter design using state diagram, state table and state equation.
- c) Semiconductor memory: classification of memories, main memory and secondary memory, sequential access memory, static and dynamic memory, volatile and nonvolatile memory, concept of ROM, PROM, EPROM, RAM, DRAM, SDRAM, PSRAM, memory decoding.

Module III (30 hours)

- a) History and evolution of microprocessor; introduction to CPU: components of CPU, block diagram, buses-data, control and address; ALU, control unit; main memory and secondary memory; I/O devices; memory addressing-memory mapped I/O and I/O mapped I/O; address decoding; memory and I/O interfacing;
- b) Introduction to 8085; block diagram, registers, use of register pairs, PSW, accumulator; addressing modes; Instruction set of 8085: data transfer, arithmetic, logic, branch and machine control instructions; instruction cycle: fetch, decode and execute. Delay and counter; stack and its application; interrupt and its application; assembly level language programming of 8085.
- c) Interfacing: Memory interfacing; I/O interfacing; interfacing small devices like keyboard, 7-segment display, relay, event counter etc.; idea of PPIs like 8251, 8255, 8257 and 8279 (block diagram and function only); serial communication standard (RS-232C).
- d) Example of 16-bit processors (introduction to 8086); microcontroller (block diagram and application of 8051).

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Illustrate advanced topics of digital electronics (Understanding)
- CO2:** Explain microprocessor, microcontroller and assembly language (Understanding)
- CO3:** Apply the knowledge in advanced structures (Applying)

Suggested Readings

1. M. Mano, Digital Logic and computer Design, PHI.
2. R. P. Jain, Modern Digital Electronics, TMGH.
3. Jain and Floyd, Digital Fundamentals, Pearson Education.
4. Malvino and Leach, Digital Electronics, Pearson Education.
5. Malvino, Digital Computer Electronics, TMGH.
6. Morris Mano, Digital Design, Principles and Practices, Pearson Education.
7. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, Vikash Publishing House Pvt. Ltd.
8. P. H. Talukdar, Digital Techniques, N. L. Publications.
9. Anand Kumar, Fundamentals of Digital Circuits, PHI.
10. Gaonkar, Introduction to Microprocessors, New age Publication.
11. B. Ram, Fundamentals of Microprocessor, Dhanpat Rai.
12. N. K. Srinath, 8085 Microprocessor Programming and Interfacing, PHI.

13. Slater, Microprocessor Based Design, PHI.
14. Gilmore, Microprocessors, McGraw Hill Publication.

PSNY0048: NANOPHYSICS III

(4 credits – 60 hours)

Objective: *This course will help students to understand the physics behind the different properties of nanoparticles and nanostructures. The quantum effect of nanostructures and their conduction and electronic behaviours are included in the course. Understanding of this course will build a strong base for pursuing theoretical and practical research in the field of nanoscience and nanotechnology. Emphasis shall be laid upon the solution of numerical problems.*

Module I (15 Hours)

Absorption and scattering of EM waves from nanoparticles based on bulk properties. Electronic phenomena in nanostructures: electronic structures and effective mass theory for bulk Si, Ge, GaAs; excitons. Boltzmann electron transport in bulk. Electron energy states in quantum confined systems, semiconductor heterojunctions.

Module II (20 Hours)

- a) X-ray photoelectron spectroscopy (XPS): fundamentals: photoelectric effect, binding energy and chemical shift, ultraviolet photoelectron spectroscopy (UPS): information.
- b) Extracted: band structure, occupied band states of clean solid surfaces as well as bonding orbital states of adsorbed molecules; fundamentals of Fourier transform infrared radiation (FTIR) and Raman spectroscopy.
- c) 2-DEG systems, quantum wires, quantum dots. Transmission in nanostructures: tunneling in planar barrier, resonant tunnel diodes. Ballistic transport, Landauer formula, electron transport in quantum wave-guide structures.

Module III (15 Hours)

Single electron phenomena: electronic states in quantum dots, without and with magnetic fields, single electron tunneling and Coulomb blockade, single electron tunneling, elastic, inelastic, spin polarized tunneling, surface density of states for different dimensions, role of tip geometry, lithography and atomic manipulation; single electron transistor. Spin-orbit interaction and spin effects.

Module IV (10 Hours)

Nanomechanics: introduction to NEMS, CNT oscillation, nanoscale electrometer, bolometer nanophotonics; science of Graphene.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain properties of nanomaterials in details. (Understanding)
- CO2:** Explain quantum effects on nanostructures (Understanding)
- CO3:** Outline nanomechanics (Understanding)
- CO4:** Take part in higher studies and research in nanophysics (Analysing)

Suggested Readings

1. D. K. Ferry and S. M. Goodnick, Transport in Nano-Structures, Cambridge University Press, 1997.
2. S. Datta, Electronic Transport in Mesoscopic Systems, Cambridge University Press.

PSEL0049: ELECTRONICS I**(4 credits-60 hours)**

Objective: This course is intended to give a glimpse of the electronics world. The course is designed with a view of giving, students the knowledge of passive components, different electronic devices, digital electronics and introduction to communication so that it provides a motivation towards practical applications. Emphasis shall be laid upon the solution of numerical problems.

Module I: Passive Components and DC Networks (15 hours)

- Passive components: resistors, capacitors and inductors-types, characteristics and applications;
- DC networks: voltage and current sources, dependent sources, KCL, KVL, current division rule, voltage division rule, Y-Delta conversion, mesh analysis, node analysis, Thevenin's theorem, Norton's theorem, superposition theorem, maximum power transform theorem.

Module II: Electronic Devices and Circuits (20 hours)

- Semiconductor concepts: semiconductor material, intrinsic semiconductor, extrinsic semiconductor, energy levels, concept of hole and electron, mobility, conductivity, n-type and p-type, majority and minority carriers, mechanism of current flow.
- Semiconductor diode: PN junction and various biasing conditions, V-I characteristics, diode equation, diode resistance, equivalent circuit, transition capacitance and diffusion capacitance; rectifier circuit with filter, clipper, clamper, voltage multiplier.
- Special purpose diodes: Zener diodes, LED, 7 segment display, photo diode, photo transistor, opto coupler, Schottky diode, varactor diode, tunnel diode
- Transistor - BJT: construction, npn, pnp, operation and configuration, V-I characteristics, introduction to FET- JFET, MOSFET.
- OP-AMP: block diagram, ideal op-amp equivalent circuit, ideal characteristics, transfer curve, open loop and closed loop configurations, op-amp as an inverting amplifier, non-inverting amplifier, adder, subtractor.

Module III: Digital Circuits (12 hours)

Number systems, Boolean algebra, De-Morgan's law, AND, OR, NOT, Universal gates, combinational logic circuits.

Module IV: Communication (13 hours)

- Introduction: communication process, source of information, communication channels, modulation types and need, block diagram of communication systems, AM, FM, PAM, PWM, PPM.
- Introduction to digital modulation: ASK, PSK, FSK.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain about passive components and DC networks (Understanding)
- CO2:** Explain digital circuits (Understanding)
- CO3:** Explain electronic communication (Understanding)
- CO4:** Experiment with electronic devices and circuits (Applying)

Suggested Readings

- S. Salivahanan, Electronic Devices and Circuits, McGraw Hill Publications.
- R. D. Singh and S. D. Sapre, Communication System, TMGH.
- D. Roy Choudhury, Networks and Systems, New Age International.
- David A. Bell, Electronic Devices and Circuits, Oxford University Press.
- Moris Mano, Digital electronics, EEE.

PSNP0050: NANOPHYSICS I

(4 credits – 60 hours)

Objective: *The objective of this course is to get students introduced to the new branch of science called Nanoscience and the technology associated with it. Nanotechnology can be considered as an interdisciplinary converging technology that brings together aspects of hitherto unrelated fields of studies. This course will deal with basic concepts laying more stress on the science rather than the technology. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Introduction (20 hours)

Distinction between nanoscience and nanotechnology, requisite definitions; historical perspectives; nanomaterials: overview, definitions, and examples; structurally confined materials: nanoparticles, islands, nanowires, thin films; metal nanoparticles: fundamentals and applications; self-assembled monolayers, semiconductor quantum dots: fundamentals and applications; ceramic nanomaterials: fundamentals and applications; carbon nanomaterials (Fullerenes and carbon nanotubes and nanofibers): fundamentals and applications; magnetic nanoparticles: fundamentals and applications; bionanomaterials, computational nanomaterials, composite nanomaterials and applications.

Module II: Characterization tools (10 hours)

Electron microscopy, atomic force microscopes, X-ray spectroscopy, surface enhanced Raman spectroscopy, lithography, computer modelling and simulation.

Module III: General Fabrication Methods (12 hours)

Background; top down fabrication: mechanical methods, thermal methods, high energy methods, chemical fabrication methods, lithographic methods; bottom up fabrication: gaseous phase methods, liquid phase methods, template synthesis

Module IV: Basic Properties of Nanomaterials (10 hours)

Importance of surface: natural, inorganic and the nano perspectives; particle shape and surface; surface: geometric surface to volume ratio, specific surface area; atomic structure: crystal systems.

Module V: Natural and Bio-nanoscience (8 hours)

Natural nanomaterials: inorganic natural nanomaterials, nanomaterials from the animal kingdom, nanomaterials derived from cell walls, nanomaterials in insects; Introduction to biomolecular nanoscience: history, biomolecular nanoscience, nano perspective

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain nanophysics (Understanding)
- CO2:** Explain about characterization and fabrications of nanomaterials (Understanding)
- CO3:** Examine properties of nanomaterials and natural nanomaterials (Analysing)

Suggested Readings

1. G. L. Hornyak, J. Dutta and H. F. Tibbals, A. Rao Introduction to nanoscience, CRC Press.
2. T. Pradeep, Nano: The Essentials, McGraw Hill.
3. D. Maclurcan and N. Radywyl (Eds.), Nanotechnology and Global Sustainability, CRC Press.
4. E. Lichtfouse, J. Shwarzbauer and D. Robert, Environmental Chemistry for a Sustainable World, Vol.2, Springer Verlag.
5. G. L. Hornyak, J. Dutta, H. F. Tibbals and A. Rao Introduction to nanotechnology, CRC Press.
6. G. W. Hanson Fundamentals of Nanoelectronics, Pearson.

PSWO0052: ENGINEERING PHYSICS: WAVES AND OPTICS**(4 credits – 60 hours) (L-T-P:3-1-0)**

Objective: *The objective of the course is to impart the knowledge of oscillations and waves, geometrical and wave optics and fundamentals of laser structure, working and applications to the students of mechanical engineering. Emphasis shall be laid upon the solution of numerical problems.*

Module I: SHM and Oscillators (11 hours)

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

Module II: 1D Waves and Dispersion (11 hours)

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Module III: Light propagation and geometrical optics (15 hours)

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method.

Module IV: Wave Optics (11 hours)

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Module V: Laser Fundamentals (12 hours)

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO₂), solid-state lasers(ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Understand and explain the principle of superposition of harmonic motion and waves (Understanding)
- CO2:** Understand and explain the principles of wave optics, interference and diffraction (Analysing)
- CO3:** Explain the working principles of optical instruments like interferometers, Newton's rings, diffracting gratings, etc. and LASER (Analysing)

Suggested Readings

1. Ian G. Main, Oscillations and waves in physics.
2. H. J. Pain, The physics of vibrations and waves.

3. E. Hecht, Optics.
4. A. Ghatak, Optics.
5. W. T. Silfvast, Laser Fundamentals.
6. O. Svelto, Principles of Lasers.

PSMY0101: MATHEMATICAL PHYSICS-I

(4 credits–60 hours)

Objective: The objective of the course is to make students familiar with basic mathematical methods for application to problems in physics and the formulation of physical theories in different disciplines of physics. Emphasis shall be laid upon the solution of numerical problems. The importance of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.

Module I: Calculus (21 hours)

Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only).

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

Module II: Vector Calculus (27 hours)

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

Module III: Orthogonal Curvilinear Coordinates (6 hours)

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Module IV: Introduction to Probability (4 hours)

Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance.

Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.

Module IV: Dirac Delta Function and its Properties (2 hours)

Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Demonstrate the concept of curvilinear coordinates (Understanding)
- CO2:** Apply some advanced topics of vectors (Applying)

- CO3:** Develop an understanding of different types of differential equations and find their solutions (Applying)
- CO4:** Utilize some basic concepts of probability and distribution functions (Applying)
- CO5:** Inspect Dirac delta function and some of its properties (Analysing)

Suggested Readings

1. G. B. Arfken, H. J. Weber and F. E. Harris, Mathematical Methods for Physicists, Elsevier.
2. E. A. Coddington, An introduction to ordinary differential equations, PHI learning.
3. George F. Simmons, Differential Equations, McGraw Hill.
4. James Nearing, Mathematical Tools for Physics, Dover Publications.
5. D. A. McQuarrie, Mathematical methods for Scientists and Engineers, Viva Book.
6. D. G. Zill and W. S. Wright, Advanced Engineering Mathematics, Jones and Bartlett Learning.
7. Goswami, Mathematical Physics, Cengage Learning.
8. S. Pal and S. C. Bhunia, Engineering Mathematics, Oxford University Press.
9. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India.
10. K. F. Riley and M. P. Hobson Essential Mathematical Methods, Cambridge Univ. Press.
11. H. K. Das, Advanced Engineering Mathematics, S. Chand.

PSMC0102: MECHANICS

(4 credits–60 hours)

Objective: The objective of the course is to give a clear understanding of the motion of and forces on objects. Emphasis shall be laid upon the solution of numerical problems.

Module I: Fundamentals of Dynamics (6 hours)

Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable- mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

Module II: Work and Energy (4 hours)

Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

Module III: Collisions (3 hours)

Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

Module IV: Rotational Dynamics (12 hours)

Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

Module V: Elasticity (3 hours)

Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

Module VI: Fluid Motion (2 hours)

Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

Module VII: Gravitation and Central Force Motion (9 hours)

Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere.

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

Module VIII: Oscillations (7 hours)

SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

Module IX: Non-Inertial Systems (4 hours)

Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Module X: Special Theory of Relativity (10 hours)

Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall concept of frames (Remembering)
- CO2:** Explain mechanics starting from basic concepts (Understanding)
- CO3:** Interpret central force and analyse Kepler's laws (Understanding)
- CO4:** Develop their understanding of modern physics from Einstein's special theory of relativity (Applying)

Suggested Readings

1. D. Kleppner, R. J. Kolenkow, An introduction to mechanics, McGraw-Hill.
2. C. Kittel, W. Knight, et.al. Mechanics, Berkeley Physics, vol.1, 2007, Tata McGraw-Hill.
3. Resnick, Halliday and Walker, Physics, Wiley.
4. G. R. Fowles and G. L. Cassiday, Analytical Mechanics, Cengage Learning.
5. R. P. Feynman, R. B. Leighton and M. Sands, Feynman Lectures, Vol. I, 2008, Pearson Education.
6. R. Resnick, Introduction to Special Relativity, John Wiley and Sons.
7. Ronald Lane Reese, University Physics, Thomson Brooks/Cole.
8. D. S. Mathur, Mechanics, S. Chand and Company Limited.
9. F. W. Sears, M.W. Zemansky and H. D. Young, University Physics, Addison Wesley.
10. J. W. Jewett and R. A. Serway, Physics for scientists and Engineers with Modern Phys., Cengage Learning.
11. M. R. Spiegel, Theoretical Mechanics, Tata McGraw Hill.

PSEM0103: ELECTRICITY AND MAGNETISM

(4 credits–60 hours)

Objective: The course intends to provide a clear understanding and important concepts of the interactions between electric charges and currents using an extension of the classical Newtonian model. Emphasis shall be laid upon the solution of numerical problems.

Module I: Electric Field and Electric Potential (22 hours)

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

Module II: Dielectric Properties of Matter (8 hours)

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D . Relations between E , P and D . Gauss' Law in dielectrics.

Module III: Magnetic Field (9 hours)

Magnetic force between current elements and definition of Magnetic Field B . Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B : curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

Module IV: Magnetic Properties of Matter (4 hours)

Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B , H , M . Ferromagnetism. B - H curve and hysteresis.

Module V: Electromagnetic Induction (6 hours)

Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

Module VI: Electrical Circuits (4 hours)

AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.

Module VI: Network theorems (4 hours)

Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.

Module VII: Ballistic Galvanometer (3 hours)

Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall basic laws of electricity and Magnetism (Remembering)
- CO2:** Explain electromagnetism (Understanding)
- CO3:** Explain physics of magnetic materials (Understanding)
- CO4:** Inspect network circuits (Analysing)

Suggested Readings

1. S. Mahajan and Choudhury, Electricity, Magnetism & Electromagnetic Theory, Tata McGraw.
2. Edward M. Purcell, Electricity and Magnetism, McGraw-Hill Education.
3. D. J. Griffiths, Introduction to Electrodynamics, Benjamin Cummings.
4. R. P. Feynman, R. B. Leighton and M. Sands, Feynman Lectures, Pearson Education.
5. M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press.
6. J. H. Fewkes & J. Yarwood, Electricity and Magnetism, Vol. I, Oxford Univ. Press.

PSWO0104: WAVES AND OPTICS

(4 credits–60 hours)

Objective: *The objective of this curriculum is to provide a clear concept of science of waves. This will make students obtain a comprehensive knowledge of optics. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Superposition of Collinear Harmonic oscillations (5 hours)

Simple harmonic motion, Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

Module II: Superposition of Two Perpendicular Harmonic Oscillations (5 hours)

Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their uses.

Module III: Wave Motion (5 hours)

Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

Module IV: Velocity of Waves (6 hours)

Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

Module V: Superposition of Two Harmonic Waves (7 hours)

Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

Module VI: Wave Optics (3 hours)

Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

Module VII: Interference (9 hours)

Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

Module VIII: Interferometer (4 hours)

Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

Module IX: Diffraction (2 hours)

Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only)

Module X: Fraunhofer diffraction (8 hours)

Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

Module XI: Fresnel Diffraction (7 hours)

Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Module XII: Holography (3 hours)

Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain the principle of superposition of harmonic motion and waves (Understanding)
- CO2:** Explain the principles of wave optics, interference and diffraction (Understanding)
- CO3:** Explain the working principles of optical instruments like interferometers, Newton's rings, diffracting gratings and holograms (Understanding)

Suggested Readings

1. Francis Crawford, Waves: Berkeley Physics Course, vol. 3, Tata McGraw-Hill.
2. F. A. Jenkins and H.E. White, Fundamentals of Optics, McGraw-Hill.
3. Max Born and Emil Wolf, Principles of Optics, Pergamon Press.
4. Ajoy Ghatak, Optics, 2008, Tata McGraw Hill.
5. H. J. Pain, The Physics of Vibrations and Waves, John Wiley and Sons.
6. N. K. Bajaj, The Physics of Waves and Oscillations, Tata McGraw Hill.
7. A. Kumar, H. R. Gulati and D. R. Khanna, Fundamental of Optics, R. Chand Publications.

PSMS0105: MATHEMATICAL PHYSICS-II**(4 credits–60 hours)**

Objective: *The objective of the course in mathematical physics is to make students further conversant with mathematical methods for application to problems in physics and the formulation of physical theories in different disciplines of physics. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Fourier Series (10 hours)

Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.

Module II: Frobenius Method and Special Functions (24 hours)

Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre

Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions ($J_0(x)$ and $J_1(x)$) and Orthogonality.

Module III: Some Special Integrals (4 hours)

Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

Module IV: Theory of Errors (6 hours)

Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. Least-squares fit. Error on the slope and intercept of a fitted line.

Module V: Partial Differential Equations (14 hours)

Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes. Diffusion Equation.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Apply the knowledge of Fourier series to different physical problems (Applying)
- CO2:** Apply the concepts of errors and special integrals (Applying)
- CO3:** Utilize partial differential equations to various problems in physics (Applying)
- CO4:** Analyse various special functions and their applications (Analysing)

Suggested Readings

1. Arfken, Weber and Harris, Mathematical Methods for Physicists, Elsevier.
2. M. R. Spiegel, Fourier Analysis, Tata McGraw-Hill.
3. Susan M. Lea, Mathematics for Physicists, Thomson Brooks/Cole.
4. George F. Simmons, Differential Equations, Tata McGraw-Hill.
5. S. J. Farlow, Partial Differential Equations for Scientists & Engineers, Dover Pub.
6. S. Pal and S. C. Bhunia, Engineering Mathematics, Oxford University Press.
7. D. A. McQuarrie, Mathematical methods for Scientists & Engineers, Viva Books.

PSPT0106: THERMAL PHYSICS

(4 credits–60 hours)

***Objective:** The objective of this curriculum is to provide an overview of thermodynamics and thus, deal with heat and temperature, and their relation to energy, work, radiation, and properties of matter. Explanations for these by statistical mechanics are also provided. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Zeroth and First Law of Thermodynamics (8 hours)

Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_p and C_v , Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.

Module II: Second Law of Thermodynamics (10 hours)

Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

Module III: Entropy (7 hours)

Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot’s Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

Module IV: Thermodynamic Potentials (7 hours)

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb’s Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations

Module V: Maxwell’s Thermodynamic Relations (7 hours)

Derivations and applications of Maxwell’s Relations, Maxwell’s Relations:(1) Clausius Clapeyron equation, (2) Values of C_p-C_v , (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.

Module VI: Distribution of Velocities (7 hours)

Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern’s Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.

Module VII: Molecular Collisions (4 hours)

Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

Module VIII: Real Gases (10 hours)

Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew’s Experiments on CO₂ Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal’s Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule’s Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule- Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain the concept of thermodynamic potential (Understanding)
- CO2:** Illustrate Maxwell’s thermodynamic relations (Understanding)
- CO3:** Apply different laws to thermodynamics to different physical problems (Applying)
- CO4:** Combine the concepts of thermodynamics to those of statistical mechanics (Creating)

Suggested Readings

1. M. W. Zemansky and Richard Dittman, Heat and Thermodynamics, McGraw-Hill.
2. Meghnad Saha, and B. N. Srivastava, A Treatise on Heat, Indian Press.
3. S. Garg, R. Bansal and Ghosh, Thermal Physics, Tata McGraw-Hill.
4. Carl S. Helrich, Modern Thermodynamics with Statistical Mechanics, Springer.
5. Sears and Salinger, Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Narosa.

6. S. J. Blundell and K. M. Blundell, Concepts in Thermal Physics, Oxford University Press.
7. A. Kumar and S.P. Taneja, Thermal Physics, R. Chand Publications.

PSDA0107: DIGITAL SYSTEMS AND APPLICATIONS

(4 credits–60 hours)

Objective: *The objective of this curriculum is to provide an extensive knowledge of digital system. The aim is to provide the knowledge of both instruments and the corresponding theoretical concepts, starting from Boolean algebra to assembly language. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Introduction to CRO (3 hours)

Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.

Module II: Integrated Circuits (3 hours)

Qualitative treatment only): Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital ICs.

Module III: Digital Circuits (6 hours)

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers.

Module IV: Boolean Algebra (6 hours)

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

Module V: Data Processing Circuits (4 hours)

Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.

Module VI: Arithmetic Circuits (5 hours)

Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.

Module VII: Sequential Circuits (6 hours)

SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.

Module VIII: Timers (3 hours)

IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator.

Module IX: Shift Registers (2 hours)

Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).

Module X: Counters (4 bits) (3 hours)

Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

Module XI: Computer Organization (6 hours)

Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map.

Module XII: Intel 8085 Microprocessor Architecture (6 hours)

Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers. ALU. Memory. Stack memory. Timing & Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI.

Module XIII: Introduction to Assembly Language (4 hours)

1 byte, 2 byte & 3 byte instructions.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain and apply different theoretical knowledge provided in the course (Understanding)
- CO2:** Explain the working of different electronic components and instruments, from adders to microprocessors (Understanding)
- CO3:** Build complex electronic circuits (Creating)

Suggested Readings

1. A. P. Malvino, D. P. Leach and Saha, Digital Principles and Applications, Tata McGraw.
2. Anand Kumar, Fundamentals of Digital Circuits, PHI Learning Pvt. Ltd.
3. Venugopal, Digital Circuits and systems, Tata McGraw Hill.
4. G. K. Kharate, Digital Electronics, Oxford University Press.
5. R. J. Tocci, N. S. Widmer, Digital Systems: Principles & Applications, PHI Learning.
6. Shimon P. Vingron, Logic circuit design, Springer.
7. Subrata Ghoshal, Digital Electronics, Cengage Learning.
8. S. K. Mandal, Digital Electronics, McGraw Hill.
9. R. S. Goankar, Microprocessor Architecture Programming & applications with 8085, Prentice Hall.
10. Principles of Electronic Instrumentation, A. James Diefenderfer, Saunders College Pub.

PSMP0108: MATHEMATICAL PHYSICS-III**(4 credits–60 hours)**

Objective: *The objective of the course in mathematical physics is to provide students furthermore acquainted with mathematical methods for application to problems in physics and the formulation of physical theories in different disciplines of physics. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Complex Analysis (30 hours)

Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.

Module II: Integrals Transforms (15 hours)

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution

theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

Module III: Laplace Transforms (15 hours)

Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1st order. Solution of heat flow along infinite bar using Laplace transform.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Apply the concept of complex analysis to solve a number of physical problems (Applying)
- CO2:** Understand and apply the concepts of integral transform and Laplace transform (Applying)

Suggested Readings

1. K. F. Riley, M. P. Hobson and S. J. Bence, *Mathematical Methods for Physics and Engineers*, Cambridge University Press.
2. P. Dennery and A. Krzywicki, *Mathematics for Physicists*, Dover Publications.
3. A. S. Fokas and M. J. Ablowitz, *Complex Variables*, Cambridge Univ. Press.
4. A. K. Kapoor, *Complex Variables*, Cambridge Univ. Press.
5. J. W. Brown and R. V. Churchill, *Complex Variables and Applications*, Tata McGraw-Hill.
6. D. G. Zill and P. D. Shanahan, *First course in complex analysis with applications*, Jones & Bartlett.

PSEP0109: ELEMENTS OF MODERN PHYSICS

(4 credits–60 hours)

Objective: *The objective of this curriculum is to give students an overview of the modern physics which led to the development of advanced physics of today's world. These mainly include the important developments of late nineteenth century and early twentieth century. Emphasis shall be laid upon the solution of numerical problems.*

Module I (14 hours)

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

Module II (5 hours)

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables); Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle-application to virtual particles and range of an interaction.

Module III (10 hours)

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic

particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

Module IV (10 hours)

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier.

Module V (6 hours)

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Module VI (8 hours)

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

Module VII (3 hours)

Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions).

Module VIII (4 hours)

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. Basic lasing.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Build the foundational knowledge of quantum mechanics, nuclear physics and atomic physics (Applying)
- CO2:** Develop a sound understanding of LASER (Applying)
- CO3:** Analyse the significant developments of the late nineteenth century and early twentieth century (Analysing)

Suggested Readings

1. Arthur Beiser, Concepts of Modern Physics, McGraw-Hill.
2. Rich Meyer, Kennard and Coop, Introduction to Modern Physics, Tata McGraw Hill.
3. David J. Griffith, Introduction to Quantum Mechanics, Pearson Education.
4. Jewett and Serway, Physics for scientists and Engineers with Modern Physics, Cengage Learning.
5. Modern Physics, G. Kaur and G. R. Pickrell, 2014, McGraw Hill.
6. A. K. Ghatak and S. Lokanathan, Quantum Mechanics: Theory & Applications, Macmillan.

PSAS0110: ANALOG SYSTEMS AND APPLICATIONS

(4 credits–60 hours)

Objective: The objective of this curriculum is to familiarise the students with analog electronics. All the fundamentals of electronics from diodes and transistors to amplifiers, oscillators and Op-Amps will be explained in details. Emphasis shall be laid upon the solution of numerical problems.

Module I: Semiconductor Diodes (10 hours)

P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode.

Module II: Two-terminal Devices and their Applications (6 hours)

(1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.

Module III: Bipolar Junction transistors (6 hours)

n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β . Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions.

Module IV: Amplifiers (10 hours)

Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.

Module V: Coupled Amplifier (4 hours)

Two stage RC-coupled amplifier and its frequency response.

Module VI: Feedback in Amplifiers (4 hours)

Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.

Module VII: Sinusoidal Oscillators (4 hours)

Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.

Module VIII: Operational Amplifiers (Black Box approach) (4 hours)

Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.

Module IX: Applications of Op-Amps (4 hours)

(1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator.

Module X: Conversion (4 hours)

Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain the working of diodes, transistors, amplifiers, oscillators and Op-Amps (Understanding)
- CO2:** Illustrate the theoretical concepts of the corresponding electronic circuits (Understanding)
- CO3:** Develop and simplify an electronic circuit (Applying)

Suggested Readings

1. J. Millman and C. C. Halkias, Integrated Electronics, Tata Mc-Graw Hill.
2. J. D. Ryder, Electronics: Fundamentals and Applications, Prentice Hall.
3. B. G. Streetman and S. K. Banerjee, Solid State Electronic Devices, PHI Learning.
4. S. Salivahanan and N. S. Kumar, Electronic Devices & circuits, Tata Mc-Graw Hill.
5. R. A. Gayakwad, OP-Amps and Linear Integrated Circuit, Prentice Hall.
6. K. C. Smith and A. N. Chandorkar, Microelectronic circuits, A. S. Sedra, Oxford University Press.
7. U. Tietze and C. Schenk, Electronic circuits: Handbook of design & applications, Springer.
8. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley India.
9. M. H. Rashid, Microelectronic Circuits, Cengage Learning.
10. Thomas L. Floyd, Electronic Devices, Pearson India.

PSCP0111: COMPUTATIONAL PHYSICS SKILLS**(2 credits–30 hours)**

Objective: *The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. Its objective is to highlight the use of computational methods to solve physical problems, Use of computer language as a tool in solving physics problems (applications) and provide hands on training on the Problem solving on Computers. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Introduction (4 hours)

Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of $\sin(x)$ as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

Module II: Scientific Programming (5 hours)

Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.

Module III: Control Statements (6 hours)

Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO- WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems. Programming: 1. Exercises on syntax on usage of FORTRAN. 2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN. 3. To print out all natural even/ odd numbers between given limits. 4. To find maximum, minimum and range of a given set of numbers. 5. Calculating Euler number using $\exp(x)$ series evaluated at $x=1$.

Module IV: Scientific Word Processing (6 hours)

Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. Equation representation: Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

Module V: Visualization (9 hours)

Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot Hands on exercises: 1. To compile a frequency distribution and evaluate mean, standard deviation etc. 2. To evaluate sum of finite series and the area under a curve. 3. To find the product of two matrices. 4. To find a set of prime numbers and Fibonacci series. 5. To write program to open a file and generate data for plotting using Gnuplot. 6. Plotting trajectory of a projectile projected horizontally. 7. Plotting trajectory of a projectile projected making an angle with the horizontally. 8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file. 9. To find the roots of a quadratic equation. 10. Motion of a projectile using simulation and plot the output for visualization. 11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization. 12. Motion of particle in a central force field and plot the output for visualization.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain the concept of high level language in computer programming (Understanding)
- CO2:** Utilize a programming language to write a program to solve physical problems (Applying)
- CO3:** Utilize LaTeX for document preparation (Applying)
- CO4:** Utilize Gnuplot for plotting data (Applying)

Suggested Readings

1. S. S. Sastry, Introduction to Numerical Analysis, PHI Learning Pvt. Ltd.
2. V. Rajaraman Computer Programming in Fortran 77", PHI.
3. Leslie Lamport, "LaTeX—A Document Preparation System", Addison-Wesley.
4. Philip K Janert, Gnuplot in action: understanding data with graphs, Manning.
5. Slipsdutz and A Poe, Schaum's Outline of Theory and Problems of Programming with Fortran, c-Graw Hill Book Co.
6. R. C. Verma, et al., Computational Physics: An Introduction, New Age International Publishers, New Delhi.
7. U. M. Ascher and C. Greif, A first course in Numerical Methods, PHI Learning.
8. K. E. Atkinson, Elementary Numerical Analysis, Wiley India Edition.

PSEN0112: ELECTRICAL CIRCUITS AND NETWORK SKILLS

(2 credits–30 hours)

Objective: The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode. Emphasis shall be laid upon the solution of numerical problems.

Module I: Basic Electricity Principles (3 hours)

Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

Module II: Understanding Electrical Circuits (4 hours)

Main electric circuit elements and their combination. Rules to Analyse DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to Analyse AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

Module III: Electrical Drawing and Symbols (4 hours)

Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.

Module IV: Generators and Transformers (3 hours)

DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

Module V: Electric Motors (4 hours)

Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

Module VI: Solid-State Devices (3 hours)

Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.

Module VII: Electrical Protection (4 hours)

Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)

Module VII: Electrical Wiring (5 hours)

Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Design electrical circuits (Creating)
- CO2:** Design electronics circuits (Creating)
- CO3:** Test and troubleshoot electrical and electronics circuits (Creating)

Suggested Readings

1. B. L. Theraja, A text book in Electrical Technology, S Chand & Co.
2. A. K. Theraja, A text book of Electrical Technology.
3. M. G. Say, Performance and design of AC machines, ELBS Edn.

PSBI0113: BASIC INSTRUMENTATION SKILLS

(2 credits–30 hours)

Objective: This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Emphasis shall be laid upon the solution of numerical problems.

Module I: Basic of Measurement (4 hours)

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

Module II: Electronic Voltmeter (4 hours)

Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

Module III: Cathode Ray Oscilloscope (6 hours)

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

Module IV (3 hours)

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

Module V: Signal Generators and Analysis Instruments (4 hours)

Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Module VI: Impedance Bridges & Q-Meters: (3 hours)

Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges.

Module VII: Digital Instruments: (3 hours)

Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Module VIII: Digital Multimeter: (3 hours)

Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Utilize of a CRO as a versatile measuring device (Applying)
- CO2:** Make use of the concept of circuit tracing of Laboratory electronic equipment (Applying)
- CO3:** Utilize Digital multimeter/VTVM for measuring voltages (Applying)
- CO4:** Experiment with wind a coil / transformer (Applying)
- CO5:** Identify the layout of receiver circuit (Applying)
- CO6:** Make use of a Dual Trace Oscilloscope (Applying)
- CO7:** Experiment with conversion of the range of a given measuring instrument (voltmeter, ammeter) (Applying)
- CO8:** Examine the loading effect of a multimeter while measuring voltage across a low resistance and high resistance (Analysing)

- CO9:** Examine the limitations of a multimeter for measuring high frequency voltage and currents (Analysing)
- CO10:** Test and troubleshoot a circuit (Analysing)
- CO11:** Test for balance bridges (Analysing)
- CO12:** Measure time period, frequency, average period using universal counter/ frequency counter (Evaluating)
- CO13:** Measure rise, fall and delay times using a CRO (Evaluating)
- CO14:** Measure distortion of a RF signal generator using distortion factor meter (Evaluating)
- CO15:** Measure R, L and C using a LCR bridge/ universal bridge (Evaluating)
- CO16:** Measure Q of a coil and its dependence on frequency, using a Q- meter (Evaluating)
- CO17:** Measure voltage, frequency, time period and phase angle using CRO (Evaluating)

Suggested Readings

1. B. L. Theraja, A text book in Electrical Technology, S Chand & Co.
2. M. G. Say, Performance and design of AC machines, ELBS Edn.
3. Venugopal, Digital Circuits and systems, Tata McGraw Hill.
4. Shimon P. Vingron, Logic circuit design, Springer.
5. Subrata Ghoshal, Digital Electronics, Cengage Learning.
6. S. Salivahanan & N. S.Kumar, Electronic Devices and circuits, Tata Mc-Graw Hill.
7. U. Tietze, Ch. Schenk, Electronic circuits: Handbook of design and applications, Springer.
8. Thomas L. Floyd, Electronic Devices, Pearson India

PSRS0114: RADIATION SAFETY

(2 credits–30 hours)

Objective: *The aim of this course is for awareness and understanding regarding radiation hazards and safety. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Basics of Atomic and Nuclear Physics (6 hours)

Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission.

Module II: Interaction of Radiation with Matter (7 hours)

Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, Interaction of Photons - Photo- electric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients, Interaction of Charged Particles: Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung), Interaction of Neutrons- Collision, slowing down and Moderation.

Module III: Radiation Detection and Monitoring Devices (7 hours)

Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, mrads, rads, gy, rem, mrem, SV and mSV. absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC). Radiation detection: Basic concept and working principle of gas detectors (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Gieger Muller Counter), Scintillation Detectors (Inorganic and Organic Scintillators), Solid States Detectors and Neutron Detectors, Thermo luminescent Dosimetry.

Module IV: Radiation Safety Management (7 hours)

Biological effects of ionizing radiation, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation. Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management. management. Basics of radiation safety and safety of radiation sources.

Module V: Application of Nuclear Techniques (5 hours)

Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. Industrial Uses: Tracing, Gauging, Material Modification, Sterization, Food preservation.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Obtain the background radiation levels using Radiation meter (Applying)
- CO2:** Analyse characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source) (Analysing)
- CO3:** Understand counting statistics using background radiation using GM counter (Understanding)
- CO4:** Analysis radiation in various materials (e.g. KSO₄ etc.) and possible radiation in different routine materials by operating GM at operating voltage (Analysing)
- CO5:** Study the absorption of beta particles in Aluminum using GM counter (Analysis)
- CO6:** Detect α particles using reference source & determine its half life using spark counter (Analysis)
- CO7:** Get gamma spectrum of Gas Light mantle (Source of Thorium) (Analysis)

Suggested Readings

1. W. E. Burcham and M. Jobes, Nuclear and Particle Physics, Longman.
2. G. F. Knoll, Radiation detection and measurements.
3. A. F. Mcknlly, Thermoluminescence Dosimetry, Adam Hilger Ltd., Bristol.
4. W. J. Meredith and J. B. Massey, Fundamental Physics of Radiology, John Wright and Sons, UK.
5. J. R. Greening, Fundamentals of Radiation Dosimetry, Adam Hilger Ltd., Bristol.
6. G. C. Lowental and P. L. Airey, Practical Applications of Radioactivity and Nuclear Radiations, Cambridge University Press, U.K.
7. A. Martin and S.A. Harbisor, An Introduction to Radiation Protection, John Willey & Sons, Inc., New York.
8. NCRP, ICRP, ICRU, IAEA, AERB Publications.
9. W. R. Hendee, Medical Radiation Physics, Year Book – Medical Publishers Inc., London.

PSGP0115: GENERAL THERMAL PHYSICS

(4 credits–60 hours)

Objective: *The objective of this curriculum is to provide a basic overview of thermodynamics and thus, deal with heat and temperature, and their relation to energy, work, radiation, and properties of matter. Basic explanations for these by statistical mechanics are also provided. Emphasis shall be laid upon the solution of numerical problems.*

Module I: Laws of Thermodynamics (22 hours)

Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Module II: Thermodynamical Potentials (10 hours)

Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for $(C_p - C_v)$, C_p/C_v , TdS equations.

Module III: Kinetic Theory of Gases (10 hours)

Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Module IV: Theory of Radiation (6 hours)

Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

Module V: Statistical Mechanics (12 hours)

Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain the concept of thermodynamic potential (Understanding)
- CO2:** Illustrate Maxwell's thermodynamic relations (Understanding)
- CO3:** Apply different laws to thermodynamics to different physical problems (Applying)
- CO4:** Combine the concepts of thermodynamics to those of statistical mechanics (Creating)

Suggested Readings

1. S. Garg, R. Bansal and C. Ghosh, Thermal Physics, Tata McGraw-Hill.
2. Meghnad Saha, and B. N. Srivastava, A Treatise on Heat, Indian Press.
3. Enrico Fermi, Thermodynamics, Courier Dover Publications.
4. M. W. Zemasky and R. Dittman, Heat and Thermodynamics, McGraw Hill.
5. F. W. Sears and G. L. Salinger. Thermodynamics, Kinetic theory & Statistical thermodynamics, Narosa.
7. Ronald Lane Reese, University Physics, Thomson Brooks/Cole.
8. A. Kumar and S. P. Taneja, Thermal Physics, R. Chand Publications.

PSGM0116: GENERAL ELEMENTS OF MODERN PHYSICS

(4 credits–60 hours)

Objective: The objective of this curriculum is to give students a basic overview of the modern physics which led to the development of advanced physics of today's world. These mainly include the important developments of late nineteenth century and early twentieth century. Emphasis shall be laid upon the solution of numerical problems.

Module I (8 hours)

Planck's quantum, Planck's constant and light as a collection of photons; Photo- electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment.

Module II (4 hours)

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra.

Module III (4 hours)

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

Module IV (11 hours)

Two slit interference experiment with photons, atoms & particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization; Probability and probability current densities in one dimension.

Module V (12 hours)

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

Module VI (6 hours)

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy.

Module VII (11 hours)

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life and half-life; alpha decay; beta decay - energy released, spectrum and Pauli's prediction of neutrino; gamma-ray emission.

Module VIII (4 hours)

Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Build foundational knowledge of quantum mechanics, nuclear physics and atomic physics (Applying)
- CO2:** Analyse the significant developments of the late nineteenth century and early twentieth century (Analysing)

Suggested Readings

1. Arthur Beiser, Concepts of Modern Physics, McGraw-Hill.
2. J. R. Taylor, C. D. Zafiratos, M. A. Dubson, Modern Physics, PHI Learning.
3. Thomas A. Moore, Six Ideas that Shaped Physics: Particle Behave like Waves, McGraw Hill.
4. E.H. Wichman, Quantum Physics, Berkeley Physics, Vol.4., Tata McGraw- Hill Co.

5. R. A. Serway, C. J. Moses, and C. A. Moyer, Modern Physics, Cengage Learning.
6. G. Kaur and G. R. Pickrell, Modern Physics, McGraw Hill.

LABORATORY COURSES

PSPL6003: PHYSICS LABORATORY II

(4 Credits)

At least 10 experiments should be performed from the following

1. To study the characteristic of SCR using the breadboard.
2. To study resistivity of a semiconductor by probe method.
3. Determination of difference in wavelengths of Na using Fabry-Perot interferometer.
4. To verify the Beer-Lambert law using UV visible spectrometer.
5. Verification of inverse square law for gamma ray using GM counter.
6. To study attenuation of beta rays using GM counter.
7. To determine the activity of a gamma emitter.
8. To study gamma ray spectrum of Cs-137 source and determine the resolution of a gamma-ray spectrometer.
9. To calibrate the scintillation spectrometer and determine the energy of gamma rays from an unknown source.
10. To study attenuation of gamma-rays from Cs-137 source by using different absorbers.
11. To study decay curve for half-life components of irradiated ^{115}In by a neutron source.
12. To study phonon dispersion of a monatomic chain of atoms using electronic analogue of the chain.
13. Experimental verification of Paschen law in a glow discharge system.
14. To find the floating potential of a plasma using Langmuir probe.

PSPL6009: PHYSICS LABORATORY I

(4 Credits)

At least 10 experiments should be performed from the following

1. Verification of KCL and KVL using discrete components.
2. Verification of Thevenins theorem.
3. VI characteristics of PN junction diode.
4. Series voltage regulaton using zener diode and transistor.
5. Design and study the clipper circuit.
6. Design and study the clamper circuit.
7. VI characteristics of Zener diode.
8. Design of Half wave and Full wave rectifier with and without filter.
9. RC low pass and high pass filter realization.
10. Static Characteristics of a Bipolar Junction Transistor (CE Mode).
11. Static Characteristics of a Bipolar Junction Transistor (CB Mode).
12. Design of voltage multiplier: voltage doubler / quadrupler.
13. Design BJT as a switch.
14. Op-Amp as Inverting and Non Inverting amplifier.

15. Realization of basic gates using discrete components.
16. To measure attenuation and bending losses of an optical fibre.
17. To study and verify the truth table of logic gates.
18. To realize half/full adder and half/full subtractor.

PSCN6010: COMPUTER ORIENTED NUMERICAL METHODS LAB

(4 Credits)

At least 10 experiments should be performed from the following

(All experiments are to be done using the Fortran or C Language)

1. Basic operations using a matrix A.
 - a. To find the transpose of A.
 - b. To find the inverse of A.
 - c. To verify the accuracy of $AA^{-1} = I$.
 - d. To diagonalise a given matrix.
 - e. To find the eigenvalues and eigenvectors.
2. Numerical differentiation.
 - a. To find the derivative of a given function $f(x)$ using the standard formula where h is the step size.
 - b. To determine the second derivative of a given function $f(x)$ using the standard formula.
 - c. Plot the case (a) as a function of x .
 - d. Plot the case (b) as a function of x .
 - e. Compare the above cases (a) and (b) with the results obtained analytically in specific cases.
3. Numerical method of solving Schrödinger equation.
 - a. Obtain numerical solution for the time independent Schrodinger equation in one dimension for a given potential using Runge-Kutta Method or Fox Godwin method.
 - b. To plot the wave function obtained from above versus x .
 - c. Obtain numerical solution for the time independent Schrodinger equation in three dimension for a given potential using Runge-Kutta method or Fox Godwin method.
 - d. To plot the wave function obtained from above versus r .
 - e. To evaluate the eigenvalues and eigenvectors for case (a).
 - f. To evaluate eigenvalues and eigenvectors for case (b).
 - g. To count the number of nodes of the function determined in (a) above and see if it is consistent with the theoretical expectation.
 - h. To determine the boundary value problems for cases (a) and (c).
4. Spherical harmonics.
 - a. To compute the Legendre polynomials.
 - b. To plot spherical harmonics as a function of polar angles.
 - c. To compute the spherical Bessel function (regular and irregular).
 - d. To plot the case (c).
5. Numerical integration.

- a. To integrate a given function numerically by Simpson's Rule.
 - b. To compare the results obtained from (a) with those obtained analytically.
 - c. To integrate a given function numerically by Trapezoidal rule.
 - d. To compare the results obtained from (b) with those obtained analytically.
 - e. To integrate a given function numerically by Gauss-Legendre integration.
 - f. To compare the results obtained from (c) with those obtained analytically.
6. Solution of algebraic equations.
- a. Solve a given equation numerically using Newton Raphson method.
 - b. Compare the result of (a) with those obtained numerically.
 - c. To solve a given equation using bisection method.
 - d. Comparative study of (a), (b) and (c).
7. Solution of simultaneous equations.
- a. Using Gauss-elimination and Gauss Jordan elimination method.
 - b. Compare (a) with solutions obtained analytically or algebraically.
8. Logistic systems.
To explore the regions of (a) stable fixed points (b) periodic and (c) chaotic solution.
9. Radioactivity.
- a. Use Monte-Carlo method to simulate radioactive decay.
 - b. Write a program for a radioactive series, when the daughter is also radioactive and so on.
 - c. Plot N (number of nuclei) Vs time t .
 - d. From the slope calculate the activity at different times.
10. LCR circuits.
- a. To compute the charge and discharge of RC circuit using DC source.
 - b. To compute the charge and discharge of RC circuits using AC source.
 - c. Analyse the energy in RL circuit using Runge-Kutta method.
 - d. Study the energy dissipated in a series LCR circuit. Plot it versus time t .
11. Modelling of data.
- a. To compute for a given sample of data.
 - b. To fit a given sample of data by least square method by a straight line.
 - c. To fit by minimizing by straight line.
 - d. To make a polynomial fit by least square method.
 - e. To make a polynomial fit by minimizing.
12. Fourier transform special methods.
- a. To compute Fourier transform of discretely sampled data.
 - b. To compute Fast Fourier transform of real functions and Sine and Cosine transformations.
 - c. To compute Fourier transform of a given function in two or more dimensions.

Suggested Readings

1. R. C. Verma et al., Computational Physics An Introduction, New Age International.
2. C. Xavier, Fortran 77 and Numerical Methods, New Age International.
3. E. W. Schmid, G. Spitz and W. Losch, Theoretical Physics on the Personal Computer, Springer-Verlag.

4. W. H. Press, S. S. Teukolsky, W. T. Vetterling and B. P. Flanner, Numerical Recipes in FORTRAN, Cambridge University Press.
5. M. K. Jain et al., Numerical Methods for Scientific and Engineering and Computation, New Age Int. Pub.

PSPP6011: PROJECT PHASE I

(4 credits)

During this phase the student will start a project applying the knowledge acquired during the first two semesters and also incorporating the recent trends in the chosen area. It should include phases of design, implementation and reporting. This project is to be executed individually within or outside the campus. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

E-resource for learning:

LaTeX, www.spokentutorial.org

PSPR6012: PROJECT PHASE II

(6 credits)

During this phase the student will complete the project started in the previous semester. The final implementation of the project and report writing shall be done in this semester. The student shall be required to make a number of presentations to report on the progress of the project. There will be a viva voce examination which shall follow the final submission of the project report. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

PSPM6013: PLASMA PHYSICS LABORATORY

(4 Credits)

At least 10 experiments should be performed from the following

1. Experimental determination of minimum breakdown voltage in a glow discharge system.
2. To study the effect of variation in chamber pressure on different regions of a glow discharge.
3. To study the effect of variation in discharge voltage on different regions of a glow discharge.
4. To plot the I-V characteristics of a glow discharge plasma.
5. To find the variation in resistance of a glow discharge plasma with chamber pressure.
6. To find the variation in resistance of a glow discharge plasma with discharge voltage.
7. To find the variation in floating potential with discharge voltage of a plasma using Langmuir probe.
8. To find the variation in floating potential with chamber pressure of a plasma using Langmuir probe.
9. To find the plasma potential of a plasma using Langmuir.
10. To find the electron temperature of a plasma using Langmuir probe.
11. To find the electron density of a plasma using Langmuir probe.
12. Identification of different ions/atoms/molecules in plasma by optical emission spectroscopy (OES).
13. To find the plasma density by optical emission spectroscopy (OES) using Stark Broadening of hydrogen lines.
14. To find the plasma temperature by optical emission spectroscopy (OES) using line intensity ratio method.

- To find the plasma temperature by optical emission spectroscopy (OES) using Boltzmann Plot method.

PSEL6014: ELECTRONICS LABORATORY

(4 Credits)

At least 10 experiments should be performed from the following

- Design of amplifiers: Transistor amplifiers with and without feedback.
- Design of Integrator and Differentiator using Op-amp.
- Op-amp linear applications: adders, subtractors, comparator
- Op-amp based active filters.
- 555 timer as monostable multivibrator.
- 555 timer as astable multivibrator.
- 555 timer as bistable multivibrator
- To verify the truth table of MUX and DEMUX.
- Realization of 2:4 decoder and 4:2 encoder design.
- To verify the truth table of one bit and four bit comparators using logic Gates.
- Truth table verification of Flip-Flops: (i) RS-Type, (ii) D- Type, (iii) T- Type, (iv) J-K Master Slave
- To study shift register in all its modes i.e. SIPO/SISO, PISO/PIPO.

PSNY6015: NANOPHYSICS LABORATORY

(4 Credits)

At least 10 experiments should be performed from the following

- Calculate molarity for different solutions. Learn to use the scientific balance (adjustments, taring, etc.).
- Prepare stock solution of the following (100 ml)
 - 10mM $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
 - 10mM 100ml $\text{C}_6\text{H}_{12}\text{N}_4$
 - 25mM $\text{Na}_3\text{C}_6\text{H}_5\text{O}_7$
- Synthesize ZnO nanoparticles using hydrothermal process.
- Perform seeding of pre-synthesized ZnO nanoparticles on glass substrate. Also perform direct seeding of ZnO particles on glass substrate by thermal oxidation.
- Grow ZnO nanorods on glass substrate hydrothermally.
- Synthesize ZnS nanoparticles using hydrothermal process.
- Synthesize manganese doped ZnS nanoparticles using hydrothermal process.
- Make film of ZnO nanoparticles on glass substrate using the LBL machine.
- Use Super-hydrophobicity testing machine to find out the roll-off and contact angle of a nanoparticle coated surface.
- Synthesize CdS nanoparticles using hydrothermal process. Observe colour variations with size when illuminated with UV light.
- Synthesize gold nanoparticles using Turkevitch process.
- Sample preparation for different characterization techniques.
- UV-vis spectroscopy to study optical properties of nanomaterials.

14. Tauc's plot to determine band gap of semiconductors.
15. Electron Microscopy Imaging of metallic and semiconducting nanoparticles.
16. Analysing SAED patterns.
17. Measurement of lattice fringes in TEM images using ImageJ software.
18. Analysing EDS plots.
19. Extracting information from XRD plots.
20. Measurement of WCA and ROA for different nanomaterial coated substrates.
21. PL spectroscopy on luminescent nanoparticles.

PSST6016: STUDY TOUR

Study Tour is a mandatory non-credited course to be taken up in the final semester of M.Sc. (physics) with an objective to provide students an exposure to higher studies and research in physics in other reputed institutes of the county. The study tour will not be of less than 2 days and will not exceed 14 days. During the tour, the focus will be on visiting different higher educational institutes and/or research institutes. A report will be submitted and a presentation will be given at the end of the tour by each student based on which he/she will be declared "Pass"/"No Pass" in the course.

PSTC6016: PHYSICS LAB FOR TECHNOLOGISTS

(2 credits) (L-T-P:0-0-4)

At least 10 experiments to be performed from the following.

1. To determine the frequency of an Electrical maintained tuning fork by Melde's experiments
2. Determination of surface tension by capillary rise method.
3. Determination of wavelength of light by Newton's ring method.
4. Determination of grating element of a diffraction grating.
5. Determination of wavelength of laser source by diffraction grating method.
6. Study of photoemission.
7. Determination of Rigidity modulus by static method.
8. Determination of acceleration due to gravity by Bar pendulum.
9. Determination of thermal conductivity by Lee's method
10. Plotting of characteristic curve of a PN junction diode.
11. Determination of Young's modulus by Searle's method.
12. Study of RC circuit.

PSEG6017: PHYSICS LAB FOR ENGINEERS

(1 credit) (L-T-P:0-0-2)

At least 10 experiments to be performed from the following.

1. To determine the frequency of an Electrical maintained tuning fork by Melde's experiments
2. Determination of surface tension by capillary rise method.
3. Determination of wave length of light by Newton's ring method.
4. Determination of grating element of a diffraction grating.
5. Determination of wavelength of laser source by diffraction grating method.
6. Study of photoemission.
7. Determination of Rigidity modulus by static method.

8. Determination of acceleration due to gravity by Bar pendulum.
9. Determination of thermal conductivity by Lee's method
10. Plotting of characteristic curve of a PN junction diode.
11. Determination of Young's modulus by Searle's method.
12. Study of RC circuit.

PSMY6101: MATHEMATICAL PHYSICS-I LABORATORY

(2 Credits)

At least 10 experiments should be performed from the following

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow-emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D & 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of pi (π)
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving $\alpha = \tan\alpha$; $I = I_0 (\sin\alpha/\alpha)^2$ in optics
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. $\sin \theta$, $\cos \theta$, $\tan \theta$, etc.

<p>Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method</p>	<p>Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop</p>
<p>Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods</p>	<p>First order differential equation</p> <ul style="list-style-type: none"> • Radioactive decay • Current in RC, LC circuits with DC source • Newton’s law of cooling • Classical equations of motion • Attempt following problems using RK 4 order method: • Solve the coupled differential equations $\frac{dx}{dt} = y + x - \frac{x^3}{3}; \frac{dy}{dx} = -x$ <p>for four initial conditions $x(0) = 0, y(0) = -1, -2, -3, -4$. Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$ The differential equation describing the motion of a pendulum is $\frac{d^2\theta}{dt^2} = -\sin \theta$. The pendulum is released from rest at an angular displacement, i. e. $\theta(0) = \alpha$ and $\theta'(0) = 0$. Solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot θ as a function of time in the range $0 \leq t \leq 8\pi$ Also plot the analytic solution valid for small θ $\sin(\theta) = \theta$</p>

PSMA6102: MECHANICS LABORATORY

(2 Credits)

At least 10 experiments should be performed from the following

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. Study the random error in observations.
3. Determine the height of a building using a Sextant.
4. Study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
5. Determine the Moment of Inertia of a Flywheel.
6. Determine g and velocity for a freely falling body using Digital Timing Technique
7. Determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille’s method).
8. Determine the Young’s Modulus of a Wire by Optical Lever Method.
9. Determine the Modulus of Rigidity of a Wire by Maxwell’s needle.
10. Determine the elastic Constants of a wire by Searle’s method.
11. Determine the value of g using Bar Pendulum.
12. Determine the value of g using Kater’s Pendulum.

PSEM6103: ELECTRICITY AND MAGNETISM LABORATORY**(2 Credits)**

At least 10 experiments should be performed from the following

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. Study the characteristics of a series RC Circuit.
3. Determine an unknown Low Resistance using Potentiometer.
4. Determine an unknown Low Resistance using Carey Foster's Bridge.
5. Compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. Verify the Thevenin and Norton theorems.
8. Verify the Superposition, and Maximum power transfer theorems.
9. Determine self inductance of a coil by Anderson's bridge.
10. Study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11. Study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
13. Determine a high resistance by leakage method using Ballistic Galvanometer.
14. Determine self-inductance of a coil by Rayleigh's method.
15. Determine the mutual inductance of two coils by Absolute method.

PSWO6104: WAVES AND OPTICS LABORATORY**(2 Credits)**

At least 10 experiments should be performed from the following

1. Determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda^2 - T$ law.
2. Investigate the motion of coupled oscillators.
3. Study Lissajous Figures.
4. Familiarization with: Schuster's focusing; determination of angle of prism.
5. Determine refractive index of the Material of a prism using sodium source.
6. Determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. Determine the wavelength of sodium source using Michelson's interferometer.
8. Determine wavelength of sodium light using Fresnel Biprism.
9. Determine wavelength of sodium light using Newton's Rings.
10. Determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. Determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. Determine dispersive power and resolving power of a plane diffraction grating.

PSMS6105: MATHEMATICAL PHYSICS-II LABORATORY

(2 Credits)

At least 10 experiments should be performed from the following

Topics	Description with Applications
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program (2).
Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke’s law to calculate spring constant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)
Generation of Special functions using User defined functions in Scilab	Generating and plotting Legendre Polynomials Generating and plotting Bessel function

<p>Solution of ODE</p> <p>First order Differential equation Euler, modified Euler and Runge-Kutta second order methods</p> <p>Second order differential equation</p> <p>Fixed difference method</p> <p>Partial differential equations</p>	<p>First order differential equation</p> <ul style="list-style-type: none"> • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion <p>Second order Differential Equation</p> <ul style="list-style-type: none"> • Harmonic oscillator (no friction) • Damped Harmonic oscillator • Over damped • Critical damped • Oscillatory • Forced Harmonic oscillator • Transient and • Steady state solution • Apply above to LCR circuits also <ul style="list-style-type: none"> • Solve $x^2 \frac{d^2y}{dx^2} - 4x(1+x) \frac{dy}{dx} + 2(1+x)y = x^3$ <p>with the boundary conditions at $x = 1, y = \frac{1}{2}e^2, \frac{dy}{dx} = -\frac{3}{2}e^2 - 0.5$</p> <p>in the range $1 \leq x \leq 3$. Plot y and dy against x in the ds given range on the same graph.</p> <p>Partial Differential Equation:</p> <ul style="list-style-type: none"> • Wave equation • Heat equation • Poisson equation • Laplace equation
<p>Using Scicos / xcoss</p>	<p>Generating square wave, sine wave, saw tooth wave</p> <p>Solution to harmonic oscillator</p> <p>Study of beat phenomenon</p> <p>Phase space plots</p>

PSPT6106: THERMAL PHYSICS LABORATORY

(2 Credits)

At least 5 experiments should be performed from the following

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature..

PSDA6107: DIGITAL SYSTEMS AND APPLICATIONS LABORATORY

(2 Credits)

At least 10 experiments should be performed from the following

1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. To test a Diode and Transistor using a Multimeter.
3. To design a switch (NOT gate) using a transistor.
4. To verify and design AND, OR, NOT and XOR gates using NAND gates.
5. To design a combinational logic system for a specified Truth Table.
6. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
7. To minimize a given logic circuit.
8. Half Adder, Full Adder and 4-bit binary Adder.
9. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
10. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
11. To build JK Master-slave flip-flop using Flip-Flop ICs.
12. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
13. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
14. To design an astable multivibrator of given specifications using 555 Timer.
15. To design a monostable multivibrator of given specifications using 555 Timer.
16. Write the following programs using 8085 Microprocessor.
 - a) Addition and subtraction of numbers using direct addressing mode
 - b) Addition and subtraction of numbers using indirect addressing mode
 - c) Multiplication by repeated addition.
 - d) Division by repeated subtraction.
 - e) Handling of 16-bit Numbers.
 - f) Use of CALL and RETURN Instruction.
 - g) Block data handling.
 - h) Other programs (e.g. Parity Check, using interrupts, etc.).

PSMP6108: MATHEMATICAL PHYSICS III LABORATORY

(2 Credits)

At least 5 experiments should be performed from the following

1. Solve formula differential equations:

$$\frac{dy}{dx} = e^{-x} \text{ with } y = 0 \text{ for } x = 0$$
2. Dirac Delta Function:
 Evaluate $\frac{1}{\sqrt{2\pi\sigma^2}} \int e^{-\frac{(x-2)^2}{2\sigma^2}} (x+3) dx$ for $\sigma = 1, 0.1, 0.01$ and show it tends to 5.
3. Fourier formula Series:
 Program to sum $\sum_{n=1}^{\infty} (0.2)^n$
 Evaluate the Fourier coefficients of a given periodic function (square wave)

4. Frobenius method and Special functions:

$$\int_{-1}^{+1} P_n(\mu)P_m(\mu)d\mu = \delta_{n,m}$$

Plot $P_n(x)$, $j_\nu(x)$

Show recursion relation

5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).
6. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.
7. Evaluation of trigonometric functions e.g. $\sin \theta$, Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ numerically and check with computer integration.
8. Compute the n^{th} roots of unity for $n = 2, 3$, and 4.
9. Find the two square roots of $-5+12j$.
10. Integral transform: FFT of e^{-s^2}
11. Solve Kirchoff's Current law for any node of an arbitrary circuit using Laplace's transform.
12. Solve Kirchoff's Voltage law for any loop of an arbitrary circuit using Laplace's transform.
13. Perform circuit analysis of a general LCR circuit using Laplace's transform

PSEP6109: ELEMENTS OF MODERN PHYSICS LABORATORY**(2 Credits)**

At least 10 experiments should be performed from the following

1. Measurement of Planck's constant using black body radiation and photo-detector.
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating.

PSAS6110: ANALOG SYSTEMS AND APPLICATIONS LABORATORY

(2 Credits)

At least 10 experiments should be performed from the following

1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the various biasing configurations of BJT for normal class A operation.
6. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
7. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
8. To design a Wien bridge oscillator for given frequency using an op-amp.
9. To design a phase shift oscillator of given specifications using BJT.
10. To study the Colpitt's oscillator.
11. To design a digital to analog converter (DAC) of given specifications.
12. To study the analog to digital converter (ADC) IC.
13. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
14. To design inverting amplifier using Op-amp (741,351) and study its frequency response
15. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
16. To study the zero-crossing detector and comparator
17. To add two dc voltages using Op-amp in inverting and non-inverting mode
18. To design a precision Differential amplifier of given I/O specification using Op-amp.
19. To investigate the use of an op-amp as an Integrator.
20. To investigate the use of an op-amp as a Differentiator.
21. To design a circuit to simulate the solution of a 1st/2nd order differential equation.

PSGP6111: GENERAL THERMAL PHYSICS LABORATORY

(2 Credits)

At least 8 experiments should be performed from the following

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and Analyse the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off- Balance Bridge

PSGM6112: GENERAL ELEMENTS OF MODERN PHYSICS LABORATORY**(2 Credits)**

At least 8 experiments should be performed from the following

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine the ionization potential of mercury.
4. To determine value of Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser and measure its intensity variation using Photosensor & compare with incoherent source – Na.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

DEPARTMENT OF CHEMISTRY

Vision: To produce competent chemistry graduates through dedicated teaching in classrooms, through labs and research, who can contribute meaningfully to society while fulfilling their own ambitions in academia, research or industry.

Mission:

- The objective of the department is to provide dedicated guidance and support to students to equip them with a sound understanding of the fundamentals of chemistry,
- to enable them to explore the diverse and hitherto unexplored resources of the north-eastern region
- to make significant contributions to fundamental and socially relevant research in the frontiers of chemistry
- to help them generate their own ideas and provide them the knowhow to convert them into reality

MSc Chemistry - Program Outcomes

A student upon completing the Masters in Chemistry Program should

- Acquire an in depth understanding of the three branches of chemistry viz., Physical Chemistry, Inorganic Chemistry and Organic Chemistry
- Acquire skills in handling scientific instruments, planning and performing laboratory experiments
- Be well versed in the most recent developments in Chemistry
- Communicate effectively both orally and in writing.
- Acquire the training necessary to pursue research
- Have an understanding of the interdisciplinary nature of research in today's world

BSc Chemistry – Program Outcomes

A student upon completing the Bachelor of Science in Chemistry program should

- Acquire a thorough and deep understanding of chemistry and allied subjects
- Acquire skills in planning and performing laboratory experiments
- Communicate effectively both orally and in writing

DETAILED SYLLABUS

THEORY COURSES

CHES0002: ENVIRONMENTAL STUDIES

CHES0029: ENVIRONMENTAL SCIENCE

(2 Credits - 30 Hours)

Objective: This course is designed to enhance knowledge skills and attitude to environment. It will help a student to get a broad exposure to problems facing our environment.

Module I: The Multidisciplinary Nature of Environmental Studies (3 hours)

Definition, scope and importance, need for public awareness.

Module II: Natural Resources (3 hours)

- a. Different types of natural resources and associated problems - forest resources, water resources, mineral resources, food resources, energy resources, land resources.
- b. Conservation of natural resources.

Module III: Ecosystems (4 hours)

- a. Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, food chains, food webs.
- b. Structure of following ecosystems - forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems.

Module IV: Biodiversity and Its Conservation (4 hours)

Types of biodiversity – genetic, species and ecosystem, value of biodiversity, global biodiversity, India as a mega-diversity nation, threats to biodiversity, conservation of biodiversity - in-situ and ex-situ conservation.

Module V: Environmental Pollution (6 hours)

- a. Definition, causes, effects and control measures of - air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards and e-pollution.
- b. Solid waste management
- c. Disaster management

Module VI: Social Issues and the Environment (6 hours)

- a. From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, climate change, global warming, acid rain, ozone layer depletion.
- b. Environment protection act.
- c. Introduction to environmental impact assessment.

Module VII: Human Population and the Environment (4 hours)

Population growth and sex ratio; Population explosion - family welfare programme; Environment and human health; HIV/AIDS; Role of information technology in environment and human health.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Name different types of natural resources; state the concept of an ecosystem, recall the types of biodiversity and ways of conserving biodiversity, causes, effects and control measures of pollution, social issues and its effect on the environment. (Remembering)

- CO2:** Explain what they understand by an ecosystem, biodiversity, explain how environmental pollution occurs and steps that can be taken to control pollution. (Understanding)
- CO3:** Compare the types of natural resources available and learn of conservation approaches taken to preserve them; compare different ecosystems and learn of their functions. (Analysing)
- CO4:** Assess the importance of conserving natural resources, ecosystems, biodiversity and minimizing environmental pollution. (Evaluating)
- CO5:** Value the overall benefit to the environment of preserving natural resources, preserving ecosystems and conserving biodiversity. Learn about sustainable development to protect the environment and promote human health. (Evaluating)
- CO6:** Develop ideas of how to preserve the environment by connecting the ideas of minimizing pollution, regulating human population growth, conserving biodiversity by preserving ecosystems and judicious use of natural resources. (Creating)

Suggested Readings

1. Erach Bharucha; Textbook for Environmental Studies, UGC, New Delhi
2. S. Somvanshi and R. Dhupper; Fundamentals of Environmental Studies, S.K. Kataria and Sons Publisher.
3. A.K. De; Environmental Chemistry, New age publishers.
4. J.P. Sharma; Environmental Studies, University Science Press
5. K.G. Bhattacharyya and A. Sarma; Comprehensive Environmental Studies, Narosa Publishing House Pvt, Ltd.

CHIC0003: FUNDAMENTALS OF INORGANIC CHEMISTRY

(4 Credits - 60 Hours)

Objective: This course is designed to deal with the concept of acids and bases, properties of transition metals and transition metal complexes.

Module I: Concepts of Acids and Bases (10 hours)

Hard and soft acid-base concept, non-aqueous solvents, redox chemistry

Module II: Transition Metal Chemistry (8 hours)

Descriptive chemistry of transition metals including lanthanides and actinides, coordination chemistry - coordination number and geometry, isomerism, thermodynamic stability - successive and overall stability constants, Irving-William series, chelate and macrocyclic effects.

Module III: Bonding in Inorganic and Coordination Compounds (20 hours)

VBT (hybridization), CFT and their limitations, ligand field theory, d-orbital wave functions, d-orbital splitting in octahedral, square planar, square pyramidal, trigonalbipyramidal, and tetrahedral complexes; Jahn-Teller distortion, CFSE for d^1 to d^{10} systems, pairing energy, low-spin and high-spin complexes and molecular orbital (MO) theory of selected octahedral, tetrahedral complexes and other geometries, Walsh Diagram.

Module IV: Electronic Spectra of Transition Metal Complexes (12 hours)

d-d transition, charge transfer transition, color, intensity and origin of spectra, interpretation, term symbols and splitting of terms different geometries, selection rules for electronic transitions, correlation, Tanabe-Sugano and Orgel diagrams, calculation of Dq , B and C, nephelauxetic ratio.

Module V: Magnetic Properties of Transition Metal Complexes (10 hours)

Magnetic properties of free ions, types of magnetic behavior: dia-, para-, ferro- and antiferromagnetism, temperature independent paramagnetism, magnetic susceptibility - Van Vleck equation, experimental measurement, magnetic moment - orbital contribution, quenching of

contribution, effect of spin orbit coupling, spin crossover, temperature dependence of magnetic susceptibility, exchange coupling effects, magnetic properties of second and third transition series and lanthanides

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall fundamental concepts associated with hard and soft acids and bases, the properties of inorganic nonaqueous solvents, redox reactions, the properties of transition metals and their complexes. (Remembering)
- CO2:** Explain (i) periodic variation of the strength of acids and bases, their classification and applications, the (ii) general characteristics, structure, theory, reactivity and applications of coordination compounds. (Understanding)
- CO3:** Classify a given set of metal ions or ligands, into hard and soft acids or bases respectively, distinguish a reductant from an oxidant, classify transition metal complexes as ferro- or para- or diamagnetic, infer whether a given set of complexes have tetrahedral or octahedral geometry, infer the nature of electronic transitions possible in a transition metal complex. (Analysing)
- CO4:** Determine the preference of a given metal ion for a ligand to form a complex based on their hardness or softness, they should be able to deduce the electronic and magnetic properties of transition metal complexes. Given a redox reaction, they should be able to distinguish between oxidizing and reducing agents. (Evaluating)
- CO5:** Design complexes of transition metal complexes and predict their electronic and magnetic properties, they should be able to design redox reactions and they should be able to choose non-aqueous solvents for carrying out desired reactions. (Creating)
- CO6:** Predict the hardness or softness of acids and bases, predict the outcome of redox reactions, the mechanism of ionization of a molecule in a nonaqueous-solvent, geometries of coordination complexes, different types of electronic transitions that take place giving rise to colour, whether a transition metal complex will be dia-, para-, ferro- or antiferro magnetic. (Creating)

Suggested Readings

1. J. E. Huheey, E. A. Keiter and R. L. Keiter; Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education.
2. B. N. Figgis, M. A. Hitchman; Ligand Field theory and its Applications, Wiley India.
3. G. L. Miessler, D Tarr; Inorganic Chemistry, Pearson Education.
4. P. W. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong; Shriver and Atkins: Inorganic Chemistry, Oxford University Press.
5. A.K. Das and M. Das; Fundamental Concepts of Inorganic Chemistry, Vols. 1-7, CBS Publishers and Distributors.
6. H.J. Arnika; Essentials of Nuclear Chemistry, Wiley Eastern, New Delhi.
7. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann; Advanced Inorganic Chemistry, Wiley.
8. C. E. Housecroft and A. G. Sharpe; Inorganic Chemistry, Prentice Hall.
9. F. A. Cotton; Chemical Applications of Group Theory, Wiley.
10. S. A. Cotton; Lanthanide and Actinide Chemistry, John Wiley.
11. G. Fridlander, J.W. Kennedy, E. S. Macias, and J. M. Miller; Nuclear and Radiochemistry, John Wiley, New York.
12. M. Weller, F. Armstrong, J. Rourke, T. Overton; Inorganic Chemistry, Oxford University Press.
13. R. L. Dutta, A. Syamal; Elements of Magnetochemistry, Affiliated East-West Press Pvt. Ltd.-New Delhi.
14. F. E. Mabbs, D. J. Machin; Magnetism and Transition Metal Complexes, Dover Pub.Inc.

CHOC0004: FUNDAMENTALS OF ORGANIC CHEMISTRY

(4 Credits - 60 hours)

Objective: This course is designed to make the students familiar with reaction mechanisms, reactivity of organic compounds and the stereochemistry.

Module I: Kinetics and Energetics of Reaction Mechanism (15 hours)

Transition state theory of reaction rates - kinetics and thermodynamics of activation, reaction profiles for multistep reactions, Hammond postulate, Curtin-Hammett Principle, kinetic and thermodynamic control, Linear free energy relationships (LFER), Hammett equation - substituent and reaction constants, the Taft treatment of polar and steric effects in aliphatic compounds, kinetic isotope effects in organic reactions, effects of conformation on reactivity, stereoelectronic effects, neighbouring group participation, anomeric effect.

Module II: Reaction Mechanisms and Intermediates (Structure and Reactivity) - I (15 hours)

- Carbanions: enolates and enamines, kinetic and thermodynamic enolates, lithium and boron enolates in Aldol and Michael reactions, alkylation and acylation of enolates, name reactions under carbanion chemistry - Claisen, Dieckmann, Knoevenagel, Stobbe, Darzen, Acyloin condensations, Shapiro reaction, Julia olefination, Brook rearrangement, Sakurai reaction, Henry reaction, Kulinkovich reaction, Nef reaction, Baylis-Hillman reaction.
- Ylids: Chemistry of phosphorous and sulfur ylids - Wittig and related reactions, Peterson olefination
- Carbocations: structure and stability of carbocations, classical and non-classical carbocations, neighbouring group participation and rearrangements including Wagner-Meerwein, pinacol- pinacolone, semi-pinacol rearrangement, C-C bond formation involving carbocations, oxymercuration, halolactonisation, Tishchenko reaction, Ritter reaction, Prins reaction.

Module III: Reaction Mechanisms and Intermediates (Structure and Reactivity) - II (15 hours)

- Carbenes and Nitrenes: Structure of carbenes, generation of carbenes, addition and insertion reactions, rearrangement reactions of carbenes such as Wolff rearrangement, generation and reactions of ylids by carbenoid decomposition (existence of O and N based ylids), Structure of nitrene, generation and reactions of nitrene and related electron deficient nitrogen intermediates, Curtius, Hoffmann, Schmidt, Beckmann rearrangement, structure and reactivity of benzyne.
- Radicals: Generation of radical intermediates and its addition to alkenes, alkynes (inter AND intramolecular) for C-C bond formation and Baldwin's rules, name reactions involving radical intermediates such as Barton deoxygenation and decarboxylation, McMurry coupling.

Module IV: Stereochemistry (15 hours)

- Classification of organic molecules into different Point Groups, R and S, E and Z nomenclature in C, N, S, P containing compounds, concept of absolute and relative
- Configuration, chirality in molecules devoid of chiral centres - allenes, spiranes and biphenyls.
- Concepts of stereogenic centres – chirotopic and achirotopic centres, homotopic and heterotopic ligands and faces, optical purity and enantiomeric excess, conformation of acyclic organic molecules, cyclohexane and decalins.
- Dynamic stereochemistry, stereoselective synthesis, classification of stereoselective synthesis, diastereoselective, enantioselective and double stereo-differentiating reactions, nucleophilic addition to aldehyde and acyclic ketones, Prelog's rule, nucleophilic addition to cyclic ketones.
- Enantioselective synthesis, use of chiral reagent, chiral catalyst and chiral auxiliary, stereospecific and stereoselective reactions

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall unique features of organic reactions mechanism, reaction intermediates, stereochemistry and reaction kinetics and principles involved in it. (Remembering)
- CO2:** Compare the application of reaction mechanisms and stereochemistry in different reactions as well as products. (Understanding)
- CO3:** Identify the stereochemistry of the product and mechanism of different reactions. (Applying)
- CO4:** Solve different problems related to organic reaction mechanisms and stereochemistry. (Creating)
- CO5:** Assess the unique features of organic reaction mechanisms, and stereochemistry. (Evaluating)
- CO6:** Elaborate and compare applications of reaction mechanisms of different types of reactions involving reactive intermediates like carbocation, carbanion, carbene etc and should be able to provide analytical solution towards their design. (Creating)

Suggested Readings

1. F. A. Cary and R. I. Sundberg; Advanced Organic Chemistry, Part A and B, Springer.
2. A. J. Kirby; Stereoelectronic Effects, OUP.
3. W. Carruthers and I. Coldham; Modern methods of Organic Synthesis, South Asian Edition, Cambridge University Press.
4. T. H. Lowry, K. S. Richardson; Mechanism and Theory in Organic Chemistry.
5. J. Clayden, N. Greeves, S. Warren, Organic Chemistry.
6. E. V. Anslyn, D. A. Dougherty; Modern Physical Organic Chemistry, University Science Books.

CHPC0005: FUNDAMENTALS OF PHYSICAL CHEMISTRY

(4 Credits - 60 hours)

Objective: This course is designed to give the students a basic understanding of equilibrium, non-equilibrium and statistical thermodynamics, polymer chemistry and some concepts of sampling and data analysis.

Module I: Equilibrium and Non-equilibrium Thermodynamics (22 hours)

- a) Laws of thermodynamics, state and path functions and their applications, Maxwell's relations, spontaneity and equilibria, Le Chatelier principle.
- b) Non-ideal system - thermodynamics of real gases and gas mixtures, fugacity and its determination, non-ideal solutions, activity and activity coefficient, different scales of activity coefficient, electronic activity coefficients.
- c) Phase equilibrium - thermodynamic criteria of phase equilibrium, Gibbs phase rule and its application to three component systems - triangular plots - water-acetic acid-chloroform system and ammonium chloride-ammonium sulphate-water system.
- d) Non-equilibrium thermodynamics - forced flows and entropy of production, coupled flows and phenomenological relations, Onsager reciprocal relations, thermodynamic effects - Seebeck, Peltier and Thomson effects.

Module II: Statistical Thermodynamics (22 hours)

- a) Statistical mechanics of systems independent particles - Maxwell Boltzmann distribution, entropy and probability, calculation of thermodynamic properties for independent particles, molecular partition functions, evaluation of translational, rotational and vibrational and nuclear partition functions.

- b) Thermodynamic properties of monatomic and diatomic gases (Suckur Tetrode equation), calculation of partition functions, thermodynamic function, principles of equipartition, heat capacities (Einstein model and Debye modification), residual entropy, equilibrium constant.

Module III: Polymer Chemistry (8 hours)

Molecular weight of polymers, determination of molecular weight, kinetics of polymerization reaction, copolymerization, average dimension of polymer molecules, size exclusion chromatography.

Module IV: Sampling and Data Analysis (8 hours)

Sampling of solid, liquid and gaseous samples, mean and standard deviation, absolute and relative errors, linear regression, covariance and correlation coefficient

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Define the laws of thermodynamics in the context of equilibrium and non-equilibrium systems, the calculation of partition functions; structure and properties of polymers; methods of sampling and analysis of chemical data. (Remembering)
- CO2:** Explain the laws of thermodynamics in the context of equilibrium and non-equilibrium states; explain the methods to determine the molecular weight of polymers, kinetics of polymerization reactions etc. (Understanding)
- CO3:** Apply the laws of thermodynamics to solve numerical problems and derive thermodynamic relations; solve problems such as finding out ways to determine the mechanism of a polymerization reaction given a set of precursors, separate a mixture of polymers based on their properties. (Applying)
- CO4:** Distinguish between different types of systems and know which of the laws of thermodynamics can be applied to calculate state and path functions; draw comparisons and differences between equilibrium, non-equilibrium and statistical thermodynamics and their applications. (Analysing).
- CO5:** Assess the nature of the system they are dealing with and know which of the realms of thermodynamics the system falls under and apply appropriate laws; calculate sizes of polymer molecules and analyse results of different chemical experiment from the statistical point of view. (Evaluating)
- CO6:** Develop a clear understanding of application of thermodynamics and polymerization process. (Creating)

Suggested Readings

1. P. Atkins, J. Paula; Physical Chemistry, Oxford University Press.
2. I. R. Levine, Physical chemistry, Mcgraw Hill Education.
3. D. A. McQuarrie, J. D. Simon; Physical Chemistry: A Molecular Approach, Viva Student Edition.
4. R. S. Berry, S. A. Rice and J. Ross; Physical Chemistry, Oxford University Press.
5. D. A. McQuarrie; Statistical Mechanics, University Science Books, California.
6. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis, Pearson.
7. V. R. Gowarikar, N. V. Viswanathan, J. Sreedhar; Polymer Science, New age International Publishers.
8. G. Odian; Principles of Polymerization, Wiley Student Edition.

CHQG0006: INTRODUCTION TO QUANTUM CHEMISTRY AND GROUP THEORY**(3 Credits-45 hours)***Objective: This course serves to introduce the concepts of quantum chemistry and group theory to students***Module I: Quantum Chemistry I (15 hours)**

Planck's theory, wave-particle duality, uncertainty principle, postulates of quantum mechanics, Schrodinger equation, free particle, particle in a box, degeneracy, harmonic oscillator, rigid rotator, the hydrogen atom, angular momentum, electron spin, spin-orbit coupling.

Module II: Quantum Chemistry II (15 hours)

Approximate methods in quantum mechanics - the variation theorem, linear variation principle and perturbation theory (first order and non-degenerate), application of variation method and perturbation theory to the Helium atom, antisymmetry, Slater determinant, term symbols and spectroscopic states

Module III: Chemical Applications of Group Theory (15 hours)

Symmetry elements and operations, equivalent symmetry elements and equivalent atoms, identification of symmetry point groups with examples, groups of very high symmetry, molecular dissymmetry and optical activity, systematic procedure for symmetry classification of molecules and illustrative examples, brief review of matrix representation of groups, reducible and irreducible representations, rules about irreducible representations as derived from great orthogonality theorem, relationship between reducible and irreducible groups, character tables.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- C01:** Recall fundamental concepts of quantum chemistry and group theory such as the postulates and theorems of quantum mechanics, complete solution of the Schrödinger equation for one electron systems, approximation methods for multi-electron systems, properties of symmetry groups, assigning symmetry point groups to molecules, irreducible representations of groups. (Remembering)
- C02:** Explain the concepts of operators, eigen functions and eigen values and their uses in solving the Schrodinger equation for ideal systems, application of approximation methods applied to multi-electron atoms, symmetry classes and groups, degenerate and non degenerate representations. (Understanding)
- C03:** Examine the properties of simple systems e. g., calculating the probability of an electron occupying a certain energy state inside a well or a box, or the probability of finding an electron outside a potential well, and also determine the symmetry operations that can be applied to a molecule in group theory. (Applying)
- C04:** Discover the applications of the concepts they learn to solve numerical problems such as writing the Schrodinger equation for a multi-electron atom or devising a trial variation wave function for a particle in a 1-D box. (Analysing)
- C05:** Distinguish between cases when an exact solution of the Schrodinger equation is possible and cases when an exact solution is not possible, they should be able to differentiate between applicability of different approximation methods in quantum chemistry and be able to assign point groups and calculate the character table for a particular point group in group theory. (Analysing)
- C06:** Design simple problems in quantum chemistry and group theory by incorporating the different concepts they learn. (Creating)

Suggested Readings

1. P. Atkins, R. Friedman; Molecular quantum Mechanics, Oxford University Press.
2. I. N. Levine, Quantum Chemistry, PHI Learning Pvt. Ltd.
3. David J. Griffiths; Introduction to Quantum mechanics, Pearson Education Ltd.
4. F. A. Cotton; Chemical Applications of Group Theory, Wiley India Pvt. Ltd.
5. R. L. Carter; Molecular Symmetry and Group Theory, John Wiley & Sons.

CHIR0007: ADVANCED INORGANIC CHEMISTRY I

(4 Credits-60 hours)

Objective: *The objective of this course is to teach students core concepts of organometallic chemistry, inorganic reaction mechanisms, inorganic photochemistry, solid state chemistry, and structure and bonding in different inorganic compounds.*

Module I: Descriptive Inorganic Chemistry (15 hours)

- a) Structure and bonding in polyhedral boranes and carboranes, styx notation, Wade's rules, electron count in polyhedral boranes, synthesis of polyhedral boranes, isolobal analogy, boron halides, phosphine-boranes, boron heterocycles, borazine.
- b) Silanes, silicon halides, silicates, silicones, silanols, zeolites, germanium, tin and lead organyls, silenes, germenes, stannenes, phosphorous halides, phosphazenes, sulphur halides, structural features and reactivity of S-N heterocycles.
- c) Synthesis and reactivity of organo-lithium, -beryllium and -magnesium compounds, calixarines, cryptands and crown ethers in complexation chemistry.
- d) Preparation and reactivity of aluminum organyls, carbalumination, hydroalumination, chemistry of Ga (I) and In (I), reduction of Al, Ga and In organyls, Metal organic framework structures (MOFs)

Module II: Introduction to Solid State Chemistry (10 hours)

Structure of simple solids – metals, alloys and compounds; common structure types; synthesis of solid state compounds - ceramic method, microwave synthesis, sol-gel, precursor method, hydrothermal synthesis, CVD and intercalation; characterization of solids, bonding in solids – free-electron and molecular orbital theory; bands in solid state compounds, properties of solids – optical, magnetic and electrical properties of solids.

Module III: Organometallic Chemistry (10 hours)

- a) Valence electron count (16/18 electron rules), synthesis, structure, bonding and reactivity of mono and polynuclear metal carbonyls, substituted metal carbonyls, vibrational spectra of metal carbonyls, metal-metal bonding.
- b) Types of M-C bonds, synthesis and reactivity of metal alkyls, carbenes, alkenes, alkynes, and arene complexes, metallocenes and bent metallocenes, isolobal analogy.
- c) Reactions of organometallic complexes: Substitution, oxidative addition, reductive elimination, insertion and deinsertion, catalysis, hydrogenation, hydroformylation, Monsanto process, Wacker process, alkene polymerization.

Module IV: Mechanism of Inorganic Reactions (7 hours)

Substitution in octahedral and square planar complexes, lability, trans-effect, conjugate base mechanism, racemisation, electron transfer reactions - inertness and lability, inner sphere and outer sphere mechanism, Marcus theory, solid state reactions – topotactic and epitactic mechanisms.

Module V: Inorganic Photochemistry (3 hours)

Photosubstitution and photoredox reactions of chromium, cobalt and ruthenium compounds, Ligand field and charge transfer state (Thexi and DOSENCO states), cis-trans isomerization, photocatalysis and solar energy conservation by ruthenium complexes.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the concepts of organometallic chemistry, inorganic reaction mechanisms, inorganic photochemistry, solid state chemistry and structure and bonding in different inorganic compounds. (Remembering)
- CO2:** Interpret information based on their understanding of the concepts of bonding, structure, photochemistry and reaction mechanism of different inorganic compounds. (Understanding)
- CO3:** Solve problems which arise in different industrial and analytical fields by knowing the characteristics of the inorganic compounds. (Applying)
- CO4:** Apply their idea for using different inorganic compounds in different industrial fields . (Analysing)
- CO5:** Judge and assess the inorganic compounds based on their structure and reactivity. (Evaluating)
- CO6:** Identify the inorganic compounds for their suitable analytical and industrial use. (Creating)
- CO7:** Design protocols for Analysing inorganic mixtures and synthesizing nanoparticles. (Creating)

Suggested Readings

1. Cotton, F. A., Wilkinson, G., Murillo, C. A. and Bochmann, M., Advanced Inorganic Chemistry, Wiley.
2. Greenwood, N. N. and Earnshaw, E. A., Chemistry of elements, Butterworth-Heinemann.
3. Huheey, J. E., Keiter, E. A., . Keiter, R. L., Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education.
4. Miessler, G. L., Tarr, D., Inorganic.Chemistry, Pearson Education.
5. Atkins, P.W., Overton, T., Rourke, J., Weller, M., Armstrong, F., Shriver & Atkins: Inorganic Chemistry, Oxford University Press.
6. Douglas, B. E., McDaniel, D. H., Alexander, J. J. Concepts and Models of Inorganic Chemistry, John Wiley.
7. Wulfsberg, G., Inorganic Chemistry, University Science Books.
8. Smart, L., Moore, E. Solid State Chemistry: An Introduction, Nelson Thorns Ltd.
9. Das, A. K. and Das, M., Fundamental Concepts of Inorganic Chemistry, Vols. 1-7, CBS Publishers and Distributors
10. Crabtree, R. H., Organometallic Chemistry of the Transition Metals, John Wiley.
11. Basalo, F. and Pearson, R. G. Mechanisms of Inorganic Reactions, John Wiley

CHOG0008: ADVANCED ORGANIC CHEMISTRY I**(4 Credits- 60 hours)**

Objective: This course will discuss nucleophilic, electrophilic and elimination reaction mechanisms along with various oxidation-reduction methods.

Module I (15 hours)

- a) Nucleophilic Substitution: S_N1 , S_N2 and related mechanisms; Factors influencing reaction rates; Neighbouring group participation by π - and σ -bond; Anchimeric assistance; Aromatic Nucleophilic Substitution: The S_NAr , S_N1 , benzyne and S_N1 mechanisms. Reactivity; effect of

substrate structure, leaving group and attacking nucleophile; The S_N1 mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinyl carbon. Aromaticity, antiaromaticity and homoaromaticity.

- b) Electrophilic Substitution: Aliphatic: Bimolecular mechanisms: $SE1$, $SE2$ and SEi . The $SE1$ mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity. Aromatic: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems.

Module II (15 hours)

- a) Elimination reactions: Mechanism and stereochemistry of different types of elimination reactions; Effects of substrate structure, attacking base, leaving group and medium; Formation of other double bonds ($C=N$, $C=O$) and triple bonds by elimination reactions; Mechanism and orientation in pyrolytic elimination.
- b) Miscellaneous Reactions: Biginelli reaction, Passerini reaction, Nazarov cyclisation, Pd-catalyzed reactions, Vilsmeier Hack reaction, Ugi reaction, Robinson annulations, Mitsunobu reaction, Appel reaction, Favoriskii rearrangement.

Module III Oxidation Reactions (15 hours)

Metal and non-metal based oxidations (Cr, Mn, Al, Ag, Os, Ru, Se, DMSO, hypervalent iodine), reagents (Fremy's salt, silver carbonate, peroxides/per-acids), Sharpless asymmetric epoxidation, Jacobsen epoxidation, Shi epoxidation, Sharpless asymmetric dihydroxylation, Baeyer-Villiger oxidation, Wacker oxidation, hydroboration-oxidation, Prevost reaction and Woodward modification.

Module IV Reduction Reactions (15 hours)

Catalytic hydrogenation (Pd/Pt/Rh/Ni), Wilkinson catalyst, Noyori asymmetric hydrogenation, metal based reductions using Li/Na/Ca in liquid ammonia, Sodium, Magnesium, Zinc, Titanium and Samarium (Birch, Pinacol formation, McMurry, Acyloin formation, dehalogenation and deoxygenations), Hydride transfer reagents from Group III and Group IV in reductions ($NaBH_4$ triacetoxyborohydride, L-selectride, K-selectride, Luche reduction, $LiAlH_4$, DIBAL-H, and Red-Al, Trialkylsilanes and Trialkylstannane, Meerwein-Ponndorf-Verley reduction), stereo/enantioselective reductions (Chiral Boranes, Corey-Bakshi-Shibata).

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the concepts involved in electrophilic substitution, nucleophilic substitution, elimination, organic oxidation and reduction reactions. (Remembering)
- CO2:** Explain how to apply the concept of mechanisms and different types of reactions in the synthetic organic chemistry research field. (Understanding)
- CO3:** Apply the knowledge of mechanisms and different types of reactions in the synthetic organic chemistry research field. (Applying)
- CO4:** Analyse different problems related to organic reaction mechanisms. (Analysing)
- CO5:** Prioritize the important features of basic organic reactions like electrophilic substitution reaction, nucleophilic substitution, elimination and oxidation-reduction reactions. (Evaluation)
- CO6:** Design reactions using their knowledge and understanding of reaction mechanisms of different types of reactions. (Creating)

Suggested Readings

1. Cary, F. A., Sundberg, R. I., Advanced Organic Chemistry, Part A and B, Springer.
2. Smith, M. B., Organic Synthesis, Academic Press.
3. Carruthers, W. and Coldham, I., Modern Methods of Organic Synthesis, South Asian Edition, Cambridge University Press.
4. Clayden, J., Greeves, N., Warren, S., Organic Chemistry, Oxford University Press.
5. Pine, S. H., Organic Chemistry (5th edn.), McGraw-Hill Book (1987).
6. March, J. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Wiley Student Edition, John Wiley & Sons Asia Pte. Ltd. (2005).
7. House, H. O. Modern Synthetic Reaction, (W. A. Benjamin Inc. 1972).

CHAP0009: ADVANCED PHYSICAL CHEMISTRY I**(4 Credits - 60 hours)**

Objective: This course is intended to give students a deep understanding of the kinetics and reaction dynamics of chemical reactions as well as an insight into the principles of electrochemistry

Module I Chemical Kinetics (15 hours)

Theories of unimolecular reactions: Lindemann theory, drawbacks of Lindemann theory-inshelwood modification, RRK theory, Slaters treatment, RRKM theory. Steady state approximation and its applications, oscillating reactions, chemical chaos, Belousov-Zhabotinski reaction, straight chain reactions - hydrogen-halogen reactions, alkane pyrolysis, Branching-chain reactions - the hydrogen- oxygen reaction, explosion limits, Enzyme catalyzed reactions, Michaelis-Menten mechanism-Lineweaver-Burk and Eadie plots, enzyme inhibitor.

Module II Study of Fast Reactions (5 hours)

Stopped flow technique, temperature and pressure jump methods, NMR studies in fast reactions, shock tube kinetics, relaxation kinetics, Linearized rate equation, relaxation time in single step fast reactions, determination of relaxation time.

Module III Molecular Reaction Dynamics (15 hours)

Collisions of real molecules- trajectory calculations, Laser techniques, reactions in molecular beam, reaction dynamics, estimation of activation energy and calculation of potential energy surface-the transition state theory (TST) of bimolecular gaseous reactions, statistical and thermodynamic formulations. Comparison between TST and hard sphere collision theory, theory of unimolecular reactions- Lindemann theory and its limitations, kinetics of reactions in solution-diffusion controlled and chemically controlled reactions, TST of reactions in solution- Bronsted and Bjerrum equation, effect of ionic strength, kinetic salt effect.

Module IV Electrochemistry - I (10 hours)

- a) Ion-solvent interaction- the Born model, Thermodynamic parameters of ion solvent interactions- structural treatment, the ion-dipole model-its modifications, ion-quadrupole and ion-induced dipole interactions.
- b) Primary solution- determination of hydration number, compressibility method and viscosity-mobility method, Debye-Huckel theory of ion-ion interactions, derivation, validity and limitations, extended Debye-Huckel-Onsager equation, random walk model of ionic diffusion-Einstein Smoluchowski reaction.

Module V Electrochemistry - II (15 hours)

- a) Theories of Electrical Interface: Electrocapillary phenomena - Lippmann equation, electron transfer at interfaces, polarizable, non polarizable and nonpolarisable interfaces, Butler-Volmer equation, Tafel plot

- b) Electro-analytical Techniques: Potential step methods, potential sweep methods, Polarography and Pulse voltammetry, controlled current techniques, techniques based on impedance.
- c) Systems for Electro-chemical Energy Storage and Conversion: Types of Batteries, Lead- acid batteries, Nickel-cadmium batteries and Li-ion batteries, electrical double layer capacitor, pseudo-capacitor, fuel cells.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall kinetics of different types of chemical reactions including unimolecular, bimolecular and chain reactions; theories of electrochemistry. (Remembering)
- CO2:** Explain the application of chemical kinetics to different systems, interactions of ionic species with solvent molecules, different electrochemical techniques, different types of batteries. (Understanding)
- CO3:** Apply the knowledge of chemical kinetics to some important types of reactions and to learn the use of different analytical techniques, and batteries. (Applying)
- CO4:** Analyse the application of reaction rate theories to different system and to analyse the application of electrochemistry in different fields. (Analysing)
- CO5:** Measure rate of different types chemical reactions, compare reaction rate theories, apply the electrochemical techniques to analyse samples, construct different types of batteries. (Evaluating)
- CO6:** Build a clear understanding of kinetics of chemical reaction and application of electrochemistry. (Creating)

Suggested Readings

1. Atkins, P. and Paula, J. Physical Chemistry, Oxford University Press, Oxford.
2. Levine, I. R., Physical chemistry, Mcgraw Hill Education.
3. Laidler, K. J., Chemical Kinetics, Pearson.
4. Bockris, J. O., Reddy, A. K. N., Modern Electrochemistry Part 1, 2A and 2B, Springer.
5. Bard, A. J., Faulkner, L. R., Electrochemical Methods Fundamentals and Applications, Wiley India.

CHFS0010: FUNDAMENTALS OF SPECTROSCOPY

(3 Credits-45 hours)

Objective: This course introduces students to the concepts of a range of spectroscopic techniques including rotational, vibrational, electronic, magnetic resonance and Mössbauer spectroscopies as well as to mass spectrometry.

Module I: Interaction of light with matter (5 hours)

Fundamental aspects of absorption and emission spectroscopy, probability of transition, oscillator strength, dipole strength, Spontaneous and stimulated emission, origin of selection rules

Module II: Rotational and Vibrational Spectroscopy (10 hours)

Degrees of freedom of molecules, rigid rotor model, rotational spectra of diatomics and polyatomics, effect of isotopic substitution and non rigidity, selection rules and intensity distribution, Vibrational spectra of diatomics, effect of anharmonicity, Morse potential, Vibrational-rotational spectra of diatomics, P,Q,R branches, normal modes of vibration, overtones, hot bands, Raman spectroscopy - Origin, rotational and vibrational Raman spectra of diatomics.

Module III: Electronic Spectroscopy (12 hours)

Electronic spectra of diatomic molecules, Frank-Condon principle, vibronic transitions, Spectra of organic compounds, $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transition, Photoelectron Spectroscopy - basic principle,

photoelectron spectra of simple molecules, X-ray photoelectron spectroscopy (ESCA), Auger electron spectroscopy, Lasers - Laser action, population inversion, properties of laser radiation, examples of simple laser systems.

Module IV: Magnetic Resonance Spectroscopy (10 hours)

- Nuclear Magnetic Resonance: Nuclear spin and nuclear spin states in magnetic field, resonance phenomenon, relaxation process, NMR line shapes and saturation, shielding and de-shielding of magnetic nuclei, chemical shift, spin-spin interactions, spectra of two-spin system (A_2 , AB and AX cases), ^{13}C , ^{19}F and ^{31}P NMR spectroscopy.
- Electron Spin Resonance: Basic principles, factors affecting g values, hyperfine coupling, spin densities and McConnell relationship, Zero field splitting

Module V: Mass spectrometry and Mössbauer spectroscopy (8 hours)

- Mass spectrometry: Basic principles, ionization techniques, isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation
- Mössbauer spectroscopy: Principles, instrumentation and applications

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the fundamental principles of the spectroscopic techniques they are taught and also state their applications in chemistry. (Remembering)
- CO2:** Explain the concepts of spectroscopic techniques and their applications. (Understanding)
- CO3:** Choose the best technique suited for determining a particular property of a molecule e.g. if the mass of an unknown compound is to be determined, they should know that mass spectrometry can be used. (Applying)
- CO4:** Distinguish between one spectroscopic technique and another and decide which would be appropriate for getting necessary information about a molecule. (Analysing)
- CO5:** Decide on which individual spectroscopic technique or range of techniques is applicable for obtaining information about a given molecule or molecules. (Evaluating)
- CO6:** Propose a series of experiments to characterize a molecule using a range of spectroscopic techniques. (Creating)

Suggested Readings

- Hollas, J. M., Modern Spectroscopy, Wiley
- Banwell, C. N., McCash, E. M. Fundamentals of Molecular Spectroscopy, Tata McGraw Hill.
- Pavia, D.L., Lampman, G. M., Kriz, G. S., Introduction to Spectroscopy, Brooks/Cole Cengage Learning.
- Drago, R.S., Physical Methods in Chemistry, Saunders, Thomson Learning
- Silverstein, R.M., Webster, F. X., Kiemle, D. J., Bryce, D. L., Spectrometric Identification of Organic Compounds, Wiley India
- Kemp, W., Organic Spectroscopy, Palgrave Macmillan.
- Field, L. D., Sternhell, S., Kalman, J. R., Organic Structures from Spectra, John Wiley and Sons.
- Rankin, D.W.H., Mitzel, N., Morrison, C. Structural Methods in Molecular Inorganic Chemistry, Wiley.

CHGC0011: INTRODUCTION TO GREEN AND ENVIRONMENTAL CHEMISTRY

(3 Credits - 45 hours)

Objective: The course is aimed at familiarizing students with the concepts and techniques of environmental chemistry and introduction to green chemistry.

Module I: Environmental pollution (15 hours)

Chemistry and environmental pollution: Chemical hazards, chemical disasters, Water pollution, air pollution and soil pollution; agricultural pollution, pollution by plastics; environmental biochemistry, toxicological chemistry, e-pollution and nuclear hazard. Environmental analysis: Analysis of water and wastewater, solid-wastes and air pollution.

Module II: Environmental protection (10 hours)

Environmental protection: pollution prevention, green chemistry, biodegradation, water and wastewater purification – removal of arsenic, iron, fluoride, etc.; air purification, waste minimization, industrial and municipal waste treatment and soil remediation

Module III: Principles and concepts of Green Chemistry (10 hours)

Green chemistry: Principles of green chemistry, development of green chemistry; atom economy reactions – rearrangement reactions, addition reactions; atom uneconomic reactions–sublimation, elimination; toxicity measures, need of green chemistry in day to day life.

Module IV: Emerging Green Technology and alternative energy sources (10 hours)

Design for energy efficiency, photochemical reactions – advantages, disadvantages; microwave technology in chemistry - microwave heating, microwave assisted reactions, ultrasound assisted reactions, reactions in organic liquids, reactions in aqueous media, electrochemical synthesis-examples. Supercritical solvents, ionic liquids, green catalyst, auto-exhaust catalyst and clean technology. Real world examples.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall basic concepts of environmental greenchemistry. (Remembering)
- CO2:** Explain principles of green chemistry, green solvent, energy efficiency, renewable source of energy, cause, prevention of all types of pollution. (Understanding)
- CO3:** Apply their knowledge of green chemistry and environmental chemistry in the applied research field. (Applying)
- CO4:** Analyse and solve the problems related to environment. (Analysing)
- CO5:** Justify the implementation of the green techniques for research and development in the future course of time. (Evaluating)
- CO6:** Elaborate the causes of environmental degradation and find solutions for its protection. (Creating)

Suggested Readings

1. Manahan, S. E., Environmental Chemistry, 9 th edn (CRC Press, Boca Raton, 2010).
2. Anastas, P. T. and Warner, J. C., Green Chemistry: Theory and Practice, (Oxford University Press, 1998).
3. Moore, J. W. & Moore, E. A., Environmental Chemistry, Academic Press, London (1976).
4. Lancaster, M., Green Chemistry: An Introductory Text, RSC.
5. Hutzinger, O., Handbook of Environmental Chemistry, Springer-Verlag, 1991.
6. Cann, M. C. & Connelly, M. E., Real World Cases in Green Chemistry, ACS, , 2000.

CHAI0012: ADVANCED INORGANIC CHEMISTRY II

(4 Credits - 60 hours)

Objectives: *The objective of this course is to teach students core concepts of analytical techniques used in inorganic analysis, the role of metal ions in the function of biological macromolecules, supramolecular chemistry and nanomaterials*

Module I: Special Analytical Techniques (25 hours)

- a) Principles and applications of Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDS/EDX), Transmission Electron Microscopy (TEM), Selected Area (Electron) Diffraction (SAED), Thermal methods of analysis – thermogravimetric analysis (TGA), Differential Thermal Analysis (DTA), Differential Thermogravimetry (DTG), Differential Scanning Calorimetry (DSC), Powder X-ray Diffraction, Single crystal X-ray diffraction
- b) Principles and applications of atomic absorption spectroscopy, atomic emission spectroscopy, Infrared and Raman Spectroscopy, Magnetic Resonance Spectroscopy- Electron Spin Resonance (ESR) of d^1 and d^9 transition metal ions in cubic and tetragonal ligand fields, applications of ^{31}P , ^{19}F , ^{119}Sn and ^{195}Pt nuclear magnetic resonance (NMR) spectroscopy

Module II: Bioinorganic Chemistry (15 hours)

Role of metal ions in biology and their toxic effects; Iron management in biological systems – siderophores, ferritin and transferrin; Dioxygen storage and transport – structure of myoglobin and haemoglobin, cooperativity of O_2 binding in haemoglobin, Bohr effect and Hill coefficients; Electron transfer proteins (structure and function) - Fe-S proteins, cytochromes and plastocyanines; Structure of nitrogenase and its role in di-nitrogen fixation; Structure and function of vitamin B_{12} and mechanism of 1,2-shift reaction; Inorganic therapeutics - chelate therapy, metal based drugs.

Module III: Introduction to Supramolecular Chemistry (5 hours)

Supramolecular chemistry: Definition, supramolecular host-guest compounds, macrocyclic effect, nature of supramolecular interactions.

Module IV: Introduction to Nanomaterials (5 hours)

Fabrication of nanomaterials – top-down and bottom-up approaches; solution-based synthesis of nanoparticles; other methods of nanomaterial synthesis – brief overview. Carbon fullerenes and nanotubes. Applications of nanoparticles.

Module V: Nuclear and Radiochemistry (10 hours)

Radioactive decay and equilibrium. Mass defect and binding energy, packing fraction, stability of nucleus, neutron-proton ratio, Artificial radioactivity. Nuclear reactions; Q value, cross sections, types of reactions, Chemical effects of nuclear transformations; fission and fusion, fission products and fission yields. Radioactive techniques; nuclear reactors, separation of isotopes; tracer technique, neutron activation analysis, counting techniques such as G.M. ionization and proportional counter. Application of radio-isotopes in agriculture, medicine and industry. Radiocarbon dating

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall concepts of analytical techniques used in inorganic analysis, the role of metal ions in the function of biological macromolecules and also the concepts of supramolecular chemistry, nanomaterials and nuclear chemistry. (Remembering)
- CO2:** Explain (i) principles and application of various analytical techniques, (ii) nuclear reactions, (iii) biological uses of different metal ions, and (iv) Uses of nano materials in practical field. (Understanding)
- CO3:** Apply the knowledge to proper use of various analytical techniques to characterize the chemical compounds which are synthesized in laboratories and industries. (Applying)
- CO4:** Analyse the different uses of biomolecules, nano materials, supramolecules and various analytical techniques. (Analysing)
- CO5:** Judge the need of different analytical techniques for characterization (Evaluating)
- CO6:** Test their analytical skills for characterization of chemical compounds. (Creating)

Suggested Readings

1. D. B. Murphy, M. W. Davidson, Fundamentals of Light Microscopy and Electronic Imaging, Wiley.
2. D. B. Williams, C. B. Carter, Transmission Electron Microscopy A Textbook for Materials Science, Springer.
3. D. L. Nelson, M. M. Cox, Lehninger Principles of Biochemistry (W. H. Freeman & Co.).
4. R. H. Abeles, P. A. Frey, W. P. Jencks, Biochemistry, Jones and Bartlett Publishers, Boston.
5. D. Voet, J. G. Voet, C. W. Pratt, Fundamentals of Biochemistry: Life at the Molecular Level.
6. I. Bertini, H. B. Gray, S. J. Lippard, J. S. Valentine, Bioinorganic Chemistry; Viva books Pvt. Ltd.
7. J. A. Cowan, Inorganic Biochemistry: An introduction, Wiley.
8. J. W. Steed and J. L. Atwood, Supramolecular chemistry John Wiley
9. J. M. Lehn Supramolecular Chemistry : Concepts and Perspectives Wiley-VCH
10. G. Zhong Cao. Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press (2004)
11. G. Friedlander, J.W. Kennedy, E. S. Macias, and J. M. Miller; Nuclear and Radiochemistry, John Wiley, New York.
12. G. R. Desiraju Ed. Perspectives in Supramolecular Chemistry and Molecular Recognition Wiley
13. M. Ratner & D. Ratner. Nanotechnology: A Gentle Introduction to the Next Big Idea, Pearson Education.

CHAO0013: ADVANCED ORGANIC CHEMISTRY-II

(4 Credits - 60 hours)

Objective: This course will discuss organic photochemistry, pericyclic reactions, heterocyclic chemistry and Synthetic Strategies towards the synthesis of organic molecules.

Module I: Organic Photochemistry (15 hours)

- a) Introduction to organic photochemical-photophysical processes, chemiluminescence, photosensitization.
- b) Photochemistry of carbonyl compounds - α -cleavage, β -cleavage, intramolecular H-abstraction, addition to π -systems- Paterno-Buchi reaction, electron transfer reactions, Photochemistry of olefins - photostereomutation of cis-trans isomers, optical pumping, cycloaddition, photochemistry of conjugated polyenes.
- c) Photochemistry of enones, photo-rearrangement reactions- di- π -methane rearrangement, Photo-rearrangement of cyclohexadienones, Barton rearrangement, singlet oxygen photochemistry.

Module II: Pericyclic Reactions (15 hours)

Main features of pericyclic reactions; Woodward-Hoffman rules, correlation diagram and FMO approaches; Electrocyclic reactions – conrotatory and disrotatory motions for $4n$ and $4n+2$ systems;. Cycloadditions – antarafacial and suprafacial additions, $[2+2]$ and $[4+2]$ reactions (hv and Δ), 1,3-dipolar cycloadditions and chelotropic reactions; Sigmatropic $[i,j]$ shifts of C-H and C-C bonds; Sommelet-Hauser, Claisen, thio-Claisen, Cope and aza-Cope rearrangements.

Module III: Introduction to Heterocyclic chemistry (15 hours)

Nomenclature of heterocyclic compounds. Structure, reactivity, synthesis and reactions Pyridine, quinoline, Isoquinoline, Indole, Benzofuran, Benzothiophene, pyrazole, Imidazole, oxazole, Isoxazole, Thiazole, Isothiazole, pyridazine, pyrimidine and pyrazine.

Module IV: Synthetic Strategies (15 hours)

Synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, importance of order of events in organic synthesis, one group and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis.

One group C-C disconnections – alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.

Two group C-C disconnections – Diels-Alder reaction, 1,3-difunctionalised compounds, α , β -unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annelation. Principle of protection of alcohol, amine, carbonyl and carboxyl groups; Common protecting groups.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles of organic photochemistry, pericyclic reactions, heterocyclic chemistry and Synthetic Strategies towards the synthesis of organic molecules. (Remembering)
- CO2:** Explain FMO approach, suprafacialantarafacial, conrotatory-disrotatory motion, Woodward Hoffmann rules, Electrocyclic reactions, Cycloaddition reactions, Sigmatropic rearrangement reactions, Chelotropic reaction, Ene reaction and Correlation diagrams of different types of reactions. (Understanding)
- CO3:** Apply their knowledge of pericyclic reactions, photochemistry, heterocyclic and retrosynthesis in research and industrial field. (Applying)
- CO4:** Analyse problems related to pericyclic reactions, photochemistry, heterocyclic compounds and synthetic strategy. (Analysing)
- CO5:** Select different theories in pericyclic reaction and photochemistry in order to check feasibility of chemical reaction. (Evaluating)
- CO6:** Have a clear understanding of heterocyclic compounds and would be able to provide analytical solution towards their synthesis. (Creating)

Suggested Readings

1. J. Clayden, N. Greeves, S. Warren; Organic Chemistry, Oxford University Press.
2. Norman, R. O. C., Coxon, J. M. Principles of Organic Synthesis, (Blackie Academic and Professional, 1993).
3. M. Harmata. Strategies and Tactics in Organic Synthesis 4 & 5, Academic Press (2004).
4. L. A. Paquette, Modern Heterocyclic Chemistry, John Wiley, (2007)

CHAP0014: ADVANCED PHYSICAL CHEMISTRY II**(4 Credits - 60 hours)**

Objective: This objective of this course to make the students familiar with solid state chemistry, surface chemistry and catalysis.

Module I: Solid state (18 hours)

Structures of solids - crystal planes and Miller indices, Bragg's law and applications, Debye-Scherrer powder method, nanoparticles and nanotechnology, defects in solids, thermodynamics of Schottky and Frenkel defect formation, thin films, Langmuir-Blodgett film. Electrical properties of solids, intrinsic and extrinsic semiconductors, doping of semiconductors, p-n junction, super conductors, conducting polymers, organic conductors, molecular electronic devices, nonlinear optical materials, optical reflectance, photoconduction, ionic conductors, Meissner effect, BCS theory.

Module II: Surface Chemistry (22 hours)

- a) Electrical aspects of surface chemistry, Electro kinetic phenomena, the structure of electrical double layer, Zeta potential and colloidal stability, Measurement of zeta potential. Surfactants – definition and classification, micelle formation and determination of critical micelle concentration. Reverse micelle and its application, solubilization, microemulsion.
- b) Adsorption of gases on solid surfaces – Langmuir’s theory and its limitations. Derivation of BET equation – determination of surface area of an adsorbent, thermodynamics of adsorption processes. Capillary condensation – adsorption in micro pores, Kinetics of heterogeneous catalysis – Langmuir-Hinselwood model and Eley-Riedel mechanism.

Module III: Catalysis and Photochemistry (20 hours)

- a) Catalysts, classification of catalysts. Characterization of catalysts: Methods of surface analysis, surface area, pore size, void fraction, particle size, mechanical strength, surface chemical composition, surface acidity and reactivity, rates of homogeneously catalysed reactions, turnover number and frequency.
- b) Photochemistry – kinetics of photophysical and photochemical processes, complex photochemical processes

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the basic structure and properties of solids, different surface processes and types catalyst and catalytic processes. (Remembering)
- CO2:** Explain the electrical properties in terms of semiconductor, superconductor etc., classification of different surfactants, process of adsorption gases on solid surfaces, types and characterization of catalyst. (Understanding)
- CO3:** Apply the knowledge solid chemistry to understand about different types of conducting materials, interpret the results of adsorption processes in terms of known isotherms, interpret the electro kinetic phenomena of surfaces, explain the mechanism of different types of catalytic processes. (Applying)
- CO4:** Analyse the application of solid state chemistry in terms of electrical, magnetic and optical properties, classification of surfactants, process of surface adsorption and types catalysed reaction in terms of homogeneous and heterogeneous catalysis. (Analysing)
- CO5:** Assess the properties of solids to interpret the conducting behaviour of different types of materials, derive different adsorption isotherms, and interpret the different catalytic processes. (Evaluating)
- CO6:** Build a clear understanding of solid state chemistry, electro kinetic phenomena, colloids, surfactants, different types of adsorption isotherms, different types of catalyst and catalytic process. (Creating)

Suggested Readings

1. A. R. West. Solid State Chemistry and its Applications, John Wiley.
2. D.K. Chakrabarty. Solid State Chemistry, New Age Publishers.
3. New Directions in Solid State Chemistry- C N R Rao and J Gopalakrishnan
4. Catalytic Chemistry, B. C. Gates, John Wiley & Sons.
5. Fundamentals of Industrial Catalytic Processes C.H. Bartholomew, R. J. Furrauto, Wiley Interscience.
6. M. J. Rosen. Surfactants and Interfacial Phenomena, John Wiley.
7. Atkins, J. Paula; Physical Chemistry, Oxford University Press.

CHSP0015: SPECIAL TOPICS IN BIOCHEMISTRY**(3 Credits - 45 hours)**

Objective: *The aim of this paper is to introduce properties of biomolecules, their roles in health and disease and chemical and biochemical methods of synthesizing them.*

Module I: Carbohydrates (9 hours)

Characteristics and properties of carbohydrates – nomenclature and stereochemistry of monosaccharides, typical carbohydrates, sweetening agents; chemistry of monosaccharides – cyclic structures, Haworth and conformational representations, oxidation, determination of ring size, structure of correlations, synthesis, glycosides; Oligosaccharides and Polysaccharides - sucrose and other oligosaccharides, starch, cellulose and other polysaccharides

Module II: Lipids (9 hours)

- Glycerol derivatives- fats and oils, fatty acid biosynthesis, phospholipids, glycolipids, properties of lipid aggregates, micelles, bilayers, liposomes and biological membranes
- Steroids – structural characteristics, synthesis and biosynthesis, steroid hormones; prostaglandins – structural characteristics, synthesis and biosynthesis;
- Pheromones – structure and origin, synthesis

Module III: Nucleosides, Nucleotides and Nucleic acids (9 hours)

- Nucleosides and Nucleotides: The structure of nucleosides, chemistry of nucleosides, nucleotides; sunlight, carbohydrates and energy – photosynthesis, glycolysis and metabolic energy;
- Nucleic acids: Structure and function of DNA, RNA (m-RNA, t-RNA, r-RNA), an overview of gene expression (replication, transcription and translation), genetic code (origin, Wobble hypothesis and other features), genetic errors, carcinogenesis and recombinant DNA technology.

Module IV: Amino acids, Peptides and Proteins (9 hours)

- Amino Acids – structural characteristics, acid-base properties, synthesis;
- Peptides – amino acid analysis, terminal group analysis, the amino acid sequence, synthesis;
- Proteins, enzymes and biosynthesis – the alpha-helix, other secondary and tertiary structural characteristics, enzymes; protein synthesis;

Module V: Vitamins (9 hours)

Vitamins: Classification; occurrence; chemistry of Vitamins – structure elucidation and synthesis; biochemical functions; deficiency syndromes.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the physical, chemical and biochemical properties, biochemical and chemical methods of synthesis and functions of important biological molecules such as amino acids, proteins, carbohydrates, nucleosides, nucleotides, nucleic acids, vitamins and lipids. (Remembering)
- CO2:** Explain the properties and reactions by which biomolecules are synthesized and the reactions in which they are involved. (Understanding)
- CO3:** Distinguish between different biological molecules based on their properties and their functions. (Analysing)
- CO4:** Examine the connection of the physical, chemical and biochemical properties of biological molecules with their functions. (Analysing)

- CO5:** Assess the behaviour of biological molecules based on their properties and reactivities. (Evaluating)
- CO6:** Design theoretically the reactions of biomolecules under different conditions, estimate properties of molecules given their structure and composition, deduce their location and function in a living cell based on their properties. (Creating)

Suggested Readings

1. S. H. Pine, J. B. Hendrickson, D. J. Cram, G. S. Hammond Organic Chemistry McGraw Hill
2. J. Clayden, N. Greeves, S. Warren, P. Wothers, Organic Chemistry, Oxford University Press
3. J. M. Berg, J. L. Tymoczko, G. J. Gatto, L. Stryer Biochemistry W. H. Freeman & Co
4. D. Voet and J. G. Voet Biochemistry John Wiley and SonsBerg
5. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, W. H. Freeman & Co.

CHAS0016:APPLIED SPECTROSCOPY

(2 Credits - 30 hours)

Objective: This course will discuss the application of various spectroscopic methods like IR, NMR, Mass spectrometry.

Module I (15 hours)

- a) Infrared Spectroscopy: Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines; Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acid anhydrides, lactones, lactams, conjugated carbonyl compounds); Effects of H-bonding and solvent effect on vibrational frequency, extension to various organic molecules for structural assignment.
- b) Mass Spectrometry: Mass spectral fragmentation of organic compounds, common functional groups; molecular peak, McLafferty rearrangements, examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Module II(15 hours)

- a) Nuclear Magnetic Resonance Spectroscopy: Approximate chemical shift values of various chemically non-equivalent protons and correlation to protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic); Protons bonded to other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides, SH); Chemical exchange, effect of deuteration; complex spin-spin interaction between two, three, four and interacting nuclei (first order spectra); Complex interaction, virtual coupling, stereochemically hindered rotation, Karplus curve, variation of coupling constant with dihedral angle, nuclear magnetic double resonance, simplification of complex spectra using shift reagents, Fourier transform technique and nuclear Overhauser effect (NOE).
- b) C-13 NMR Spectroscopy: Chemical shift (aliphatic, olefinic, alkynes, aromatic, hetero-aromatic, carbonyl carbon); Coupling constants, two-dimensional NMR spectroscopy, NOESY, DEPT and INEPT terminologies.
- c) Applications of IR, NMR and Mass spectroscopy for structure elucidation of organic compounds.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall rules associated with the following spectroscopic and spectrometric techniques respectively: FT-IR, ¹H NMR, ¹³C-NMR, Mass spectrometry. (Remembering)
- CO2:** Explain the concepts of each technique and the types of molecules that can be studied with each technique and the conclusions to draw from the analyses. (Understanding)

- CO3:** Apply their knowledge of different spectroscopic techniques in structure interpretation of unknown compounds. (Applying)
- CO4:** Analyse problems related to FT-IR, ¹H NMR, ¹³C-NMR, Mass spectrometry. (Analysing)
- CO5:** Decide the set of steps necessary to elucidate the undefined molecular structure of various compounds. (Evaluating)
- CO6:** Propose the unknown compounds for their suitable analytical and industrial use. (Creating)

Suggested Readings

1. R. M. Silverstein, G. C. Basseler & T. C. Morill. Spectroscopic Identification of Organic Compounds, John Wiley (1981).
2. W. Kemp. Organic Spectroscopy (3rd edn.), McMillan Press Ltd. (1991).
3. D Williams & I. Fleming. Spectroscopic Methods in Organic Chemistry, McGraw Hill (1989).
4. C. N. Banwell & E. M. McCash. Fundamentals of Molecular Spectroscopy, Tata McGraw-Hill, New Delhi (2006).
5. D.L. Pavia, G. M. Lampman, G. S. Kriz Introduction to Spectroscopy, Harcourt College Publisher (2001) NY.

CHRM0017: RESEARCH METHODOLOGY FOR CHEMISTRY

(3 Credits - 45 hours)

Objectives: To expose students to the methods of doing research, make them aware of safe procedures for handling chemicals, to train them to assimilate ideas from scientific articles through critical reading and to enable them to identify their topics for their fourth semester research projects. Mode of Assessment: Modules I-III will be assessed based on a written examination (2 credits) while Module IV will be assessed on the basis of a seminar (1-credit).

Module I: Literature Survey, Methods of Scientific Research and Writing Scientific Papers

(10 hours)

Print resources, digital resources, information technology and library resources, reporting practical and project work, writing literature surveys and reviews, organizing a poster display, giving an oral presentation, writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publication of scientific work; writing ethics – avoiding plagiarism

Module II Chemical Safety and ethical handling of chemicals (7 hours)

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals, overview of chemical regulations in India

Module III: Data Analysis (13 hours)

The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments.

Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests.

Chemometrics, Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse. Basic aspects of multiple linear regression analysis.

Module IV: Project Proposal Writing (15 hours) (Seminar Module)

In this module, students will be reviewing scientific articles, writing reports on the papers they have read and finally prepare a research proposal.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Identify resources for research literature, learn how to work safely with chemicals, learn some principles of data analysis. (Applying)
- CO2:** Utilize print and digital resources, develop awareness on safety protocols they need to follow while using chemicals, laws governing the use and disposal of chemicals that are harmful to humans and the environment; explain the methods of data analysis they are taught and understand underlying ideas on research topics they choose. (Applying)
- CO3:** Apply their knowledge of print and digital resources to identify sources for research articles of interest to them; handle chemicals safely in the lab, dispose of chemicals the proper way, analyse data. (Applying)
- CO4:** Discover loopholes and drawbacks of methods they come across in articles and flaws in logic in the articles they read. (Analysing)
- CO5:** Examine scientific articles that are of relevance to them, select appropriate methods to analyse data, find out the flow of ideas and logic in papers they read. (Evaluating)
- CO6:** Develop a report based on the review of literature, analysis of data; have a good estimate of where research on a topic of interest stands, and come up with a workable research proposal. (Creating)

Suggested Readings

1. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011) Practical skills in chemistry. 2nd Ed. Prentice-Hall, Harlow.
2. Hibbert, D. B. & Gooding, J. J. (2006) Data analysis for chemistry. Oxford University Press.
3. Topping, J. (1984) Errors of observation and their treatment. Fourth Ed., Chapman Hall, London.
4. Harris, D. C. Quantitative chemical analysis. 6th Ed., Freeman (2007) Chapters 3-5.
5. Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis. Cambridge Univ. Press (2001) 487 pages.
6. Chemical safety matters – IUPAC – IPCS, Cambridge University Press, 1992.
7. OSU safety manual 1.01.

CHCM0018: MATERIALS CHEMISTRY

(3 Credits - 45 hours)

Objective: *This course aims to provide an understanding of how molecular structure affects the properties of materials and to predict and control material properties through an understanding of atomic, molecular, crystalline, and microscopic structures of engineering materials.*

Module I: Solid state ionic conductors (11 hours)

Structure, physico-chemical principles, applications of Ferrous alloys, Fe-C phase transformations in ferrous alloys, non-ferrous alloys, properties and applications of ferrous and non-ferrous alloys, magnetic alloy, metallic glass, ceramics, nano-materials and optical materials.

Module II: Polymeric materials and inorganic Polymers (12 hours)

- a) Molecular shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their applications, conducting and ferro-electric properties.
- b) Polysiloxanes, polysilanes, polyphosphazenes, polymeric sulphur - synthesis, structure, properties and applications, co-ordination polymers and organometallic polymers.

Module III: Liquid crystals and high Tc materials (12 hours)

Nematic, smectic, cholesteric - properties and applications, high Tc materials, defect perovskites, high Tc superconductivity in cuprates, 1-2-3 and 2-1-4 materials, anisotropy, temperature dependence of electrical resistance, optical phonon modes, superconducting state, heat capacity, coherence length, elastic constants, position lifetimes, micro-wave absorption pairing and multi gap structure in high Tc materials, applications of high Tc materials.

Module IV: Organic solids and molecular devices (10 hours)

- a) Conducting organics, organic superconductors, magnetism in organic materials, fullerenes, doped fullerenes as superconductors.
- b) Molecular rectifiers and transistors, artificial photosynthetic devices, sensors, clay -polymer and carbon composites, phosphor and laser materials.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the knowledge of basic structure of materials like ionic solids, high Tc material, inorganic polymer, liquid crystals etc. (Remembering)
- CO2:** Explain how molecular structure affects the properties of materials. (Understanding)
- CO3:** Explain the properties of different materials on the basis of their structures. (Understanding)
- CO4:** Analyse the application of different types of materials in different field. (Analysing)
- CO5:** Assess and control material properties through an understanding of atomic, molecular, crystalline, and microscopic structures of engineering materials. (Evaluating)
- CO6:** Build a clear understanding of the structure and properties of different types of engineering materials useful in day to day life. (Creating)

Suggested Readings

1. Keer, H.V. Principles of the Solid State, Wiley Eastern
2. Callister, W.D. Material Science and Engineering- An Introduction, Wiley, New York
3. Lever, K.D.; Alexander, J.M.; Rawlings, R.D. Materials Science, J.C. Sanderson, ELBS
4. Marck, J.E.; Allcock, H.R.; West, R. Inorganic Polymers, Prentice Hall
5. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders College.
6. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.
7. Handbook on Liquid Crystals, Kelker and Hatz, Chemie Verlag.

CHCC0019: COMPUTATIONAL CHEMISTRY**(3 Credits - 45 hours)**

Objective: To introduce computational methods to students to enable them to write simple programs, perform chemical calculations, simulate the dynamics of molecules and reactions as well as for them to learn how to identify and use databases relevant to chemists

Module I: Programming and some numerical methods in chemistry (15 hours)

Introduction to Linux/UNIX and shell scripts; programming in C /python; Least squares fit; root finding; numerical differentiation; integration and solution of ODE; matrix multiplication, inversion and diagonalization; interpolation; pattern recognition techniques and molecular graphics

Module II: Molecular Mechanics (MM) Methods (10 hours)

Basic geometrical description of molecules; force field energy, force field parameterization, differences between force fields, computational considerations, validation of force fields, advantages and limitations of force field methods, transition structure modelling, hybrid force field – electronic structure methods

Module III: Electronic structure (or Quantum Mechanical, QM) Methods

Many electron systems, Hartree-Fock method, basis sets, electron correlation and its treatment, basics of density functional theory, DFT based reactivity descriptors. Introduction to popular softwares (like Gaussian, DMol, GAMESS). Applications to simple molecular systems. Monte Carlo and molecular dynamics simulations

Module IV: Combined QM/MM methods (15 hours)

Implications of the choice of QM and MM methods; Application of QM/MM methods in organic, inorganic and organometallic systems including bio-organic and bio-inorganic molecules. Quantitative structure activity relation (QSAR): Early approaches, topological indices, fragmental models; quantum mechanical descriptors

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the basics of the programming language they are taught and to perform chemical calculations and simulations; they will learn about the similarities and differences between theoretical methods such as HF (Hartree-Fock), DFT (Density Functional Theory) and force field methods. (Remembering)
- CO2:** Explain the principles involved in the different theoretical methods used for simulations. (Understanding)
- CO3:** Apply QM or MM methods to simulate or model chemically related problems. (Applying)
- CO4:** Analyse the advantages and disadvantages of the various methods they learn for simulations/modeling. (Analysing)
- CO5:** Assess the calculated properties of a chosen system (a molecule) after using a method for calculating its electronic properties. (Evaluating)
- CO6:** Develop the ability to choose suitable methods for calculating electronic properties of simple molecules and crystals. (Creating)

Suggested Readings

1. Hinchcliffe, A. Modelling Molecular Structure, John Wiley and Sons
2. Holtje, H. D., Sippl, W., Rognan, D and Folkers, G. Molecular Modeling Basic Principles and Applications, Wiley-VCH
3. Leach, A. R. Molecular Modeling: Principles and Applications, Pearson Education
4. Jensen, F. Introduction to computational chemistry, John Wiley and Sons Press
5. W. H., Tenkolsky, S. A., Vetterling, W. T., and Flannery, B. P. Numerical Recipes in Fortran/C, Cambridge University Press
6. Dawson, M. Python programming for the absolute beginner, Course Technology, CENGAGE learning
7. Vine, M. C programing for the absolute beginner, Thomson Course Technology

CHFC0020: FOOD CHEMISTRY**(3 Credits - 45 hours)**

Objective: This course is aimed at familiarizing students with the importance of food and nutrition, deficiency diseases, its prevention and food additives/preservatives.

Module I: Basic idea of food and nutrients (2 hours)

Relationship between food, nutrition and health; functions of food: physiological and social.

Module II: Major nutritional constituents (12 hours)

Functions, sources, deficiency/excess diseases of the following major nutrients: (a) Carbohydrates; (b) Amino acids and proteins; (c) Lipids, sterols, metabolite; (d) Mineral; (e) Vitamins: A, D, E, K

Module III: Different categories of food (7 hours)

Selection, nutritional contribution and changes during Cooking/Ripening/storage of the following categories of food: (a) Cereals; (b) Pulses; (c) Fruits and vegetables; (d) Milk and milk products; (e) Egg, meat, poultry and fish; (f) Fats and oils.

Module IV: Nutritional needs during life cycle (6 hours)

Body composition, Influence of Nutrition, Physical Activity, Growth and Aging; Maternal Nutrition, Nutritional Requirement during Infancy, Childhood; Diet, Nutrition and Adolescence; Nutrition in the Elderly.

Module V: Prevention and management of deficiencies (6 hours)

Causes, symptoms, treatments and preventions of the following:

Protein-Energy malnutrition among children; Vitamin A deficiency; Iron deficiency; Fluorosis: Over nutrition, obesity, coronary heart diseases, Diabetes (Type I & II); Diet, Nutrition and cancer.

Module VI: Dietary goals & guidelines (10 hours)

National Perspectives; nutritional perspectives of vegetarian diets; Social Health Issues – Smoking, Alcoholism, Drug Addiction, AIDS and AIDS Control Programs; Food Preservation & Food Additives & Colorants.

Module VII: Entrepreneurship Development (2 hours)

Scope of Food based items for Entrepreneur Development in North East India & Identification of Resources; Development of a Project Plan.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Find the importance of food and nutrition, deficiency diseases, its prevention and food additives. (Remembering)
- CO2:** Explain the relationship between food, nutrition & health. (Understanding)
- CO3:** Apply their knowledge of food chemistry into personal life and food research field for societal development. (Applying)
- CO4:** Analyse and solve different problems related to food. (Analysing)
- CO5:** Explain/compare food as major dietary constituents, naturally occurring food, their energy/nutritional values. (Evaluating)
- CO6:** Discuss the causes of food borne illness and other food related diseases and be able to find a solution for its cure & prevention. (Creating)

Suggested Readings

1. S. R. Mudambi, M. V. Rajagopal, Fundamentals of Foods, Nutrition and Diet Therapy, 5th Ed, New Age International.
2. B.Srilakshmi, Nutrition Science, New Age International.
3. Handbook of Food and Nutrition, 5th Edition, BAPPCO.
4. G. M. Wardlaw, J. S. Hanpl, Perspectives of Nutrition, McGraw Hill
5. S. Sari, A. Malhotra, Food Science, Nutrition and Food Safety, Pearson India Ltd
6. C. Gopalan, B. V. Rama Sastri, S. C. Balasubramanian, Nutritive Value of Indian Foods, NIN, ICMR,
7. M. S. Bamji et al., Textbook of Human Nutrition, Oxford & IBH Pub Co Pvt Ltd

CHIC0021: INDUSTRIAL CHEMISTRY

(3 Credits - 45 hours)

Objective: This course in Industrial Chemistry is designed to provide graduates with basic understanding of chemistry in the following sectors: Rubber, synthetic fibres, fertilizers and pesticides, Sugar, Tea and paints.

Module I: Elastomers (7.5 hours)

Rubbers: origin, importance, types of rubber, natural rubber, gutta percha, guayle rubber, balata. Refining of crude rubber, drawbacks of natural rubber, vulcanization, technique of vulcanization. Synthetic rubber, poly butadiene, buna –S or SBR rubber, neoprene, nitrile rubber, butyl rubber, silicone rubber, & poly urethane.

Module II: Synthetic Fibres (5 hours)

Introduction, natural and artificial fibres characteristics and limitations. Study of following synthetic fibres :- Rayon (nitro cellulose) cupra ammonium rayon, acetate rayon, nylon 66, nylon-6, terylene (Dacron) Teflon & Saran.

Module III: Fertilisers and Pesticides (10 hours)

- a) Fertilizers: Plants nutrients, need for fertilizers, qualities of fertilizers, NPK ratio, classification of fertilizers, straight and mixed fertilizers. Nitrogenous fertilizers, manufacture of ammonium nitrate, urea, ammonium sulphate, phosphate fertilizers manufacture of triple phosphate and super phosphate, potassium fertilizers.
- b) Pesticides: Introduction, classification, Study of the following types: - Organo chlorine pesticides like DDT, BHC and Aldrin. Organo phosphorous pesticides, malathion & parathion. Rodenticides, fungicides, herbicides, fumigants and repellants (one example each).

Module IV: Sugar and Fermentation Industries (10 hours)

- a) SUGAR: Importance of sugar industry, manufacture of raw and refined sugar with flow sheet, estimation of sugar (physical and chemical methods)
- b) FERMENTATION: Definition of fermentation, importance of various fermentation industries, basic requirements for fermentation, steps in fermentation process. Manufacture of alcohol from molasses, distillation, coffey still, preparation of absolute alcohol, various useful fractions and their uses, proof sprit, denatured spirit.

Module V: Tea Industry (7.5 hours)

Chemical composition - an overview, Polyphenols in tea- Mechanism of theaflavin formation, biochemistry of tea - Biosynthesis of caffeine, Cinnamate, flavonoids, Chemical properties of tea- Polyphenols as Antioxidants.

Module VI: Paints (5 hours)

Introduction, classification of paints, constituents of paints in brief. Manufacture of paints, qualities of good paint, emulsion paints, paint removers, varnishes enamels, lacquers, thinners in brief.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Illustrate information/knowledge about a range of different chemical industries. (Understanding)
- CO2:** Explain the chemical processes involved in industries in the field of Synthetic fibre, Sugar, fertilizer, paint, Tea etc. (Understanding)
- CO3:** Apply their chemical knowledge in industries. (Applying)
- CO4:** Compare and analyse different chemical reactions and procedures followed in different chemical industries. (Analysing)
- CO5:** Evaluate the challenges existing in industries and suggest ways to overcome them. (Evaluating)
- CO6:** Develop and design different molecules or procedures for developing them as required in different industries by applying the properties of molecules and procedures as learnt during the course. (Creating)

Suggested Readings

1. Sharma, B. K. Industrial Chemistry, Goel Publishing House Meerut, India.
2. Austin, G. T. Shreeve's Chemical Process Industries, Mc Graw Hill
3. Finar, I. L. Organic Chemistry Vol I.
4. Finar, I. L. Organic Chemistry Vol II.

CHMD0022: MEDICINAL CHEMISTRY**(3 Credits - 45 hours)**

Objective: Students will be introduced to various types of drugs and medicines, their chemistry, modes of action and theoretical aspects of drug design

Module I: Introduction and History of Drug Development (5 hours)

Definition of drug and prodrugs; need of drugs; germ theory of diseases; history of sulpha drugs and their mode of action; antibacterial agents

Module II: Mechanisms and Theoretical aspects of drug action, drug discovery, design and delivery (10 hours)

Receptors – two-state model of receptor theory, drug-receptor interaction and Clark's Occupancy Theory; physiological response; drug agonist and antagonist – classification; Need of quantification of drug action; definition of chemotherapeutic index and therapeutic index; factors affecting bioactivity of drugs; pharmacokinetics and pharmacodynamics; QSAR; Lead compounds in drug discovery; importance of SAR and molecular modification; importance of combinatorial library and molecular modelling in drug discovery; drug delivery – controlled drug delivery methods

Module III: Antibiotics, Antivirals and Antimalarials (15 hours)

- a) General introduction to antibiotics – their sources and classification; causes and concerns of bacterial resistance to antibiotics; definition and need of broad Spectrum Antibiotics.
- b) Mechanism of action of lactam antibiotics, non-lactam antibiotics and quinilones;
- c) Antivirals – difficulty in developing clinical solutions to viral diseases, introduction to antiviral agents, AIDS –its cause and prevention;

- d) Antimalarials – classification of human malaria and plasmodia responsible for human malaria; discovery of quinine and its structure-activity-relationship (SAR), importance of quinine as a lead to the discovery of low cost antimalarials, artemisinin and its derivatives – their SAR and importance in dealing with chloroquine resistant malaria, mode of action

Module IV: Neurotransmitters (5 hours)

Classes of neurotransmitters, drugs affecting cholinergic and adrenergic pathways

Module V: Miscellaneous topics (10 hours)

Antihistamines, anti-inflammatory drugs, antianalgesics, anticancer and antihypertensive drugs, gene therapy, anti-sense and anti-gene strategies and drug resistance

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the properties of different types of drugs, drug-receptor interactions, drug-enzyme interactions, the mechanisms involved; topics related to drug discovery, drug design, structure activity relationships, molecular modeling of drugs, methods of drug delivery. (Remembering)
- CO2:** Explain different aspects of drug-target interactions-specific and non-specific interactions, drug discovery, molecular modeling of drugs. (Understanding)
- CO3:** Compare the effectiveness of different drugs for a particular target, how a newly discovered or synthesized molecule is compared against an existing library of drugs and tested for its specificity against a target. (Analysing)
- CO4:** Inspect reasons for differences in interaction of a drug with a range of targets or of a range of drugs with a target, or why certain targets inside a physiological system are hard to reach e. g., most drugs cannot cross the blood-brain-barrier, how to theoretically circumvent these difficulties. (Analysing)
- CO5:** Compare and critically Analyse drug-target interactions through designing drugs, SAR and molecular modeling of drugs. (Evaluating)
- CO6:** Develop molecules (drugs) for optimal interactions with selected targets. (Creating)

Suggested Readings

1. Thomas, G. Medicinal Chemistry: An Introduction, John Wiley & Sons
2. Patrick, G. L. An Introduction to Medicinal Chemistry, Oxford University Press
3. Gringauz, A. Introduction to Medicinal Chemistry, Wiley India Pvt Ltd.
4. Sriram, D., Yogeewari, P. Medicinal Chemistry, Pearson Education (Dorling Kindersley India)

CHRC0023: RECENT ADVANCES IN CATALYSIS

(3 Credits - 45 hours)

Objective: To make the students understand structure, properties of different heterogeneous catalyst and mechanism of catalytic reactions for the design of processes involving catalytic reaction

Module I: Kinetics of heterogeneous catalysis (10 hours)

Adsorption and catalysis, mechanism of heterogeneous catalysis, kinetics of heterogeneous catalytic reactions, volcano principle, shape and size selectivity of catalysts, characterization of catalysts and their surfaces, methods of surface analysis, surface area, pore size, void fraction, particle size, mechanical strength, surface chemical composition, surface acidity and reactivity.

Module II: Preparation and characterization of industrial catalysts (8 hours)

Catalyst design methods, catalyst support and preparation of industrial catalyst, supported and unsupported metal catalysts, bimetallic catalysts, Electron microscopy, XPS and PES, ESCA, IR and magnetic resonance spectroscopy, temperature programmed desorption (TDP), and DTA and TGA.

Module III: Zeolite and clays (15 hours)

- a) Synthesis of some selected important zeolites, modification of zeolites, ion exchange, metals supported on zeolites, dealumination and desilication of zeolites, shape selective catalysis in zeolites.
- b) Properties of pillared clays, use of coordination and organometallic compounds as pillaring, pillaring of acid activated clays, mesoporous materials, ordered mesoporous materials, synthesis of silica molecular sieve materials, characterization of mesoporous molecular sieves, catalytic properties of mesoporous materials, catalytic applications of zeolite, clays and mesoporous materials.

Module IV: Catalysis in petroleum industry and environmental catalysts (12 hours)

Design of catalytic reactors, promotion and promoters, catalytic processes in petroleum industry, reforming, cracking and hydrotreating, hydrogenation, hydrodesulphurization, Fischer-Tropsch process, Catalytic deactivation and reactivation, control of pollution from automobile exhaust, catalytic converters, abatement of nitrogen oxides and odours, cleaning of industrial effluents.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall concepts of structure and properties of different heterogeneous catalysts. (Remembering)
- CO2:** Explain structure, properties of different heterogeneous catalyst, mechanism of catalytic reactions, preparation and characterization of different types of catalyst. (Understanding)
- CO3:** Make use of catalyst preparation and design methods to apply them in different fields like petroleum industry and for environmental remediation. (Applying)
- CO4:** Analyze the criteria for the use of different catalyst in different application. (Analysing)
- CO5:** Utilize their knowledge to prepare and characterize properties of different types of heterogeneous catalyst. (Evaluating)
- CO6:** Develop a clear understanding of recent advances of heterogeneous catalyst in terms of structure, properties, their characterization process and application in different field. (Creating)

Suggested Readings

1. Bartholomew, C. H., Furrauto, R. J. Fundamentals of Industrial Catalytic Processes, Wiley Interscience
2. Chakrabarty, D. K., Viswanathan, B. Heterogeneous Catalysis, New Age Int.
3. Gates, B. C. Catalytic Chemistry, John Wiley & Sons
4. Augustine, R.L. Heterogeneous Catalysts for Synthetic Chemists, Marcel-Dekker
5. J. Weitkamp and L. Puppe, Catalysis and zeolites – fundamentals and applications, Springer-Verlag
6. G. Ertl, H. Knozinger, J. Weitkamp, Handbook of Heterogeneous Catalysis, Vol 4 and 5, Wiley-VCH

CHBC0024: BIOPHYSICAL CHEMISTRY**(3 Credits - 45 hours)**

Objectives: To teach the applications of physical chemistry methods for elucidation of the structure and properties of biological molecules

Module I: Fundamentals of biological macromolecules (5 hours)

Chemical bonds in biological systems; properties of water; thermodynamic principles in biological systems; properties and classification of amino acids; protein structure and function; properties of nucleosides and nucleotides; composition of nucleic acids; structure of nucleic acids

Module II: Molecular modelling and conformational analysis (10 hours)

Complexities in modelling macromolecular structure; polypeptide chain geometries and internal rotation angles; Ramachandran plots; Molecular mechanics; stabilizing interactions in biomolecules; simulating macromolecular structure; energy minimization; molecular dynamics

Module III: Methods for separation of biomolecules (10 hours)

General principles, chromatography; sedimentation - moving boundary sedimentation, zonal centrifugation; electrophoresis, isoelectric focussing; capillary electrophoresis, MALDI-TOF

Module IV: Structural determinations: Physical Methods (10 hours)

Ultracentrifugation and other hydrodynamic techniques; light scattering – fundamental concepts, scattering from a number of small particles, Rayleigh scattering, scattering from particles that are not small compared to the wavelength of radiation, dynamic light scattering, low angle X-ray scattering, neutron scattering, Raman scattering

Module V: Optical Methods and Applications (10 hours)

Optical techniques in biological systems – absorption spectroscopy, fluorescence spectroscopy, linear and circular dichroism, single and multidimensional NMR spectroscopy

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Learn about modeling biological macromolecules such as proteins and nucleic acids, they will learn about methods used to separate biological molecules in a mixture and methods to determine their structure. (Remembering)
- CO2:** Explain how to model proteins and nucleic acids, explain the methods used for separating these molecules if they are present in a mixture and also understand and explain the methods that can be used to determine their structures. (Understanding)
- CO3:** Identify conditions that are optimal for modeling a biological molecule, or to identify parameters that will enable separation of a particular protein from a mixture such as a cell or tissue homogenate and suggest optimal methods for determining its structure. (Applying)
- CO4:** Compare and contrast the advantages and disadvantages of the various methods that can be used to separate and purify a biological molecule from a mixture and determine its structure. (Analysing)
- CO5:** Assess the conditions that will be best suited for the separation and purification of a biological macromolecule from a mixture, and also determine the best method for its structural elucidation. (Evaluating)
- CO6:** Design the separation, purification and structure determination of a biological macromolecule from a mixture. (Creating)

Suggested Readings

1. Cantor and Schimmel Biophysical Chemistry Parts I-III, Macmillan
2. Lehninger, A. L., Nelson, D. L. and Cox, M. M. Lehninger Principles of Biochemistry W. H. Freeman
3. Cooper, A. Biophysical Chemistry The Royal Society of Chemistry, UK
4. Allen, J. P. Biophysical Chemistry Blackwell Publishing

CHHC0025: HETEROCYCLIC CHEMISTRY

(3 Credits - 45 hours)

Objective: Students will be introduced to nomenclature, reactivity, and synthesis of different types of heterocyclic compounds including natural heterocycles.

Module I: Introduction & Small Ring Heterocycles

Hantzsch-Widman nomenclature for monocyclic, fused and bridged heterocycles; General approaches to heterocyclic synthesis; Aliphatic and aromatic heterocycles; Basicity and aromaticity of heterocycles.

Syntheses of aziranes, oxiranes & thiranes; Ring openings and heteroatom extrusion; Synthesis & reactions of azetidines, oxetanes & thietanes; Strain.

Module II: Azoles and condensed five membered Rings

Physical and chemical properties; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis of imidazoles, thiazoles & oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages; Benzofused analogues.

Synthesis of indole, benzofuran and benzo-thiophene; Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology.

Module III: Diazines, bicyclic heterocycles & seven membered heterocycles

Physical & chemical properties and synthesis of pyridazines, pyrimidines, pyrazines; Nucleophilic and electrophilic substitutions.

Synthesis of quinolines, isoquinolines, benzofused diazines, acridines, phenothiazines, carbazoles and pteridines; Substitution reactions.

Synthesis & reactions of azepines, oxepines, thiepinines & diazepines.

Module IV: Natural heterocycles

Porphyrins: Classification and synthesis of porphin rings.

Nucleic Acids: Primary, secondary and tertiary structure of DNA; DNA replication and heredity; Structure and function of mRNA, tRNA and rRNA.

Proteins: Acid-base properties of amino acids; polypeptides; primary, secondary, tertiary and quaternary protein structures; classification of proteins on basis of structure and biological function; Merrifield peptide synthesis.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall in detail the structure, reactivity, and synthesis of different types of heterocycles. (Remembering)
- CO2:** Explain how to apply the concept of reactivity of heterocyclic compounds in the synthetic organic chemistry research field. (Understanding)
- CO3:** Apply the knowledge of reactivity of different types of heterocycles in the synthetic organic chemistry research field. (Applying)
- CO4:** Analyse and solve different problems related to heterocyclic reaction mechanisms. (Analysing)
- CO5:** Explain the important reactions like electrophilic substitution reaction, nucleophilic substitution, elimination reactions shown by different types of heterocycles. (Evaluating)
- CO6:** Build a clear understanding of application of reactions of different types of heterocycles. (Creating)

Suggested Readings

1. L. A. Paquette. Modern Heterocyclic Chemistry, W. A. Benjamin
2. I. L. Finar. Organic Chemistry, Vol. II, ELBS
3. T. L. Gilchrist. Heterocyclic Chemistry, Longman
4. A. L. Lehninger. Biochemistry, Kalyani Publishers

CHNP0026: NATURAL PRODUCTS CHEMISTRY

(3 Credits - 45 hours)

Objective: Students will be introduced to nomenclature, reactivity, and synthesis of different types of natural compounds.

Module I: Natural Products and their Biosynthetic Pathways (15 hours)

General classification of natural products, sources and their isolation, characterisation and biosynthesis of common plant products; Extraction and Separation of Natural Products Biosynthesis pathways for natural products using co-enzymes and enzymes, general biogenesis and synthesis of cis-jasmone, methyl jasmonate, prostaglandins, exaltone and muscone.

Module II: Terpenoids and Alkaloids (15 hours)

Terpenes and the Isoprene Rule; General biosyntheses of mono- and sesquiterpenes, trans-chrysanthemide acid, cyclo-pentato monoterpene lactones; Synthesis of α -vetinone and total synthesis of β -eudesmol; Synthesis of hirsutene, abietic acid, cis juvenile hormone, trans annular cyclisation of caryophyllene; Synthesis of caryophyllene and isocaryophyllene; Rearrangements of santonic acid and thujospene; Synthesis and rearrangement of longifolene; Structure, synthesis and biosynthesis of common alkaloids: reticuline, yohimbine and tylophorine.

Module III: Steroids (15 hours)

Nomenclature of steroids and synthesis of squalene; Lanosterol and caretonoids; Synthesis of equeilenins; Estrogens and total synthesis of non-aromatic steroids (progesterones); Corticosteroids; Degradation of diosgenin to progesterone and its synthesis; Miscellaneous transformations of steroid molecules.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Show their knowledge about chemistry of medicinal compounds from natural origin. (Remembering)
- CO2:** Explain general methods of structural elucidation of medicinally active natural compounds. (Understanding)
- CO3:** Apply knowledge regarding isolation and purification of medicinal compounds from natural origin to suggest ways of isolating and purifying medicinal compounds. (Applying)
- CO4:** Examine different types of natural products, their occurrence, structure, biosynthesis and properties. (Analysing)
- CO5:** Assess and characterize products by physical and spectroscopic means including IR, NMR, GC, and MS. (Evaluating)
- CO6:** Build know how of the use of natural products as starting materials. (Creating)

Suggested Readings:

1. Nakanashi, K. Natural Products Chemistry, Vols. I and II, Academic Press, New York and London
2. Cooper R. and Nicola, G. Natural Products Chemistry, sources, separations and structures, CRC Press, Taylor & Francis Group
3. Bhat, S. V., Nagasampagi, B.A., Sivakumar, M. Chemistry of Natural Products, Springer Science & Business Media

CHEC0027: ENGINEERING CHEMISTRY**(4 Credits - 60 Hours) (L-T-P:3-1-0)**

Objective: *This course of Engineering Chemistry enables the student to gain knowledge on atomic and molecular structure, application of some important spectroscopic techniques, thermodynamics, periodic properties, structure of organic molecules as well as main types of organic reaction used in the synthesis of molecules.*

Module I: Atomic and molecular structure (10 hours)

Schrodinger equation, Particle in a box solutions, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations, Equations for atomic and molecular orbitals, Energy level diagrams of diatomic, Pi-molecular orbitals of butadiene and benzene and aromaticity, Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties, Structure of Solids, Band structure of solids and the role of doping on band structures.

Module II: Spectroscopic techniques and applications (8 hours)

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules, Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques, Diffraction and scattering.

Module III: Use of free energy in chemical equilibria (7 hours)

Thermodynamic functions: energy, entropy and free energy, Free energy and emf, Cell potentials, the Nernst equation and applications., Acid base, oxidation reduction and solubility equilibria, Corrosion, Use of free energy considerations in metallurgy through Ellingham diagrams.

Module IV: Intermolecular forces and Periodic properties (8 hours)

- a) Ionic, dipolar and van Der Waals interactions.
- b) Effective nuclear charge, penetration of orbitals, variations of s, p, d orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases.

Module V: Stereochemistry (6 hours)

Representations of three dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis, Isomerism in transitional metal compounds.

Module VI: Organic reactions and synthesis of a drug molecule (6 hours)

Introduction to reactions involving substitution, addition, elimination, oxidation and reduction, Synthesis of a commonly used drug molecule – Aspirin and Paracetamol.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall fundamental concepts of atomic and molecular structure, spectroscopic techniques, free energy in chemical equilibria, intermolecular forces and periodic properties, stereochemistry and organic reactions. (Remembering)
- CO2:** Explain terms such as those of atomic and molecular orbitals, intermolecular forces, basics of thermodynamics, electromagnetic spectrum, periodic properties and types of major chemical reactions. (Understanding)

- CO3:** Apply the knowledge of atomic and molecular structure to explain the energy level diagram in the atomic and molecular level, explain the conducting properties of solids, apply spectroscopic techniques in practical field, use thermodynamics in different system, propose the mechanism of organic reactions. (Applying)
- CO4:** Analyse the meaning of atomic and molecular orbitals and intermolecular forces, rationalise bulk properties and processes using thermodynamic considerations, distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques, rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity, list major chemical reactions that are used in the synthesis of molecules. (Analysing)
- CO5:** Interpret the energy level diagram for different transition metal ion, explain the conducting behaviour of solids, apply the knowledge spectroscopy to the practical field, interpret the thermodynamics of systems, interpret the variation of periodic properties of atoms, structure of organic molecules and their reaction path. (Evaluating)
- CO6:** Develop a clear understanding of atomic and molecular structure, electromagnetic spectrum, thermodynamics of different system, variation of periodic properties, structure and reaction mechanism of organic molecules. (Creating)

Suggested Readings

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition <http://bcs.whfreeman.com/vollhardtschore5e/default.asp>

CHOC0027: ORGANOMETALLIC CHEMISTRY

(3 Credits - 45 hours)

Objective: This paper has been developed to enable students specializing in inorganic chemistry to gain a deep insight into the properties and applications of organometallic compounds

Module I: Introduction to organometallic compounds and reaction mechanisms (7 hours)

History of Organometallic Chemistry, 18 electron rule, Electronic structure, Ligand substitution, oxidative addition, reductive elimination, migratory insertion, hydride elimination, transmetallation, nucleophilic and electrophilic attack on the ligands coordinated to metals.

Module II: Physical methods in organometallic chemistry (8 hours)

Characterization of organometallic compounds using NMR, EPR, Mössbauer, IR, Mass spectroscopy and X-ray crystallography; Isotope effect; Fluxionality of organometallic complexes.

Module III: Main group organometallic compounds (8 hours)

Synthesis and reactions of main group organometallic compounds including organolithium, organomagnesium, organoboron, organoaluminium, organosilicon and organotin compounds.

Module IV: d-block organometallic compounds (8 hours)

Structure, preparation, and chemistry of transition metal carbene and σ -carbyne complexes. N-heterocyclic carbene complexes Transition metal compounds with M-H bonds (classical and non-classical metal-hydrides), agostic interaction

Module V: Organometallic catalysis and application of organometallic chemistry to organic synthesis (14 hours)

Synthetic applications of metathesis reactions, ring opening, ring closing metathesis in organic synthesis, macrocycle synthesis. Asymmetric hydrogenation, Hydrosilylation, Hydrocyanation, Palladium in Homogenous catalysis- Heck coupling, Stille coupling, Suzuki coupling, Negishi coupling, Sonogashira coupling and Buchwald-Hartwig coupling reactions. Synthetic utility of organotitanium, organochromium, organonickel, organocopper, organorhodium compounds.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Systematically understand the chemistry of organometallic compounds that includes understanding of bonding, reaction mechanism, physical methods in organometallic chemistry, organometallic catalysis and application of organometallic chemistry to organic synthesis (*Knowledge*)
- CO2:** Have a conceptual understanding of the (i) Main group organometallic compounds (ii) d-block organometallic compounds (*Comprehension*)
- CO3:** Learn the techniques in physical methods such as NMR, EPR, Mössbauer, IR, Mass spectroscopy and X-ray crystallography to characterize the organometallic compounds (*Application*).
- CO4:** Explain the synthesis process and reactions of main group organometallic compounds including organolithium, organomagnesium, organoboron, organoaluminium, organosilicon and organotin compounds. (*Analysis*)
- CO5:** To design organometallic compounds whose properties they can predict (*Synthesis*)
- CO6:** Have an overall understanding of organometallic compounds, their synthesis, structure, reaction mechanism, catalysis and applications (*Evaluation*).

Suggested Readings

1. C. Elschenbroich, Organometallics, Wiley.
2. R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, Wiley-Blackwell.
3. M. Bochmann, Organometallics and Catalysis: An Introduction, Oxford University Press.
4. Gary O. Spessard and Gary L. Miessler, Organometallic Chemistry, Oxford University Press, New York.
5. F. Mathey, Transition Metal Organometallic Chemistry, Springer.
6. M. B. Smith, Organic Synthesis, McGraw Hill Higher Education.

CHIP0028: INORGANIC RINGS, CLUSTERS AND POLYMERS**(3 Credits - 45 hours)**

Objective: *This paper will allow students specializing in inorganic chemistry to understand in detail the chemistry and applications of boranes, heteroboranes, isolobility, metal clusters and inorganic polymers*

Module I: Boranes and Heteroboranes (13 hours)

- a) Polyhedral boranes, concept of electron deficiency and sufficiency, types and IUPAC nomenclature of polyhedral boranes. Polyhedral skeleton electron pair theory (PSEPT). W. N. Equivalent and resonance structures. Wade's vs Lipscomb's methods of studying higher boranes.
- b) Heteroboranes: types and IUPAC nomenclature, structure and bonding of heteroboranes with special reference to carboranes, metallaboranes, metallacarboranes, metal σ and μ bonded borane/carborane clusters. Resemblance of Metallaboranes/ Metallacarboranes to ferrocene

and related compounds. Applications of metallaboranes/metallacarboranes as drug delivery system. Applications of PSEPT over heteroboranes.

Module II: Isolobility (6 hours)

Concept of isolobility and isolobal groups with examples and their applications in the understanding of structure and bonding of heteroboranes.

Module III: Metal Clusters (11 hours)

Metal-metal bonding, quadrupolar bond and its comparison with a C-C bond; Types of metal clusters and multiplicity of M-M bonds. Simple and condensed metal carbonyl clusters. Applications of PSEPT and Wade's-Mingo's and Lauhr's rule over metal carbonyl clusters. Metal halide and metal chalcogenide clusters, polyatomic Zintl ions, Bloomington shuffle.

Module IV: Inorganic Polymers (15 hours)

Inorganic polymers, classification of inorganic polymers, comparison with organic polymers, Boron-oxygen and boron-nitrogen polymers, silicones, polysilanes, polyphosphazenes, coordination polymers, sulphur-nitrogen, sulphur-nitrogen-fluorine compounds, preceramic inorganic polymers.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Acquire detailed knowledge of inorganic rings, clusters and inorganic polymers with special emphasis to their structural diversity. (Knowledge)
- CO2:** Understand important concepts such as isolobal analogy, polyhedral skeleton electron pair theory (PSEPT) and metal-metal bonding. (Comprehension)
- CO3:** Differentiate the properties of inorganic polymers from organic polymers. They will be able to apply the concepts of isolobal analogy, PSEPT, Wade's-Mingo's and Lauhr's rule to predict the structure of metal clusters. (Application)
- CO4:** Analyse bonding and properties of clusters such as boranes, carboranes, heteroboranes, metal carbonyl clusters, metal chalcogenides, zintl ions and polyoxometalates. In addition to it, they will be able to apply the knowledge of structure and bonding to study properties of various inorganic polymers such as phosphazenes, silicones, polysilanes, B-N containing polymers. (Analysis)
- CO5:** Have clear understanding of synthesis, structure, bonding and applications of inorganic clusters, chains and polymers. (Synthesis)
- CO6:** Appreciate the importance of inorganic clusters and polymers and different phenomenon associated with these compounds. (Evaluation).

Suggested Readings

1. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, JohnWiley & Sons, New York.
2. James E. Huheey, Inorganic Chemistry, Addison Wesley Pub. Co., New York
3. N. N. Greenwood and A. Earnshaw, Chemistry of the Elements, Butterworth Heinemann, London.
4. James E. Mark, Harry R. Allcock and Robert West, Inorganic polymers, Oxford University Press, New York

CHQT0029: INTRODUCTION TO QUANTUM CHEMISTRY AND GROUP THEORY

(4 Credits - 60 hours)

Objective: *This course aims at acquainting students with the basic concepts of Quantum Chemistry and Group Theory*

Module I: Quantum Chemistry I (20 hours)

Planck's theory, wave-particle duality, uncertainty principle, operators, eigen functions and eigen values in quantum mechanics, postulates of quantum mechanics, Schrodinger equation, free particle, particle in a box, degeneracy, harmonic oscillator, rigid rotator, the hydrogen atom, angular momentum, electron spin, spin-orbit coupling.

Module II: Quantum Chemistry II (20 hours)

Approximate methods in quantum mechanics - the variation theorem, linear variation principle and perturbation theory (first order and non-degenerate), application of variation method and perturbation theory to the Helium atom, antisymmetry, Slater determinant, term symbols and spectroscopic states, Huckel approximation for small pi-conjugated molecules.

Module III: Chemical Applications of Group Theory (20 hours)

Symmetry elements and operations, equivalent symmetry elements and equivalent atoms, identification of symmetry point groups with examples, groups of very high symmetry, molecular dissymmetry and optical activity, systematic procedure for symmetry classification of molecules and illustrative examples, brief review of matrix representation of groups, reducible and irreducible representations, rules about irreducible representations as derived from great orthogonality theorem, relationship between reducible and irreducible groups, character tables.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall fundamental concepts of quantum chemistry and group theory such as the postulates and theorems of quantum mechanics, complete solution of the Schrödinger equation for one electron systems, approximation methods for multi-electron systems, properties of symmetry groups, assigning symmetry point groups to molecules, irreducible representations of groups. (Remembering)
- CO2:** Explain the concepts of operators, eigen functions and eigen values and their uses in solving the Schrodinger equation for ideal systems, application of approximation methods applied to multi-electron atoms, symmetry classes and groups, degenerate and non degenerate representations. (Understanding)
- CO3:** Examine the properties of simple systems e. g., calculating the probability of an electron occupying a certain energy state inside a well or a box, or the probability of finding an electron outside a potential well, and also determine the symmetry operations that can be applied to a molecule in group theory. (Applying)
- CO4:** Discover the applications of the concepts they learn to solve numerical problems such as writing the Schrodinger equation for a multi-electron atom or devising a trial variation wave function for a particle in a 1-D box. (Analysing)
- CO5:** Distinguish between cases when an exact solution of the Schrodinger equation is possible and cases when an exact solution is not possible, they should be able to differentiate between applicability of different approximation methods in quantum chemistry and be able to assign point groups and calculate the character table for a particular point group in group theory. (Analysing)
- CO6:** Design simple problems in quantum chemistry and group theory by incorporating the different concepts they learn. (Creating)

Suggested Readings**Quantum Chemistry:**

1. P. Atkins, R. Friedman; Molecular quantum Mechanics, Oxford University Press.
2. I. N. Levine, Quantum Chemistry, PHI Learning Pvt. Ltd.
3. David J. Griffiths; Introduction to Quantum mechanics, Pearson Education Ltd.

Group Theory:

1. F. A. Cotton Chemical Applications of Group Theory, Wiley India Pvt. Ltd.
2. R. L. Carter Molecular Symmetry and Group Theory, John Wiley & Sons.
3. A. Vincent Molecular Symmetry and Group Theory, Wiley

CHF0030: FUNDAMENTALS OF SPECTROSCOPY

(4 Credits - 60 Hours)

Objective: This course introduces the concepts of a range of spectroscopic techniques including rotational, vibrational, electronic, magnetic resonance, Mössbauer and mass spectrometry

Module I: Interaction of light with matter (5 hours)

Fundamental aspects of absorption and emission spectroscopy, probability of transition, oscillator strength, dipole strength, Spontaneous and stimulated emission, origin of selection rules

Module II: Rotational and Vibrational Spectroscopy (15 hours)

Degrees of freedom of molecules, rigid rotor model, rotational spectra of diatomics and polyatomics, effect of isotopic substitution and non rigidity, selection rules and intensity distribution, Vibrational spectra of diatomics, effect of anharmonicity, Morse potential, Vibrational-rotational spectra of diatomics, P,Q,R branches, normal modes of vibration, overtones, hot bands, Raman spectroscopy - Origin, rotational and vibrational Raman spectra of diatomics.

Module III: Electronic Spectroscopy (15 hours)

Electronic spectra of diatomic molecules, Frank-Condon principle, vibronic transitions, Spectra of organic compounds, $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transition, Photoelectron Spectroscopy - basic principle, photoelectron spectra of simple molecules, X-ray photoelectron spectroscopy (ESCA), Auger electron spectroscopy, Lasers - Laser action, population inversion, properties of laser radiation, examples of simple laser systems.

Module IV: Magnetic Resonance Spectroscopy (15 hours)

- a) Nuclear Magnetic Resonance: Nuclear spin and nuclear spin states in magnetic field, resonance phenomenon, relaxation process, NMR line shapes and saturation, shielding and de-shielding of magnetic nuclei, chemical shift, spin-spin interactions, spectra of two-spin system (A_2 , AB and AX cases), ^{13}C , ^{19}F and ^{31}P NMR spectroscopy.
- b) Electron Spin Resonance: Basic principles, factors affecting g values, hyperfine coupling, spin densities and McConnell relationship, Zero field splitting

Module V: Mass spectrometry and Mössbauer spectroscopy (10 hours)

- a) Mass spectrometry: Basic principles, ionization techniques, isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation
- b) Mössbauer spectroscopy: Principles, instrumentation and applications

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the fundamental principles of the spectroscopic techniques they are taught and also state their applications in chemistry. (Remembering)
- CO2:** Explain the concepts of spectroscopic techniques and their applications. (Understanding)
- CO3:** Choose the best technique suited for determining a particular property of a molecule e.g. if the mass of an unknown compound is to be determined, they should know that mass spectrometry can be used. (Applying)

- CO4:** Distinguish between one spectroscopic technique and another and decide which would be appropriate for getting necessary information about a molecule. (Analysing)
- CO5:** Decide on which individual spectroscopic technique or range of techniques is applicable for obtaining information about a given molecule or molecules. (Evaluating)
- CO6:** Propose a series of experiments to characterize a molecule using a range of spectroscopic techniques. (Creating)

Suggested Readings

1. C.N. Banwell, E. M. McCash; Fundamentals of Molecular Spectroscopy, Tata McGraw Hill.
2. D.L. Pavia, G. M. Lampman, G. S. Kriz ;Introduction to Spectroscopy, Brooks/Cole Cengage Learning.
3. R.S. Drago; Physical Methods in Chemistry, Saunders, Thomson Learning.
4. R.M Silverstein, F. X. Webster, D. J. Kiemle, D. L. Bryce; Spectrometric Identifications of Organic Compounds, Wiley India Pvt. Ltd.
5. W. Kemp; Organic Spectroscopy, Palgrave Macmillan.
6. L. D. Field, S. Sternhell, J. R. Kalman; Organic Structures from Spectra, John Wiley and Sons.
7. D.W.H. Rankin, N. Mitzel, C. Morrison; Structural Methods in Molecular Inorganic Chemistry, Wiley.

CHAP0031: APPLIED SPECTROSCOPY

(3 Credits - 45 Hours)

Objective: This course will discuss the application of various spectroscopic methods such as Ultraviolet-visible, infrared, nuclear magnetic resonance and mass spectrometry respectively

Module I: (10 hours)

Ultraviolet and visible spectroscopy

Electronic transitions, chromophores, auxochromes, red and blue shift, applications of UV spectroscopy, spectrum shifts with solvents, isolated and conjugated double bonds, woodward Fieser rules, Analytical uses of UV spectroscopy in polyenes, carbonyl compounds and aromatic systems

Module II: (15 hours)

- (a) Infrared Spectroscopy: Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines; Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acid anhydrides, lactones, lactams, conjugated carbonyl compounds); Effects of H-bonding and solvent effect on vibrational frequency, extension to various organic molecules for structural assignment.
- (b) Mass Spectrometry: Mass spectral fragmentation of organic compounds, common functional groups; molecular peak, McLafferty rearrangements, examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Module III: (20 hours)

- (a) Nuclear Magnetic Resonance Spectroscopy:

Approximate chemical shift values of various chemically non-equivalent protons and correlation to protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic); Protons bonded to other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides, SH); Chemical exchange, effect of deuteration; complex spin-spin interaction between two, three, four and interacting nuclei (first order spectra); Complex interaction, virtual coupling, stereochemically hindered rotation, Karplus curve, variation of coupling constant with dihedral angle, nuclear magnetic double resonance, simplification of complex spectra using shift reagents, Fourier transform technique and nuclear Overhauser effect (NOE).

(b) C-13 NMR Spectroscopy:

Chemical shift (aliphatic, olefinic, alkynes, aromatic, hetero-aromatic, carbonyl carbon); Coupling constants, two-dimensional NMR spectroscopy, NOESY, DEPT and INEPT terminologies.

(c) Applications of IR, NMR and Mass spectroscopy for structure elucidation of organic compounds.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall rules associated with the following spectroscopic and spectrometric techniques respectively: FT-IR, ¹H NMR, ¹³C-NMR, Mass spectrometry. (Remembering)
- CO2:** Explain the concepts of each technique and the types of molecules that can be studied with each technique and the conclusions to draw from the analyses. (Understanding)
- CO3:** Apply their knowledge of different spectroscopic techniques in structure interpretation of unknown compounds. (Applying)
- CO4:** Analyse problems related to FT-IR, ¹H NMR, ¹³C-NMR, Mass spectrometry. (Analysing)
- CO5:** Decide the set of steps necessary to elucidate the undefined molecular structure of various compounds. (Evaluating)
- CO6:** Propose the unknown compounds for their suitable analytical and industrial use. (Creating)

Suggested Readings

1. R. M. Silverstein, G. C. Basseler & T. C. Morill. *Spectroscopic Identification of Organic Compounds*, John Wiley.
2. W. Kemp. *Organic Spectroscopy*, McMillan Press Ltd.

References

1. D Williams & I. Fleming. *Spectroscopic Methods in Organic Chemistry*, McGraw Hill.
2. C. N. Banwell & E. M. McCash. *Fundamentals of Molecular Spectroscopy*, Tata McGraw- Hill, New Delhi.
3. D.L. Pavia, G. M. Lampman, G. S. Kriz *Introduction to Spectroscopy*, Harcourt College Publisher NY.

CHAB0101: INORGANIC CHEMISTRY - I: ATOMIC STRUCTURE AND CHEMICAL BONDING (4 Credits - 60 Hours)

Objectives: To give students a sound understanding of the concepts of atomic structure, periodicity of elements, chemical bonding and redox reactions.

Module I: Atomic Structure (14 hours)

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2 . Quantum numbers and their significance.

Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

Module II: Periodicity of Elements (16 hours)

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-block.

- Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
- Atomic radii (van der Waals)
- Ionic and crystal radii.
- Covalent radii (octahedral and tetrahedral)
- Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
- Electron gain enthalpy, trends of electron gain enthalpy.
- Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

Module III: Chemical Bonding (26 hours)

- Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.
- Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2 , O_2 , C_2 , B_2 , F_2 , CO , NO , and their ions; HCl , BeF_2 , CO_2 , (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.
- Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.
- Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

Module IV: Oxidation-Reduction (4 hours)

Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the concepts of atomic structure, periodicity of elements and chemical bonding. (Remembering)
- CO2:** Explain the concepts they learn e.g., about quantum numbers and their significance, about properties of s and p-block elements such as electronegativity, electron gain enthalpy or electron affinity, concepts of different types of bonds etc. , in their own words. (Understanding)
- CO3:** Apply the concepts they learn to solve simple problems such as how atomic radii vary across a period or down a group, applying Heisenberg's uncertainty principle to

calculate uncertainty in position or momentum of a particle in motion, calculate redox potentials of cells, balance redox reactions etc. (Applying)

- CO4:** Analyse the difference between periodic properties of elements such as ionization enthalpy from electron gain enthalpy, they should be able to explain the shapes of s, p, d, f orbitals, explain why certain redox reactions are favorable. (Analysing)
- CO5:** Compare the advantages and disadvantages of the concepts they learn as well as their applications and limitations e.g., comparing the valence bond theory with that of the molecular orbital theory, the usefulness and limitations of valence shell electron pair repulsion theory etc. (Evaluating)
- CO6:** Combine all the concepts they learn and apply them to predict shapes of molecules, the nature of bonding in different molecules, the polarizability of ions; calculate the redox-potentials of electrochemical cells. (Creating)

Suggested Readings

1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
3. Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

CHSIO102: PHYSICAL CHEMISTRY-I: STATES OF MATTER AND IONIC EQUILIBRIUM

(4 Credits-60 hours)

Objectives: To teach students the properties of the three states of matter and the concepts associated with ionic equilibria

Module I: Gaseous state (18 hours)

- a) Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η ; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.
- b) Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Module II: Liquid state (6 hours)

Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Module III: Solid state (16 hours)

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative

idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

Module IV: Ionic equilibria (20 hours)

- Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di- and triprotic acids (exact treatment).
- Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.
- Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall concepts associated with properties of matter – the three states, solid, liquid and gaseous and the laws that govern them; they will also learn the principles of ionic equilibria. (Remembering)
- CO2:** Explain the concepts they have learnt e.g., they should be able to explain the properties of the three states of matter and the principles of ionic equilibria in their own words. (Understanding)
- CO3:** Apply the principles they learn in this course to solve problems such as calculating the solubility product of an electrolyte in water, or calculating the pressure exerted by an ideal gas or calculate the surface tension or viscosity of a liquid. (Applying)
- CO4:** Distinguish between properties of ideal and real gases, liquids and gases or liquids and solids, strong and weak electrolytes etc. (Analysing)
- CO5:** Decide which laws to apply when solving problems dealing with states of matter and topics related to chemical equilibria. (Evaluating)
- CO6:** Develop their understanding of the three states of matter and of ionic equilibria to construct an overview of these fundamental principles of physical chemistry - the applications of which they will encounter in subsequent courses in chemistry as well as in the laboratory and in everyday life. (Creating)

Suggested Readings

- Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press
- Ball, D. W. Physical Chemistry Thomson Press, India .
- Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
- Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

CHBH0103: ORGANIC CHEMISTRY- I: BASICS AND HYDROCARBONS

(4 Credits-60 hours)

Objectives: To teach students the underlying principles of organic chemistry, stereochemistry and the chemistry of aliphatic and aromatic hydrocarbons

Module I: Basics of Organic Chemistry (6 hours)

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Module II: Stereochemistry (18 hours)

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis-trans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Module III: Chemistry of Aliphatic Hydrocarbons (24 hours)

- Carbon-Carbon sigma bonds Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.
- Carbon-Carbon pi bonds: Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. 15 Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.
- Cycloalkanes and Conformational Analysis: Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Module IV: Aromatic Hydrocarbons (12 hours)

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles that govern organic molecules such as their classification, nomenclature, electronic displacements, types of fission, types of organic reactions, stereochemistry, the chemistry of aliphatic and aromatic hydrocarbons. (Remembering)
- CO2:** Explain the principles e.g., the types and mechanisms of organic reactions, the principle of optical activity, different projection formulae etc. they learn, in their own words. (Understanding)

- CO3:** Apply their understanding to solve problems such as identifying whether a molecule will undergo an addition, elimination or substitution reaction under a certain given condition, finding out whether a molecule with a chiral centre has R or S configuration etc. (Applying)
- CO4:** Distinguish between addition, elimination and substitution reactions, they should be able to distinguish between Fischer projection and Newman projection formulae, differentiate between chiral and achiral molecules, differentiate enantiomers from diastereomers. (Analysing)
- CO5:** Decide under which conditions, for example, the elimination reaction converting an alkyl halide to an alkene will take place by the E1 or E2 or E1cb mechanism. (Evaluating)
- CO6:** Discuss the classification, nomenclature, stereochemistry, and type of reaction an organic compound can undergo in a given set of conditions. (Creating)

Suggested Readings

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International.

CHCT0104: PHYSICAL CHEMISTRY- II: THERMODYNAMICS AND ITS APPLICATIONS

(4 Credits-60 hours)

Objectives: To teach students the concepts of classical thermodynamics, chemical equilibrium, properties of dilute solutions and colligative properties

Module I: Chemical Thermodynamics (36 hours)

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, q , work, w , internal energy, U , and statement of first law; enthalpy, H , relation between heat capacities, calculations of q , w , U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S , G , A with T , V , P ; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Module II: Systems of Variable Composition (8 hours)

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Module III: Chemical Equilibrium (8 hours)

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p , K_c and K_x . Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

Module IV: Solutions and Colligative Properties (8 hours)

- a) Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions.
- b) Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall concepts of thermodynamics, such as the laws of thermodynamics, chemical equilibrium, properties of dilute solutions and colligative properties. (Remembering)
- CO2:** Explain the laws of thermodynamics, the concept of free energy, concept of entropy, chemical equilibrium, etc. in their own words. (Understanding)
- CO3:** Apply the laws of thermodynamics, heats of reactions, free energy functions, reversible and irreversible processes, to solve simple problems. (Applying)
- CO4:** Distinguish between thermodynamic terms such as intensive and extensive properties; path independent and path-dependent functions; entropy, enthalpy, free energy, reversible and irreversible processes, etc. They should be able to decide the conditions that must be fulfilled, for a given chemical reaction to proceed spontaneously, etc. (Analysing)
- CO5:** Evaluate conditions under which a system goes from one state to another reversibly and conditions that would make the transformation irreversible, they should understand the derivation of relations between equilibrium constants K_p , K_c , K_x etc. (Evaluating)
- CO6:** Build their understanding to design and solve analytical problems. (Creating)

Suggested Readings

1. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press .
2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa
3. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall.
4. McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S.
6. Commonly Asked Questions in Thermodynamics. CRC Press: NY.
7. Levine, I. N. Physical Chemistry 6th Ed., Tata Mc Graw Hill .
8. Metz, C.R. 2000 solved problems in chemistry, Schaum Series (2006)

CHAH0105: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

(4 Credits-60 hours)

Objectives: To give students an understanding of atomic structure, types of bonding, fundamentals of organic chemistry, stereochemistry and aliphatic hydrocarbons

Module I: Inorganic Chemistry-1 (30 hours)

a) Atomic Structure (14 hours)

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance.

Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin - spin quantum number (s) and magnetic spin quantum number (m).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

b) Chemical Bonding and Molecular Structure (16 hours)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO⁺. Comparison of VB and MO approaches.

Module II: Organic Chemistry-1 (30 hours)

a) Fundamentals of Organic Chemistry (8 hours)

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles.

Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

b) Stereochemistry (10 hours)

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

c) Aliphatic Hydrocarbons (12 hours)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO₄) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC₂ and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO₄, ozonolysis and oxidation with hot alk. KMnO₄.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Concepts of inorganic chemistry such as atomic structure, chemical bonding and molecular structure; fundamentals of organic chemistry, stereochemistry such as electronic displacements, cleavage of bonds structure, shape, reactivity of organic molecules, stereochemistry, chemistry of aliphatic hydrocarbons (Knowledge)
- CO2:** Understanding of the concepts taught in this course, so as to be able to explain the concepts such as that of the wavefunction in quantum mechanics, the radial distribution function, principles of ionic and covalent bonding, valence bond theory, concepts of resonance MO approach etc. in their own words. Similarly they should be able to explain the concepts of organic chemistry such as electronic displacements, nucleophiles, electrophiles, Newman projection formula etc. (Comprehension)
- CO3:** Write electronic configurations of elements, predict the shapes of some inorganic molecules using the VESPR theory, calculate the strengths of organic acids and bases, predict whether a molecule is aromatic or not, draw the conformations of molecules such as ethane, butane, cyclohexane etc. (Application)
- CO4:** Compare concepts such as ψ and ψ^2 , explain the Schrodinger equation for hydrogen atom and the resulting radial and angular parts of the hydrogenic wavefunctions, function, differentiate between conformation and configuration of a molecules, nucleophiles and electrophiles, bonding and antibonding orbitals, differentiate between properties of alkanes, alkenes, alkynes (Analysis)
- CO5:** Construct examples and arguments to explain concepts they learn. E.g. when describing enantiomers, they should be able to give appropriate examples, similarly while explaining resonance in inorganic and organic compounds. They should be able to devise problems based on the theories and concepts they learn (Synthesis)

CO6: Reflected in the ease with which they can explain and relate the different concepts they learn (Evaluation)

Suggested Readings

1. J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.
2. F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
3. Douglas, McDaniel and Alexader: Concepts and Models in Inorganic Chemistry, John Wiley.
4. James E. Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
5. T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
6. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
7. E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill.
8. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
9. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.

CHCF0106: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I (4 Credits-60 hours)

Objectives: To teach students the principles of chemical energetics, chemical and ionic equilibria and some concepts of organic chemistry

Module I: Physical Chemistry-1 (30 hours)

Chemical Energetics (10 hours)

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.

Variation of enthalpy of a reaction with temperature – Kirchoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Chemical Equilibrium (8 hours)

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG_0 , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

Ionic Equilibria (12 hours)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Module II: Organic Chemistry-2 (30 hours)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons (8 hours)

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation.

Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides (8 hours)

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.

Preparation: from alkenes and alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH₂/NH₃ (or NaNH₂/NH₃).

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Alcohols, Phenols and Ethers (Upto 5 Carbons) (8 hours)

Alcohols: Preparation: Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO₄, acidic dichromate, conc. HNO₃). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic) (6 hours) (Formaldehyde, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, NaHSO₃, NH₂-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf Verley reduction.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Theories of chemical energetics; chemical equilibria; aromatic hydrocarbons; alkyl and aryl halides; alcohols, phenols and ethers; aldehydes and ketones (Knowledge)
- CO2:** Explain concepts such as the free energy changes accompanying chemical reactions, Le Chatelier's principle, principles of electrolytes, preparation and reactions of organic molecules such as aromatic hydrocarbons, nucleophilic substitution reactions of alkyl halides etc. (Comprehension)
- CO3:** Calculate the change in free energy accompanying a chemical reaction, derive equations governing the dissociation of aqueous solutions of weak acids and bases, write out the methods of preparations of alcohols, phenols etc., and mechanisms of organic chemistry reactions such as that for nucleophilic substitution reactions, elimination reactions etc. (Application)
- CO4:** Explain spontaneity of a reaction based on the measure of free energy change accompanying the reaction; they should be able to explain whether a nucleophilic substitution reaction will take place by SN1 or SN2 or SNi mechanism etc. (Analysis)

- CO5:** Put together the methods of preparation of an organic compound such as a phenol and write out the possible reactions it can undergo along with detailed mechanisms (Synthesis)
- CO6:** Differentiate the concept of free energy change from standard free energy change; they should be able to explain how the equilibrium of a system changes when subjected to a change in pressure, temperature or concentration of a reactant; they should be able to compare the mechanisms that alkyl halides undergo with those of aryl halides or the reactions of alcohols with those of phenols etc. (Evaluation).

Suggested Readings

1. T. W. Graham Solomons: Organic Chemistry, John Wiley and Sons.
2. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
3. I.L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
4. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
5. G. M. Barrow: Physical Chemistry Tata McGraw Hill .
6. G. W. Castellan: Physical Chemistry 4th Edn. Narosa .
7. J. C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry Cengage Lening India Pvt. Ltd., New Delhi.
8. B. H. Mahan: University Chemistry 3rd Ed. Narosa.
9. R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York

CHSP0107:INORGANIC CHEMISTRY II: S- AND P-BLOCK ELEMENTS

(4 Credits-60 hours)

Objective: *This course will introduce the concepts of metallurgy, chemistry of s- and p- block elements, structure, bonding and properties of inorganic compounds.*

Module I: General Principles of Metallurgy (6 hours)

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic reduction, hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: electrolytic process, van Arkel-de Boer process and Mond's process, Zone refining

Module II: Chemistry of s Block Elements (22 hours)

- (i) General characteristics: melting point, flame colour, reducing nature, diagonal relationships and analogous behaviour of first member of each group
- (ii) Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water
- (iii) Common features such as ease of formation, thermal stability and solubility of the following alkali and alkaline earth metal compounds: hydrides, oxides, peroxides, superoxides, carbonates, nitrates, sulphates
- (iv) Complex formation tendency of s-block elements; structure of the following complexes: crown ethers and cryptates of Group I; basic beryllium acetate, beryllium nitrate, EDTA complexes of calcium and magnesium
- (v) Solutions of alkali metals in liquid ammonia and their properties

Module III: Chemistry of p-block elements (6 hours)

Electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point, ionization enthalpy, electron gain enthalpy, electronegativity, allotropy of C, P, S; inert pair effect; diagonal relationship between B and Si and anomalous behaviour of first member of each group

Module IV: Structure, bonding and properties: acidic/basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat on the following compounds (13 hours)

- Hydrides: hydrides of Group 13 (only diborane), Group 14, Group 15 (EH_3 where E=N, P, As, Sb, Bi), Group 16 and Group 17
- Oxides: oxides of phosphorus, sulphur and chlorine
- Oxoacids: oxoacids of phosphorus and chlorine; peroxyacids of sulphur
- Halides: halides of silicon and phosphorus

Module V: Preparation, properties, structure and uses of the following compounds (13 hours)

- Borazine
- Silicates, silicones
- Phosphonitrile halides $\{(\text{PNCl}_2)_n \text{ where } n= 3 \text{ and } 4\}$
- Interhalogen and pseudohalogen compounds
- Clathrate compounds of noble gases, xenon fluorides (MO treatment of XeF_2)

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the concepts of General Principles of Metallurgy, Chemistry of s and p Block Elements, Structure, bonding, properties and uses of some important inorganic compounds. (Remembering)
- CO2:** Explain the concepts they learn, e.g., about properties, bonding, structure, and uses of Hydrides, Oxoacids, Halides, Borazine etc., about the properties of s and p-block elements such as electronegativity, electron gain enthalpy or electron affinity, general principle of Metallurgy etc. in their own words. (Understanding)
- CO3:** Apply the concepts they learn to solve simple problems such as how atomic radii vary across a period or down a group, calculate ionization enthalpy, electron gain enthalpy etc. (Applying)
- CO4:** Distinguish between periodic properties of s and p block elements such as ionization enthalpy from electron gain enthalpy, they should be able to explain the reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water, and complex formation tendency of s-block elements. (Analysing)
- CO5:** Compare the advantages and disadvantages of the concepts they learn as well as their applications and limitations e.g., comparing the s and p block elements, the usefulness and limitations of different Metallurgical processes. (Evaluation)
- CO6:** Develop the connection among all the concepts they learn and apply them to predict shapes and structure of molecules, the acidic/basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat and nature of bonding in different molecules. (Creating)

Suggested Readings

- Lee, J.D. Concise Inorganic Chemistry, Pearson Education
- Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry*, John Wiley Sons, N.Y.
- Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth- Heinemann.
- Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH
- Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry*, Pearson
- Shriver, D.F., Atkins P.W and Langford, C.H., *Inorganic Chemistry* Oxford University Press

CHOG0108: ORGANIC CHEMISTRY II: OXYGEN CONTAINING FUNCTIONAL GROUPS**(4 Credits-60 hours)**

Objective: In this course, students will be taught the chemistry of halogenated hydrocarbons, preparation, properties and reactions of alcohols, phenols, ethers, epoxides, carbonyl compounds and of carboxylic acids and their derivatives

Module I: Chemistry of Halogenated Hydrocarbons (16 hours)

Alkyl halides: Methods of preparation and properties, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation (including preparation from diazonium salts) and properties, nucleophilic aromatic substitution; SNAr, Benzyne mechanism.

Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg (Grignard reagent) – Use in synthesis of organic compounds.

Module II: Alcohols, Phenols, Ethers and Epoxides (16 hours)

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Oxidation of diols by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe’s–Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH₄

Module III: Carbonyl Compounds (16 hours)

Structure, reactivity, preparation and properties;

Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α - substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH₄, NaBH₄, Meerwein-Ponndorf-Verley (MPV), PDC)

Addition reactions of α , β - unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Module IV: Carboxylic Acids and their Derivatives (12 hours)

General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength. Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids.

Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann- bromamide degradation and Curtius rearrangement.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall concepts associated with chemical reactivity of different organic compounds such as alkyl halides, alcohols, aldehydes and carboxylic acids. (Remembering)
- CO2:** Compare and correlate properties of different types of organic compounds. (Understanding)
- CO3:** Solve problems of transformation of one functional group to other using different reactions conditions. (Applying)
- CO4:** Distinguish between alkyl halides, carbonyl compounds, alcohols and carboxylic acids. (Analysing)
- CO5:** Explain the classification, nomenclature, stereochemistry and type of reaction an organic compound can undergo in a given set of conditions. (Evaluating)
- CO6.** Design experiments for the various transformations of organic compounds. (Creating)

Suggested Readings

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Solomons, T.W.G., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.

CHPC0109: PHYSICAL CHEMISTRY III: PHASE EQUILIBRIA AND CHEMICAL KINETICS

(4 Credits-60 hours)

Objective: This course will introduce students to the concepts of phase equilibria, electrochemical cells and surface chemistry

Module I: Phase Equilibria (27 hours)

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems (H₂O and S), with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points. Three component systems: triangular plots, water-chloroform-acetic acid system. Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non ideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

Module II: Electrochemical Cells (27 hours)

Rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb₂O₃ electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Module III: Surface chemistry (6 hours)

Physical adsorption, chemisorption, adsorption isotherms (Langmuir and Freundlich), nature of adsorbed state, qualitative discussion of BET.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall fundamental concepts of phase equilibria, electrochemical cells, surface chemistry. (Remembering)
- CO2:** Explain concepts such as the Gibbs phase rule for nonreactive and reactive systems; Clapeyron-Clausius equation applied to solid-liquid, liquid-vapour and solid-vapour equilibria; concepts such as half-cell potentials, electromotive force of cells, potentiometric titrations, adsorption and adsorption isotherms. (Understanding)
- CO3:** Apply the concepts of phase equilibria to different systems such as one-component, two-component and three component systems; applications of electrolysis in metallurgy and industry; applications of EMF measurements to measure free energy, enthalpy, entropy etc. (Applying)
- CO4:** Compare applications of Clapeyron-Clausius equation to solid-liquid, liquid-vapour, solid-vapour equilibria; comparing the phase diagrams for one-, two- and three-component systems; comparing applications of standard reduction potentials to different kinds of half cells; comparing physisorption and chemisorption; Langmuir and Freundlich adsorption isotherms (Analysing)
- CO5:** Develop a connection of all the concepts they learn from phase equilibria with those of electrochemical cells and surface chemistry with each other and with all the concepts of thermodynamics they learnt in earlier semesters (Creating)
- CO6:** Design problems involving all the concepts they learn and find solutions for the problems. (Creating)

Suggested Readings

1. Peter Atkins & Julio De Paula, Physical Chemistry, Oxford University Press.
2. Castellan, G. W. Physical Chemistry, Narosa
3. McQuarrie, D. A. and Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi
4. Engel, T. and Reid, P. Physical Chemistry, Prentice-Hall.
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. and Will, S. Commonly Asked Questions in Thermodynamics. CRC Press: NY.
6. Zundhal, S.S. Chemistry concepts and applications Cengage India
7. Ball, D. W. Physical Chemistry Cengage India
8. Mortimer, R. G. Physical Chemistry, Elsevier: NOIDA, UP
9. Levine, I. N. Physical Chemistry, Tata McGraw-Hill
10. Metz, C. R. Physical Chemistry, Tata McGraw-Hill

CHCC0110: INORGANIC CHEMISTRY III: COORDINATION CHEMISTRY

(4 Credits-60 hours)

Objective: This course will teach students the chemistry of coordination compounds, transition elements, lanthanides, actinides and inorganic reaction mechanisms

Module I: Coordination Chemistry (26 hours)

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of $10 Dq$ (Δ_o), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of $10 Dq$ (Δ_o , Δ_t). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

Module II: Transition Elements (14 hours)

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer diagrams) Difference between the first, second and third transition series.

Chemistry of Cr, Mn, Fe and Co in various oxidation states with special reference to the following compounds: peroxo compounds of chromium, potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.

Module III: Lanthanoids and Actinoids (6 hours)

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

Module IV: Inorganic Reaction Mechanism (14 hours)

Introduction to inorganic reaction mechanisms, substitution reactions in square planar complexes, trans-effect, theories of trans effect, thermodynamic and kinetic stability.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall basic concepts of coordination chemistry such as Werner's theory, Valence Bond Theory, crystal field theory; IUPAC nomenclature of coordination compounds, properties of coordination compounds; chemistry of transition elements, lanthanoids and actinoids; principles of inorganic reaction mechanisms. (Remembering)
- CO2:** Explain the behavior of coordination compounds, properties of transition metals, lanthanoids and actinoids and the principles of inorganic reaction mechanisms. (Understanding)
- CO3:** Apply the theories of coordination compounds to explain their properties; apply the general group trends of transition metal complexes to explain their behaviours and the chemistry of the compounds formed by them etc. (Application)
- CO4:** Compare the advantages and limitations of theories governing coordination compounds. (Analysis)
- CO5:** Assess whether crystal field splitting is happening in strong or weak fields; calculate pairing energies, assess factors affecting magnitude of crystal field splitting, compare octahedral with tetrahedral coordination, etc. (Evaluation)
- CO6:** Design octahedral and tetrahedral complexes, predict the products of inorganic reactions, predict oxidation states of transition metal complexes. (Creating)

Suggested Readings

1. Purcell, K.F and Kotz, J.C., *Inorganic Chemistry* W.B. Saunders Co
2. Huheey, J.E., *Inorganic Chemistry*, Prentice Hall
3. Cotton, F.A. and Wilkinson, G., *Advanced Inorganic Chemistry* Wiley-VCH
4. Basolo, F, and Pearson, R.C., *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY,
5. Greenwood, N.N. and Earnshaw A., *Chemistry of the Elements*, Butterworth- Heinemann.
6. Miessler, G. L. and Tarr, Donald A. *Inorganic Chemistry(adapted)*, Pearson

CHHC0111: ORGANIC CHEMISTRY III: HETEROCYCLIC CHEMISTRY**(4 Credits-60 hours)**

Objectives: In this course, students will learn the preparation, properties and reactions of nitrogen containing functional groups, polynuclear hydrocarbons, heterocyclic compounds, alkaloids and terpenes.

Module I: Nitrogen Containing Functional Groups (18 hours)

Preparation and important reactions of nitro compounds, nitriles and isonitriles.

Amines: Preparation and properties: Effect of substituent and solvent on basicity; Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications.

Module II: Polynuclear Hydrocarbons (8 hours)

Aromaticity of polynuclear hydrocarbons, structure elucidation of naphthalene; Preparation and properties of naphthalene, phenanthrene and anthracene.

Module III: Heterocyclic Compounds (22 hours)

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Indole (Fischer indole synthesis and Madelung synthesis), Quinoline and isoquinoline, (Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction)

Module IV: Alkaloids (6 hours)

Natural occurrence, General structural features, Isolation and their physiological action, Hoffmann's exhaustive methylation, Emde's modification; Structure elucidation and synthesis of Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

Module V: Terpenes (6 hours)

Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles and methods for gravimetric analysis of inorganic compounds; preparing transition metal complexes and measuring their properties (Remembering)
- CO2:** Explain the principle involved in the gravimetric estimation of nickel(II) using dimethylglyoxime; the mechanisms of the reactions leading to the formation of some transition metal complexes such as potassium tri(oxalate)ferrate(III) (Understanding)
- CO3:** Apply the principles and methods learnt to estimate an element such as Copper in CuSCN; prepare a transition metal complex such as tetraaminecarbonatocobalt(III) nitrate (Applying)
- CO4:** Examine the mechanism involved in the synthesis of a transition metal Compound. (Analysing)
- CO5:** Evaluate the efficiency of estimation procedures and yield and purity of inorganic reaction products; measurement of 10Dq by spectrophotometric method (Evaluating)
- CO6:** Formulate estimations of metal ions; Preparing desired transition metal complexes and measuring their properties (Creating)

Suggested Readings:

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Welly& Sons
5. Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.
6. Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd. Pub.
7. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.
8. Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Pragati Parakashan

CHEC0112: PHYSICAL CHEMISTRY IV: ELECTROCHEMISTRY

(4 Credits-60 hours)

Objectives: *In this course, students will learn the concepts and applications of conductance, chemical kinetics, catalysis and photochemistry.*

Module 1: Conductance (18 hours)

Quantitative aspects of Faraday's laws of electrolysis Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at 29 infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules. Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

Module II: Chemical Kinetics (22 hours)

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

Module III: Catalysis (8 hours)

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Module IV: Photochemistry (12 hours)

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical 34 reactions in biochemical processes, photostationary states, chemiluminescence.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall fundamental concepts associated with conductance and conductance measurements, chemical kinetics, catalysis and photochemistry. (Remembering)
- CO2:** Explain principles such as those associated with Faraday's laws of electrolysis, equivalent and molar conductivity, ionic mobility, order, molecularity of chemical reactions, rate laws, specificity and selectivity of catalysts, explain the meaning and types of photochemical processes, etc. (Understanding)
- CO3:** Apply theories of conductance measurements to determine the degree of dissociation of weak electrolytes, ionic product of water, solubility and solubility products, experimental methods of determining rate laws, apply the Michaelis-Menten equation to determine K_M , V_{max} , k_{cat} of enzymes, etc. (Applying)
- CO4:** Distinguish between order and molecularity of reactions; distinguish between zeroth-, first- and second-order reactions; differentiate between heterogeneous and homogeneous catalysts; specificity and selectivity of catalysts; explain the significance of absorptions coefficients, quantum yields, etc. (Analysing)
- CO5:** Compare properties of strong and weak electrolytes, Compare the Langmuir-Hinshelwood mechanism with Eley-Rideal mechanism of surface-catalyzed reactions, Evaluate the applications of Beer-Lambert law and its limitations; compare photochemical and photophysical processes. (Evaluating)
- CO6:** Design experiments to determine the conductance of strong and weak electrolytes, determine the order of chemical reactions, measure K_M , V_{max} , k_{cat} of an enzyme catalyzed reaction, apply Beer Lambert law to find out the concentration of an unknown concentration of a chromophore. (Creating)

Suggested Readings

1. Atkins, P.W & Paula, J.D. Physical Chemistry, Oxford University Press
2. Castellan, G. W. Physical Chemistry, Narosa
3. Mortimer, R. G. Physical Chemistry, Elsevier: NOIDA, UP
4. Barrow, G. M., Physical Chemistry, Tata McGraw Hill: New Delhi
5. Engel, T. & Reid, P. Physical Chemistry, Prentice-Hall.
6. Rogers, D. W. Concise Physical Chemistry Wiley.
7. Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. Physical Chemistry, John Wiley & Sons, Inc.

CHBA0113: BASIC ANALYTICAL CHEMISTRY

(2 Credits-30 Hours) (Hands on Exercises)

Module I: Introduction

Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators

a. Determination of pH of soil samples.

b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

- a. Determination of pH, acidity and alkalinity of a water sample.
- b. Determination of dissolved oxygen (DO) of a water sample.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

Paper chromatographic separation of mixture of metal ion (Ni^{2+} and Co^{2+}).

Ion-exchange: Column, ion-exchange chromatography etc.

Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Suggested Applications (Any one):

- a. To study the use of phenolphthalein in trap cases.
- b. To Analyse arson accelerants.
- c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

- a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
- b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
- c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall concepts of sampling, accuracy, precision and errors in analytical measurements, significant figures, analysis of soil and water, principles of chromatography. (Remembering)
- CO2:** Explain terms associated with analytical measurements, principles of soil and water analysis, principles of chromatography. (Understanding)
- CO3:** Analyse mixture of metal ions through paper chromatography, Analyse the composition of gasoline, determine caffeine and benzoic acid concentrations in soft drinks (Analysing)
- CO4:** Determine composition of soil, pH of soil samples, estimation of calcium and magnesium ions through complexometric titrations, determine dissolved oxygen levels in water samples. (Evaluating)
- CO5:** Decide on appropriate procedure for Analysing soil or water samples, optimal methods for separating a mixture of ions etc. (Evaluating)
- CO6:** Design experiments to Analyse a soil or water sample, estimate the level of dissolved oxygen in water etc. (Creating)

Suggested Readings

1. Willard, H. H. *Instrumental Methods of Analysis*, CBS Publishers.
2. Skoog, D.A. and Leary, J.J., *Instrumental Methods of Analysis*, Saunders College Publications, New York.
3. Skoog, D.A.; West, D.M. and Holler, F.J. *Fundamentals of Analytical Chemistry*, Saunders College Publishing, Fort Worth.
4. Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman and Co., New York
5. Dean, J. A. *Analytical Chemistry Handbook*, McGraw Hill
6. Day, R. A. and Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.

7. Freifelder, D. *Physical Biochemistry*, W.H. Freeman and Co., N.Y.
8. Cooper, T.G. (Ed.) *The Tools of Biochemistry*, John Wiley and Sons, N.Y.
9. Svehla, G., *Vogel's Qualitative Inorganic Analysis*, Prentice Hall.
10. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K., *Vogel's Quantitative Chemical Analysis*, Prentice Hall.
11. Robinson, J.W. *Undergraduate Instrumental Analysis*, Marcel Dekker, Inc., New York.

CHCI0114: CHEMO INFORMATICS

(2 Credits-30 Hours) (Hands on Exercises)

Module I: Introduction to Chemoinformatics

History and evolution of chemoinformatics, Use of chemoinformatics, Prospects of chemoinformatics, Molecular Modelling and Structure elucidation.

Representation of molecules and chemical reactions: Nomenclature, Different types of notations, SMILES coding, Matrix representations, Structure of Molfiles and Sdfiles, Libraries and toolkits, Different electronic effects, Reaction classification.

Searching chemical structures: Full structure search, sub-structure search, basic ideas, similarity search, three dimensional search methods, basics of computation of physical and chemical data and structure descriptors, data visualization.

Applications: Prediction of Properties of Compounds; Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling Toxicity; Structure-Spectra correlations; Prediction of NMR, IR and Mass spectra; Computer Assisted Structure elucidations; Computer Assisted Synthesis Design, Introduction to drug design; Target Identification and Validation; Lead Finding and Optimization; Analysis of HTS data; Virtual Screening; Design of Combinatorial Libraries; Ligand-Based and Structure Based Drug design; Application of Chemoinformatics in Drug Design.

Hands-on Exercises

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the history, evolution and uses of chemoinformatics, principles of molecular modeling and structure elucidations, nomenclature and notations for representing molecules and chemical reactions etc. (Remembering)
- CO2:** Explain principles associated with chemoinformatics such as principles of molecular modeling, representing molecules and chemical reactions using different nomenclatures, classification of reactions. (Understanding)
- CO3:** Predict properties of compounds using linear free energy relations, quantitative structure-property relations, build models, model toxicity, application of chemoinformatics in drug design etc. (Creating)
- CO4:** Compare methods for predicting the properties of chemical compounds, compare methods for building models, comparing methods for searching chemical structures etc. (Analysing)
- CO5:** Compare methods for representing molecules and chemical reactions, types of notations, SMILES coding, matrix representations; methods for predicting properties of compounds etc. (Evaluating)
- CO6:** Develop structure using computers, carry out computer assisted synthesis of drugs, design combinatorial libraries, carry out ligand-based and structure-based drug design. (Creating)

Suggested Readings

1. Andrew R. Leach & Valerie, J. Gillet An introduction to Chemoinformatics. Springer: The Netherlands.
2. Gasteiger, J. & Engel, T. Chemoinformatics: A text-book. Wiley-VCH.
3. Gupta, S. P. QSAR & Molecular Modeling. Anamaya Pub.: New Delhi.

CHCP0115: CHEMISTRY OF COSMETICS AND PERFUMES

(2 Credits-30 Hours) (Hands on Exercises)

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Practicals

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles and methods involved in preparation of hair dyes, hair sprays, shampoos, lipsticks etc. and importance of essential oils in cosmetics industries. (Remembering)
- CO2:** Explain the principle involved in the preparation of cosmetics and perfumes. (Understanding)
- CO3:** Apply principles learnt to prepare shampoos, enamels, face creams etc. (Applications)
- CO4:** Develop the knowledge to choose the right methods for preparing a cosmetics product. (Creating)
- CO5:** Develop the ability to evaluate the advantages and drawbacks of methods used to prepare a cosmetic or perfume. (Creating)
- CO6:** Design cosmetics such as a face cream by modifying the proportion of ingredients used to make a basic face cream. (Creating)

Suggested Readings

1. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
3. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.

CHPY0116: PESTICIDE CHEMISTRY

(2 Credits-30 Hours) (Hands on Exercises)

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Practicals

1. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.
2. Preparation of simple organophosphates, phosphonates and thiophosphates

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the properties of natural and synthetic pesticides, structure activity relationships, synthesis of different classes of pesticides. (Remembering)
- CO2:** Explain the properties of pesticides based on their structure. (Understanding)
- CO3:** Apply the theoretical knowledge gained, to prepare pesticides such as organophosphates, phosphonates and thiophosphates. (Applying)
- CO4:** Make use of the procedures used to prepare a pesticide. (Applying)
- CO5:** Compile all the principles and methods learnt to prepare different classes of pesticides. (Creating)
- CO6:** Design pesticides by modifying known proportion of ingredients. (Creating)

Suggested Readings

R. Cremllyn, Pesticides, John Wiley.

CHFC0117:FUEL CHEMISTRY

(2 Credits-30 Hours)

Module I: Review of energy sources (renewable and non-renewable).

Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Module II: Petroleum and Petrochemical Industry

- A. Composition of crude petroleum, Refining and different types of petroleum products and their applications.
- B. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels.
- C. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.
- D. Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the basic concepts and procedures involved in the study of renewable and non-renewable energy sources. (Remembering)
- CO2:** Explain the principles of fractional distillation, cracking, the difference between petroleum and non-petroleum fuels etc. (Understanding)
- CO3:** Identify methods to prepare fuel from waste, learn how to prepare clean fuels etc. (Applying)

CO4: Distinguish between renewable and non-renewable energy sources. (Analysing)

CO5: Evaluate the merits and demerits of renewable and nonrenewable energy sources. (Evaluating)

Suggested Readings

1. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK. P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
2. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.

CHIP0118: INTELLECTUAL PROPERTY RIGHTS

(2 Credits-30 Hours)

Objective: *In this era of liberalization and globalization, the perception about science and its practices has undergone dramatic change. The importance of protecting the scientific discoveries, with commercial potential or the intellectual property rights is being discussed at all levels – statutory, administrative, and judicial. With India ratifying the WTO agreement, it has become obligatory on its part to follow a minimum acceptable standard for protection and enforcement of intellectual property rights. The purpose of this course is to apprise the students about the multifaceted dimensions of this issue.*

Module I: Introduction to Intellectual Property:

Historical Perspective, Different Types of IP, Importance of protecting IP.

Module II: Copyrights, Trade Marks, Patents

- (A) Introduction, How to obtain, Differences from Patents.
- (B) Introduction, How to obtain, Different types of marks – Collective marks, certification marks, service marks, Trade names, etc. Differences from Designs.
- (C) Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge,
- (D) Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India, geographical indications
- (E) Definition, rules for registration, prevention of illegal exploitation, importance to India.
Industrial Designs Definition, How to obtain, features, International design registration.
Layout design of integrated circuits, Circuit Boards, Integrated Chips, Importance for electronic industry.

Module III: Trade Secrets

Introduction and Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection.

Module IV: Different International agreements

- (a) World Trade Organization (WTO):
 - (i) General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement
 - (ii) General Agreement on Trade related Services (GATS)
 - (iii) Madrid Protocol
 - (iv) Berne Convention
 - (v) Budapest Treaty

(b) Paris Convention

WIPO and TRIPS, IPR and Plant Breeders Rights, IPR and Biodiversity

IP Infringement issue and enforcement – Role of Judiciary, Role of law enforcement agencies – Police, Customs etc. Economic Value of Intellectual Property – Intangible assets and their valuation, Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the definition of intellectual property, types of Intellectual property, importance of protecting intellectual property. (Remembering)
- CO2:** Explain the meaning of intellectual property and the needs for protection of intellectual property. (Understanding)
- CO3:** Develop the knowledge of different types of intellectual property such as Copyrights, trademarks etc. (Applying)
- CO4:** Distinguish between different types of intellectual properties. (Analysing)
- CO5:** Evaluate the overall laws and procedures involved in protecting intellectual property. (Evaluating)
- CO6:** Elaborate on the laws and procedures in place to protect Intellectual Property Rights. (Creating)

Suggested Readings

1. N.K. Acharya: Textbook on intellectual property rights, Asia Law House
2. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications.
3. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, TataMcGraw-Hill .
4. Arthur Raphael Miller, Micheal H.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers.
5. Jayashree Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.

CHOS0119:ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY

(4 credits – 60 hours)

Objectives: *This course involves learning about the properties of transition metal compounds, organometallic compounds, the role of metal ions in biological systems, structure, preparation and properties of some aromatic and active methylene compounds respectively, and the application of spectroscopy to organic molecules*

Module I: Inorganic Chemistry (30 hours)**A. Chemistry of 3d metals (6 hours)**

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, $K_3[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

B. Organometallic Compounds (12 hours)

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeise's salt and

ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

C. Bio-Inorganic Chemistry (12 hours)

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na⁺, K⁺ and Mg²⁺ ions: Na/K pump; Role of Mg²⁺ ions in energy production and chlorophyll. Role of iron in oxygen transport, haemoglobin, myoglobin, storage and transport of iron.

Module II: Organic Chemistry (30 hours)

A. Structure, preparation and properties of some aromatic molecules (12 hours)

Structure elucidation of naphthalene, preparation and properties of naphthalene and anthracene. Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Furan, Pyrrole, Thiophene, and Pyridine.

B. Active methylene compounds (6 hours)

Preparation: Claisen ester condensation. Keto-enol tautomerism. Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).

C. Application of Spectroscopy to Simple Organic Molecules (12 hours)

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λ_{\max} and ϵ_{\max} , chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λ_{\max} of conjugated dienes and α, β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on $>C=O$ stretching absorptions).

Suggested Readings

1. Huheey, J. E., Keiter, E. and Keiter, R.: *Inorganic Chemistry: Principles of*
2. *Structure and Reactivity*, Pearson Publication.
3. Miessler, G. L. and Tarr, D. A.: *Inorganic Chemistry*, Pearson Publication.
4. Lee, J. D. *A New Concise Inorganic Chemistry*, E.L.B.S.
5. Cotton, F. A. and Wilkinson, G. *Basic Inorganic Chemistry*, John Wiley & Sons.
6. Finar, I. L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
7. Dyer, J. L. *Applications of Absorption Spectroscopy of Organic Compounds*,
8. Prentice Hall.
9. Silverstein, R. M., Bassler, G. C. and Morrill, T. C. *Spectroscopic Identification of*
10. *Organic Compounds*, John Wiley & Sons.
11. Morrison, R. T. and Boyd, R. N. *Organic Chemistry*, Prentice Hall.
12. Sykes, P. *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.

CHCK0120: CHEMISTRY OF S- AND P- BLOCK ELEMENTS, STATES OF MATTER AND CHEMICAL KINETICS

(4 credits – 60 hours)

Objectives: This course will introduce students to the general principles of metallurgy, s- and p-block elements, the states of matter and chemical kinetics

Module I Inorganic Chemistry (30 hours)

A. General Principles of Metallurgy (4 hours)

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy with reference to cyanide process for silver and gold, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, van Arkel-de Boer process and Mond's process.

B. s- and p- block Elements (26 hours)

Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Alfred-Rochow scales). Allotropy in C, S, and P.

Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

Compounds of s- and p-Block Elements

Diborane and concept of multicentre bonding

Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial and environmental chemistry.

Hydrides of nitrogen (NH_3 , N_2H_4 , N_3H , NH_2OH) Oxoacids of P, S and Cl.

Halides and oxohalides: PCl_3 , PCl_5 , SOCl_2 and SO_2Cl_2

Module II Physical Chemistry (30 hours)

Kinetic Theory of Gases (7.5 hours)

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2 .

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids (5 hours)

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

Solids (7.5 hours)

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

Chemical Kinetics (10 hours)

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Suggested Readings

1. Barrow, G. M., *Physical Chemistry* Tata McGraw Hill.
2. Castellan, G. W., *Physical Chemistry* 4th Edn. Narosa.
3. Kotz, J. C., Treichel, P. M., and Townsend, J. R., *General Chemistry* Cengage Lening India Pvt. Ltd., New Delhi.
4. B. H. Mahan: *University Chemistry*, Narosa.
5. R. H. Petrucci: *General Chemistry*, Macmillan Publishing Co.: New York
6. J. D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.
7. F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
8. D. F. Shriver and P. W. Atkins: *Inorganic Chemistry*, Oxford University Press.
9. Gary Wulfsberg: *Inorganic Chemistry*, Viva Books Pvt. Ltd.
10. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry(adapted)*, Pearson

LABORATORY COURSES

CHI6002: INORGANIC QUALITATIVE AND QUANTITATIVE ANALYSIS - LAB

(3 Credits)

Objective: This course aims to give an idea about the qualitative and quantitative analysis of binary mixtures, alloys and ores

1. Qualitative analysis (tertiary mixtures, alloys, ores)
2. Quantitative analysis (binary mixtures, alloys, ores)
3. Inorganic preparation (crystallization, precipitation, calcination)
4. Coordination compounds through ligand synthesis and spectroscopic characterization, magnetic properties
5. Metal Nanoparticle synthesis and characterization

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall procedures followed to carry out qualitative and quantitative analysis of binary and tertiary mixtures of inorganic salts, alloys; procedures to prepare inorganic compounds, synthesis and characterization of metal nanoparticles. (Remembering)
- CO2:** Explain the reason behind the steps they followed for Analysing mixtures and preparing compounds and metal nanoparticles. (Understanding)

- CO3:** Experiment with analysis of salt mixtures and preparation of inorganic compounds independently (within limits). (Applying)
- CO4:** Distinguish between the range of experimental procedures they learn and select the right procedures for their experiments. (Analysing)
- CO5:** Evaluate the strengths and weaknesses of procedures they learn and know which procedure has the most advantage for a particular experiment. (Evaluating)
- CO6:** Design protocols for Analysing inorganic mixtures and synthesizing nanoparticles. (Creating)

Suggested Readings

1. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, B. Sivasankar; Vogel's Textbook of Quantitative Chemical Analysis, Pearson.
2. G. Svehla, S. Mittal; Vogel's Qualitative Inorganic Analysis, Pearson Education.

CHEQ6003:EXPERIMENTAL PHYSICAL CHEMISTRY - LAB

(3 Credits)

Objective: This laboratory based course is designed to learn the applications of chemical kinetics, electrochemistry, spectrophotometry and pH-metric titrations.

- a) Chemical Kinetics based experiments
- b) Electrochemistry based experiments
- c) Spectrophotometry based experiments
- d) pH-metric Titrations
- e) Adsorption on porous materials - equilibrium, kinetic and thermodynamic studies

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

At the end of the course students will be able to:

- CO1:** Recall fundamental concepts they got in the graduation level in physical chemistry that they applied in the practical field. (Remembering)
- CO2:** Explain the laboratory course which consists of experiments illustrating the principles of physical chemistry relevant to the study of Master of Science. (Comprehension)
- CO3:** Apply the knowledge of practical classes such as estimation of rate constants of reactions from concentration of reactants/products as a function of time, measure activation energy, measure molecular/system properties such as surface tension, viscosity, conductance of solutions, pH of solution etc, adsorption of liquid in solid surfaces, distribution of solutes between two immiscible solvent, determination of unknown concentration of a given solution spectrophotometrically etc. in the practical field of chemistry to solve problems. (Applying)
- CO4:** Analyse practical utility of different theories chemical kinetics, surface tension, viscosity, conductance, pH meter, phase equilibria, adsorption etc. (Analysing)
- CO5:** Estimate rate constants of reactions from concentration of reactants/products as a function of time, measure activation energy, measure molecular/system properties such as surface tension, viscosity, conductance of solutions, pH of solution etc, adsorption of liquid in solid surfaces, distribution of solutes between two immiscible solvent, determination of unknown concentration of a given solution spectrophotometrically. (Evaluating)
- CO6:** Build a clear understanding of theories of the experiments they learned in the class by performing it in the laboratory class. (Creating)

Suggested Reading

J. B. Yadav; Advanced Practical Physical Chemistry, Goel Publishing House.

CHQA6004:ORGANIC QUALITATIVE ANALYSIS AND SYNTHESIS LAB

(3 Credits)

Objective: This course will introduce common laboratory techniques, instruments for carrying out organic synthesis, isolation and extraction of natural products and qualitative and quantitative analysis.

1. Qualitative analysis of binary mixtures of organic compounds (a) Separation of binary mixture into individual components (b) Qualitative analysis of individual components by
 - (i) Detection of extra elements N, S, Halogens
 - (ii) Test for functional groups by systematic analysis
 - (iii) Solubility, melting point
 - (iv) Preparation of a derivative and determination of its melting point
2. Preparation of organic compounds by using single and multistep process.
3. Chromatographic techniques
 - (a) Qualitative TLC separation and identification
 - (b) Column chromatographic separation of a mixture of compounds.
4. Extraction of natural products.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the rules and protocols for qualitative analysis, separation of binary mixtures of organic compounds, extraction of natural product, synthesis and different chromatographic techniques. (Remembering)
- CO2:** Explain the procedures to synthesize and characterize organic compounds, perform qualitative analysis of simple as well as mixture of organic compounds and learn different chromatographic methods. (Understanding)
- CO3:** Apply different chromatographic techniques for the identification and purification of synthetic organic compounds as well as natural products. (Applying)
- CO4:** Identify different types of natural products. They will be able to describe important methods of extraction and their synthesis. (Applying)
- CO5:** Analyse practical utility of different natural product extraction methods and chromatographic techniques. (Analysing)
- CO6:** Develop a clear understanding of separation of binary mixture of organic compounds by using the concept of solubility. They would be able to synthesize different organic compounds by using single and multistep synthesis. (Creating)

Suggested Readings

1. Vogel's Textbook of Practical Organic Chemistry, Including Qualitative Organic Analysis
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, Pearson.
4. Ahluwalia, V. K.; Dhingra, S. Comprehensive Practical Organic Chemistry, University Press.

CHRP6005: RESEARCH PROJECT**(9 Credits)**

Objective: To train students to carry out research on a topic that is of relevance to the chemical sciences. In this course, each student undertakes research on a topic that he/she chooses in project phase I or on a topic assigned to him/her by the concerned mentor.

To this end, the student will first review the current status of research on the selected topic, state a hypothesis or a set of objectives and then carry out experiments (either wet-lab or theoretical) to gather data, which he/she will then analyse, draw conclusions and finally present in a dissertation at the end of the semester.

The format for the final dissertation will be as prescribed by the department. There will be a viva voce examination on the dissertation by an expert committee comprising external and internal members of the department. The mode and components of the evaluation and the weightages attached to them shall be published by the department at the beginning of the semester.

This will be a research-based module, whereby, students will carry out either theoretical or wet lab experiments and present their findings in a thesis and perhaps as a paper in a conference or a journal.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Show their knowledge to carry out experiments to fulfil their research objectives and will in the process learn a wide range of techniques both scientific and statistical, and also probably add to the existing body of scientific knowledge. (Remembering)
- CO2:** Explain the methods they use to carry out their research and why a certain set of methods is chosen. (Understanding)
- CO3:** Apply their understanding to steer their research in the right direction. (Applying)
- CO4:** Take part in troubleshooting when a chosen approach does not yield the expected result. (Analysing)
- CO5:** Assess and critically Analyse the results they obtain to decide whether the data obtained proves a stated hypothesis or not. (Evaluating)
- CO6:** Adapt a methodology or approach to fulfil a set of objectives or prove or disprove a hypothesis. (Creating)

CHCE6006: ENGINEERING CHEMISTRY I LAB**(1 Credit) (L-T-P: 0-0-2)**

Objective: This course consists of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

List of experiments –

1. Determination of Water Hardness with EDTA.
2. Estimation of Calcium in Limestone.
3. Determination of dissolved Oxygen in given Water Sample by Winkler's Method.
4. Determination of Surface Tension of a given Liquid by Stalagmometer.
5. To determine the co-efficient of Viscosity of a given liquid or solution with the help of Ostwald's Viscometer.
6. Adsorption of Acetic Acid by Charcoal.
7. Determination of Chloride Content of Water.

8. To determine the Strength of Magnesium Ions in Magnesium Sulphate solution by Complexometric Method.
9. Determination of Partition Coefficient of a substance between two immiscible liquids.
10. Determination of Free Carbon Dioxide in given Water sample.
11. To determine the Alkalinity of given water Sample.
12. Determination of Ferrous Ion in Mohr's Salt by KMnO_4 .
13. To determine the Acidity of the given water sample.
14. Determination of the Cell Constant and Conductance of solution.
15. Determination of Sodium Hydroxide and Sodium Carbonate in mixture.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall concepts and methods involved in a range of experiments such as determining hardness of water, estimation of calcium in limestone, determining dissolved oxygen levels in water, measuring the surface tension of water etc. (Remembering)
- CO2:** Explain the principles of the experiments they carry out, illustrating the principles of chemistry relevant to the study of science and engineering. (Understanding)
- CO3:** Analyse practical utility of different theories chemical kinetics, surface tension, viscosity, conductance, water quality analysis etc. (Analysing)
- CO4:** Estimate rate constants of reactions from concentration of reactants/products as a function of time, measure molecular/system properties such as surface tension, viscosity, conductance of solutions, chloride content of water, water hardness etc. (Evaluating)
- CO5:** Assess the limitations and advantages of the procedures they use in the laboratory for the various estimations and analyses. (Evaluating)
- CO6:** Design experiments such as those to measure surface tension of a liquid or measure the viscosity of a liquid etc. (Creating)

Suggested Readings

1. S. Rattan Experiments in Applied Chemistry, Katson Books
2. S. Giri, D. N. Bajpai, O. P. Pandey Practical Chemistry, S. Chand And Co.

CHCE6007: ENGINEERING CHEMISTRY II LAB

(2 Credits) (L-T-P: 0-0-4)

Objective: This course consists of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

List of experiments –

16. Determination of Water Hardness with EDTA.
17. Estimation of Calcium in Limestone.
18. Determination of dissolve Oxygen in given Water Sample by Winkler's Method.
19. Determination of Surface Tension of a given Liquid by Stalagmometer.
20. To determine the co-efficient of Viscosity of a given liquid or solution with the help of Ostwald's Viscometer.
21. Adsorption of Acetic Acid by Charcoal.
22. Determination of Chloride Content of Water.

23. To determine the Strength of Magnesium Ions in Magnesium Sulphate solution by Complexometric Method.
24. Determination of Partition Coefficient of a substance between two immiscible liquids.
25. Determination of Free Carbon Dioxide in given Water sample.
26. To determine the Alkalinity of given water Sample.
27. Determination of Ferrous Ion in Mohr's Salt by KMnO_4 .
28. To determine the Acidity of the given water sample.
29. Determination of the Cell Constant and Conductance of solution.
30. Determination of Sodium Hydroxide and Sodium Carbonate in mixture.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall concepts and methods involved in a range of experiments such as determining hardness of water, estimation of calcium in limestone, determining dissolved oxygen levels in water, measuring the surface tension of water etc. (Remembering)
- CO2:** Explain the principles of the experiments they carry out, illustrating the principles of chemistry relevant to the study of science and engineering. (Understanding)
- CO3:** Analyse practical utility of different theories chemical kinetics, surface tension, viscosity, conductance, water quality analysis etc. (Analysing)
- CO4:** Estimate rate constants of reactions from concentration of reactants/products as a function of time, measure molecular/system properties such as surface tension, viscosity, conductance of solutions, chloride content of water, water hardness etc. (Evaluating)
- CO5:** Assess the limitations and advantages of the procedures they use in the laboratory for the various estimations and analyses. (Evaluating)
- CO6:** Design experiments such as those to measure surface tension of a liquid or measure the viscosity of a liquid etc. (Creating)

Suggested Readings

1. S. Rattan Experiments in Applied Chemistry, Katson Books
2. S. Giri, D. N. Bajpai, O. P. Pandey Practical Chemistry, S. Chand And Co.

CHRP6008: RESEARCH PROJECT

(12 Credits)

Objective: *To train students to carry out research on a topic that is of relevance to the chemical sciences*

In this course, each student undertakes research on a topic that he/she chooses in project phase I or on a topic assigned to him/her by the concerned mentor.

To this end, the student will first review the current status of research on the selected topic, state a hypothesis or a set of objectives and then carry out experiments (either wet-lab or theoretical) to gather data, which he/she will then analyse, draw conclusions and finally present in a dissertation at the end of the semester.

The format for the final dissertation will be as prescribed by the department. There will be a viva voce examination on the dissertation by an expert committee comprising external and internal members of the department. The mode and components of the evaluation and the weightages attached to them shall be published by the department at the beginning of the semester

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Show their knowledge to carry out experiments to fulfil their research objectives and will in the process learn a wide range of techniques both scientific and statistical, and also probably add to the existing body of scientific knowledge. (Remembering)
- CO2:** Explain the methods they use to carry out their research and why a certain set of methods is chosen. (Understanding)
- CO3:** Apply their understanding to steer their research in the right direction. (Applying)
- CO4:** Take part in troubleshooting when a chosen approach does not yield the expected result. (Analysing)
- CO5:** Assess and critically Analyse the results they obtain to decide whether the data obtained proves a stated hypothesis or not. (Evaluating)
- CO6:** Adapt a methodology or approach to fulfil a set of objectives or prove or disprove a hypothesis. (Creating)

CHAB6101: INORGANIC CHEMISTRY-I: ATOMIC STRUCTURE AND CHEMICAL BONDING LAB

(2 Credits)

A) Titrimetric Analysis

- (i) Calibration and use of apparatus
- (ii) Preparation of solutions of different Molarity/Normality of titrants

B) Acid-Base Titrations

- (i) Estimation of carbonate and hydroxide present together in mixture.
- (ii) Estimation of carbonate and bicarbonate present together in a mixture.
- (iii) Estimation of free alkali present in different soaps/detergents

C) Oxidation-Reduction Titrimetry

- (i) Estimation of Fe(II) and oxalic acid using standardized KMnO_4 solution.
- (ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
- (iii) Estimation of Fe(II) with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall how to carry out acid-base and oxidation-reduction titrations for the estimation of salts ions in mixtures or in a solution. (Remembering)
- CO2:** Show an understanding of the principles and procedures that they use in the laboratory to carry out titrations to estimate the concentrations of ions in solution. (Understanding)
- CO3:** Distinguish between procedures of acid-base titration used for estimating carbonate and hydroxide ions in a mixture from the procedure used to estimate concentration of Fe(II) ions in a solution. They should be able to interpret the data they obtain from their measurements. (Analysing)
- CO4:** Estimate ions present in unknown proportions in a mixture or estimate ions such as Fe(II) present in unknown concentrations in solution. (Evaluating)

- CO5:** Compare the different principles and procedures that they follow to estimate ions whether present in mixtures or independently. (Evaluating)
- CO6:** Develop their ability to set up the methods used for estimating an unknown mixture of ions and interpret the results they obtain. (Creating)

Suggested Readings

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

CHIS6102: PHYSICAL CHEMISTRY-I: STATES OF MATTER AND IONIC EQUILIBRIUM LAB

(2 Credits)

1. Surface tension measurements.
 - a. Determine the surface tension by (i) drop number (ii) drop weight method.
 - b. Study the variation of surface tension of detergent solutions with concentration.
2. Viscosity measurement using Ostwald's viscometer.
 - a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
 - b. Study the variation of viscosity of sucrose solution with the concentration of solute.
3. Indexing of a given powder diffraction pattern of a cubic crystalline system. pH metry
 - a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
 - b. Preparation of buffer solutions of different pH
 - i. Sodium acetate-acetic acid
 - ii. Ammonium chloride-ammonium hydroxide
 - c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
 - d. Determination of dissociation constant of a weak acid.

Any other experiment carried out in the class.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles and methods to measure properties such as surface tension, viscosity, pH of solutions, index a given powder diffraction pattern of a cubic crystalline system, prepare buffers etc. (Remembering)
- CO2:** Explain the principles underlying the experiments they carry out and be able to explain the principles in their own words. (Understanding)
- CO3:** Apply the right principles when measuring the property of a given solution be it surface tension, pH or dissociation constant. (Applying)
- CO4:** Measure surface tension, viscosity, pH of any given solution and the dissociation constant of unknown weak acids. (Evaluating)
- CO5:** Assess the advantages and limitations of the principles and procedures they learn in the lab for Analysing properties such as surface tension of a solution or the dissociation constant of an unknown weak acid. (Evaluating)
- CO6:** Develop know-how to set up an experimental protocol for measuring the property of an unknown sample which may be a sugar solution whose viscosity they want to measure by varying its concentration. (Creating)

Suggested Readings

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

CHBH6103: ORGANIC CHEMISTRY- I: BASICS AND HYDROCARBONS LAB

(2 Credits)

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:
 - a. Water
 - b. Alcohol
 - c. Alcohol-Water
3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)
6. Chromatography:
 - a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
 - b. Separation of a mixture of two sugars by ascending paper chromatography
 - c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles and methods to purify organic compounds by crystallization, to determine melting points of the purified compounds, to determine boiling point of liquid compounds and to use chromatography to separate out mixtures of two organic compounds. (Remembering)
- CO2:** Explain which solvents give the best crystals, how the melting point apparatus works, setting up a distillation apparatus to determine the boiling of a liquid, and the significance of melting and boiling points of organic compounds, and the principle of chromatographic separation. (Understanding)
- CO3:** Experiment with organic compound to crystallize and determine its melting point or in the case of a liquid, determine its boiling point by distillation or the capillary method; they should be able to set up a chromatography experiment to separate a mixture of two organic compounds. (Applying)
- CO4:** Assess the conditions required for crystallization and in the case of a liquid whether to use the distillation method or the capillary method for measuring the boiling point; they should be also determine optimal solvent compositions to use for chromatographic separation. (Evaluating)

- CO5:** Decide based on observations and acquired data, which chromatographic technique and solvent mixtures yield the best separation of a mixture of two organic compounds. (Evaluating)
- CO6:** Develop an experimental set up to separate a mixture of organic compounds using an appropriate chromatographic technique and identify the compounds based on their R_f values, they should be able to determine the melting point of an unknown organic compound. (Creating)

Suggested Readings

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi.
2. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi.

CHCT6104: PHYSICAL CHEMISTRY- II: THERMODYNAMICS AND ITS APPLICATIONS LAB

(2 Credits)

Thermochemistry

1. Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
2. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Calculation of the enthalpy of ionization of ethanoic acid.
4. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
5. Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
6. Determination of enthalpy of hydration of copper sulphate.
7. Study of the solubility of benzoic acid in water and determination of ΔH .

Any other experiment carried out in the class.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles, methods to determine: heat capacity of a calorimeter, enthalpies of neutralization, ionization, hydration, dissolution; basicity/proticity of a polyprotic acid etc. (Remembering)
- CO2:** Explain methods and underlying principles used to carry out the measurements in this lab course. (Understanding)
- CO3:** Apply the principles they learn in the theory classes to draw conclusions from the measurements they make in the lab. (Applying)
- CO4:** Distinguish differences between the concepts of enthalpy of neutralization from enthalpy of ionization or from enthalpy of dissolution, they should be able to differentiate between heat capacity at constant volume from heat capacity at constant pressure and the resulting differences in experimental set up. (Analysing)
- CO5:** Assess advantages and drawbacks of the methods they use for carrying out the different measurements in this lab course. (Evaluating)
- CO6:** Design experiments to measure heat capacity, enthalpy. (Creating)

Suggested Readings

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi.
2. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi.

CHAH6105: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB

(2 Credits)

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
 - (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
 - (b) Identify and separate the sugars present in the given mixture by paper chromatography.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles and methods to (i) estimate inorganic salts such as sodium carbonate, sodium bicarbonate, Fe(II) ions, Cu(II) ions by volumetric analysis; (ii) detect the presence of N,S, Cl, Br, I in organic compounds, separate mixtures of organic molecules by chromatography. (Remembering)
- CO2:** Explain the principles of the experiments they perform in this course in their own words. (Understanding)
- CO3:** Experiment with elemental analysis of an organic molecule, know the best procedure for estimating salts in a mixture by volumetric analysis, and know why certain solvent ratios result in better separation of a pair of molecules in paper chromatography experiments, learn the shortcomings and advantages of the various experimental procedures they learn. (Applying)
- CO4:** Decide the best method for measuring the proportion of salts in a mixture by volumetric analysis, decide appropriate solvent ratios to use for chromatographic separation of organic molecules in a mixture. (Evaluating)
- CO5:** Estimate mixtures of salts present in different proportions, estimate unknown quantities of Cu(II) or Fe(II) ions, determine the presence of N or S in unknown organic compounds, separate unknown mixtures by chromatography and identify them by comparing their R_f values with standard tables. (Evaluating)
- CO6:** Design experiments to estimate for instance Cu(II) ions iodometrically, or design the solvent ratios in a chamber for optimal separation of organic molecules in a mixture by paper chromatography. (Creating)

Suggested Readings

1. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall
2. Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall.
3. Textbook of Practical Organic Chemistry, A.I. Vogel, Prentice Hall.
4. Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman.

CHCF6106: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY - LAB**(2 Credits)****Section A: Physical Chemistry**

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO₃, NH₄Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH .
7. Ionic equilibria

pH measurements

1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
2. Preparation of buffer solutions:
 - i) Sodium acetate-acetic acid 82
 - ii) Ammonium chloride-ammonium hydroxide
3. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.
Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
 - (a) Bromination of Phenol/Aniline
 - (b) Benzoylation of amines/phenols
 - (c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall how to measure the heat capacity of a calorimeter for different volumes, the enthalpy of neutralization, ionization, hydration etc; they will learn to measure pH of aerated drinks, fruit juices etc., prepare buffers, purify organic compounds by crystallization, determine melting and boiling points of organic compounds, they will prepare organic compounds, carry out bromination of phenol/aniline etc. (Remembering)

- CO2:** Explain the principles of the experiments they carry out as well as of the methodologies involved. (Understanding)
- CO3:** Interpret the results they get of a set of measurements and draw relevant conclusions, they should be able to troubleshoot when results are not conclusive, they should be able to come up with mechanisms for the organic preparations they carry out, etc. (Understanding)
- CO4:** Measure enthalpy of neutralization of any given unknown salt, measure the pH of an unknown aqueous solution, prepare a buffer solution using any weak acid or base, determine the melting point or boiling point of an unknown organic compound (solid/liquid) etc. (Evaluating)
- CO5:** Determine the optimal methods for measuring a property, Analyse and interpret data correctly, describe mechanisms involved in preparation of organic compounds they synthesize etc. (Evaluating)
- CO6:** Be able to design experiments to measure for instance, the enthalpy of solvation of a solute, or the method of preparation of an organic compound, measure its melting/boiling point, depending on whether it is a solid or a liquid etc. (Creating)

Suggested Books

1. A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
2. F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

CHSP6107: INORGANIC CHEMISTRY II: S- AND P-BLOCK ELEMENTS -LAB

(2 Credits)

(A) Iodo / Iodimetric Titrations

- (i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (iodometrically)
- (ii) Estimation of antimony in tartar-emetic iodometrically

(B) Complexometric titrations using disodium salt of EDTA

- (i) Estimation of Mg^{2+} , Zn^{2+}
- (ii) Estimation of Ca^{2+} by substitution method

(C) Inorganic Preparations

- (i) Cuprous chloride, Cu_2Cl_2
- (ii) Manganese (III) phosphate, $MnPO_4 \cdot H_2O$
- (iii) Aluminium potassium sulphate $KAl(SO_4)_2 \cdot 12H_2O$ (potash alum) or chrome alum

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the idea of different types of estimations for analysis of inorganic compounds. (Remembering)
- CO2:** Explain the principles of different types of inorganic estimations. (Understanding)
- CO3:** Apply the knowledge of inorganic qualitative analysis for the detection of the different components of inorganic compounds. (Applying)
- CO4:** Analyse the best method for measuring the proportion of salts in a mixture by volumetric analysis. (Analysing)
- CO5:** Compare different types of volumetric analysis. (Evaluating)
- CO6:** Predict the ratios of different chemical reagents for the preparation of inorganic compounds. (Creating)

Suggested Readings

1. Vogel, A. I., A textbook of quantitative inorganic analysis, ELBS
2. Marr, G and Rockett, R.W. Practical Inorganic Chemistry, van Nostrand Reinhold

CHOG6108: ORGANIC CHEMISTRY II: OXYGEN CONTAINING FUNCTIONAL GROUPS LAB**(2 Credits)**

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:
 - i. Acetylation of one of the following compounds: amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and phenols (β -naphthol, vanillin, salicylic acid) by any one method:
 - a. Using conventional method, b. Using green approach
 - ii. Benzoylation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the following phenols (β -naphthol, resorcinol, p- cresol) by Schotten-Baumann reaction.
 - iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).
 - iv. Selective reduction of meta dinitrobenzene to m-nitroaniline.
 - v. Hydrolysis of amides and esters.
 - vi. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
 - vii. S-Benzylisothiuronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
 - viii. Aldol condensation using either conventional or green method.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles and procedures involved in testing for functional groups of organic molecules and reactions of organic compounds such as acetylation using conventional and green approaches. (Remembering)
- CO2:** Explain the concepts involved in testing for functional groups such as alcohols, phenols, carbonyl and carboxylic acids and the principles and methods followed for reactions such as acetylation, benzoylation etc. that organic compounds undergo. (Understanding)
- CO3:** Apply the concepts they learn to test for presence of functional groups in simple organic compounds and carry out reactions such as oxidation/reduction reactions to transform functional groups; add functional groups through reactions such as acetylation, benzoylation etc.). (Applying)
- CO4:** Distinguish between procedures for testing for different functional groups and carrying out transformation or addition reactions of organic molecules under different conditions. (Analysing)
- CO5:** Assess optimal conditions for organic reactions such as conditions for oxidation of an alcohol; conditions for acetylation of aliphatic and aromatic amines etc., assess the ideal sequence of steps to follow to identify the functional group present in an organic molecule. (Evaluating)

CO6: Design experiments to test for presence of functional groups such as alcohols, aliphatic and aromatic amines, carbonyl groups etc. and design conditions for oxidation of an alcohol, benzylation of an amine etc. (Creating)

Suggested Readings

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, Pearson
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press

CHPC6109: PHYSICAL CHEMISTRY III: PHASE EQUILIBRIA AND CHEMICAL KINETICS LAB

(2 Credits)

Phase Equilibria:

- I. Determination of critical solution temperature and composition at CST of the phenol-water system and to study the effect of impurities of sodium chloride and succinic acid on it.
- II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method: a. simple eutectic and b. congruently melting systems.
- III. Distribution of acetic/ benzoic acid between water and chloroform or cyclohexane.
- IV. Study the equilibrium of at least one of the following reactions by the distribution method:
(i) $I_2(aq) + I^-(aq) \rightarrow I_3^-(aq)$
(ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n^{2+}$

Potentiometry:

- V. Perform the following potentiometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Dibasic acid vs. strong base iv. Potassium dichromate vs. Mohr's salt

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the principles and methods involved in determining for example critical solution temperature, construction of phase diagrams; distribution of acetic acid/benzoic acid between water and chloroform etc; principles of potentiometric titrations etc. (Remembering)
- CO2:** Explain the concepts and methods for determining critical solution temperature (CST) and composition at CST of a binary solution; construction of phase diagrams; explain the principles of potentiometric titrations e.g., measuring equivalence points on titrating a strong acid with a strong base, Mohr's salt with potassium dichromate. (Understanding)
- CO3:** Make use of the phase rule for example to determine the degrees of freedom of a system. (Applying)
- CO4:** Determine how critical solution temperature of phenol-water system is affected by impurities, find out how to measure equivalence points in redox titrations through measuring change in solution potentials. (Evaluating)
- CO5:** Measure the distribution coefficient of a molecule between two immiscible phases; the CST and composition at CST of a phenol-water mixture; measure equivalence points and strengths of titrants through potentiometric titrations. (Evaluating)

CO6: Construct phase diagrams of simple eutectic mixtures, congruently melting systems, distribution coefficient of a solute between immiscible solutions; measure equivalence points of redox reactions through potentiometric titrations. (Creating)

Suggested Readings

1. Khosla, B. D.; Garg, V. C. and Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi
2. Garland, C. W.; Nibler, J. W. and Shoemaker, D. P. Experiments in Physical Chemistry; McGraw-Hill: New York
3. Halpern, A. M. and McBane, G. C. Experimental Physical Chemistry; W.H. Freeman & Co.: New York.

CHCC6110: INORGANIC CHEMISTRY III: COORDINATION CHEMISTRY – LAB

(2 Credits)

Gravimetric Analysis:

- i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
- ii. Estimation of copper as CuSCN
- iii. Estimation of iron as Fe₂O₃ by precipitating iron as Fe(OH)₃.
- iv. Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine)₃ (aluminium oxinate).

Inorganic Preparations:

- i. Tetraamminecopper (II) sulphate, [Cu(NH₃)₄]SO₄.H₂O
- ii. Acetylacetonate complexes of Cu²⁺/Fe³⁺
- iii. Tetraamminecarbonatocobalt (III) nitrate
- iv. Potassium tri(oxalato)ferrate(III)

Properties of Complexes

- i. Measurement of 10 Dq by spectrophotometric method
- ii. Verification of spectrochemical series.
- iii. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetonate, DMG, glycine) by substitution method.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall principles and methods for gravimetric analysis of inorganic compounds; preparing transition metal complexes and measuring their properties (Remembering)
- CO2:** Explain the principle involved in the gravimetric estimation of nickel(II) using dimethylglyoxime; the mechanisms of the reactions leading to the formation of some transition metal complexes such as potassium tri(oxalato)ferrate(III) (Understanding)
- CO3:** Apply the principles and methods learnt to estimate an element such as Copper in CuSCN; prepare a transition metal complex such as tetraamminecarbonatocobalt(III) nitrate (Applying)
- CO4:** Examine the mechanism involved in the synthesis of a transition metal Compound. (Analysing)
- CO5:** Evaluate the efficiency of estimation procedures and yield and purity of inorganic reaction products; measurement of 10Dq by spectrophotometric method (Evaluating)
- CO6:** Formulate estimations of metal ions; Preparing desired transition metal complexes and measuring their properties (Creating)

Suggested Readings

1. Vogel, A.I. A text book of Quantitative Analysis, ELBS.
2. G. Marr and B.W. Rockett, Practical Inorganic Chemistry, Van Nostrand Reinhold.

CHHC6111: ORGANIC CHEMISTRY III: HETEROCYCLIC CHEMISTRY LAB

(2 Credits)

1. Functional group test for nitro, amine and amide groups.
2. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols, carbonyl compounds and esters)

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Find out functional groups in different organic compounds. (Remembering)
- CO2:** Demonstrate the chemistry behind the detection of functional group in qualitative analysis. (Understanding)
- CO3:** Apply the knowledge of qualitative analysis for the identification of organic compounds in different mixture of organic sample. (Applying)
- CO4:** Analyse qualitatively any unknown organic sample by detecting functional group, elements etc. (Analysing)
- CO5:** Determine the unknown organic sample by comparing the melting points. (Evaluating)
- CO6:** Design the solvent ratios for recrystallisation of derivatives of unknown organic sample. (Creating)

Suggested Readings

1. Mann, F.G. and Saunders, B.C. Practical Organic Chemistry, Pearson Education.
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, Pearson.
3. Ahluwalia, V.K. and Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press.
4. Ahluwalia, V.K. and Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.

CHEC6112: PHYSICAL CHEMISTRY IV: ELECTROCHEMISTRY LAB

(2 Credits)

Conductometry:

- I. Determination of cell constant
- II. Determination of conductivity, molar conductivity, degree of dissociation and dissociation constant of a weak acid.
- III. Perform the following conductometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Mixture of strong acid and weak acid vs. strong base iv. Strong acid vs. weak base

Chemical Kinetics:

- IV. Study the kinetics of the following reactions.
 1. Iodide-persulphate reaction (i) Initial rate method; (ii) Integrated rate method
 2. Acid hydrolysis of methyl acetate with hydrochloric acid.
 3. Saponification of ethyl acetate.
 4. Comparison of the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the principles and methods involved in experiments of conductometry and chemical kinetics. (Remembering)
- CO2:** Explain the meaning of cell constant, conductivity, molar conductivity, degree of dissociation and dissociation constant of weak acids, explain the principle of determining end points of conductometric titrations, kinetics of reactions such as the iodide-perfulfate reaction, acid hydrolysis of methyl acetate etc. (Understanding)
- CO3:** Analyse and interpret the data obtained from conductance measurements, conductometric titrations, estimating the order of reactions. (Analysing)
- CO4:** Determine the cell constant, conductivity, molar conductivity, determining equivalence points through conductometric titrations of weak acids with weak bases, strong acids with strong bases etc. (Evaluating)
- CO5:** Determine the method best suited for measuring conductivity of an electrolyte solution, the equivalence point in a conductometric titration, the order of a chemical reaction. (Evaluating)
- CO6:** Design experiments to measure conductivity of electrolytes, equivalence point of an acid-base reaction conductometrically, determine the order of a reaction. (Creating)

Suggested Readings

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry; McGraw-Hill: New York
3. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry; W.H. Freeman & Co.: New York

CHOS6113: ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY - LAB**(2 Credits)****Section A: Inorganic Chemistry**

1. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given)
Paper chromatographic separation of Fe^{3+} , Al^{3+} and Cr^{3+} or
Paper chromatographic separation of Ni^{2+} , Co^{2+} , Mn^{2+} and Zn^{2+}
2. Preparation of any two of the following complexes and measurement of their conductivity: (i) tetraamminecarbonatocobalt (III) nitrate
(ii) tetraamminecopper (II) sulphate
(iii) potassium trioxalatoferate (III) trihydrate
Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl_2 and LiCl_3

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, alcoholic, phenolic, carbohydrates, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative

Suggested Readings

1. Vogel, A. I., Qualitative Inorganic Analysis, Prentice Hall
2. Vogel, A. I., Quantitative Chemical Analysis, Prentice Hall

3. Vogel, A. I., Textbook of Practical Organic Chemistry, Prentice Hall
4. Mann, F. G. and Saunders, B. C., Practical Organic Chemistry, Orient Longman.

CHCK6114:CHEMISTRY OF S- AND P- BLOCK ELEMENTS, STATES OF MATTER AND CHEMICAL KINETICS LAB

(2 Credits)

Section A: Inorganic Chemistry

Semi-micro qualitative analysis of mixtures using H₂S or any other scheme- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH₄⁺, Pb²⁺, Bi³⁺, Cu²⁺, Fe³⁺, Al³⁺, Co²⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, K⁺

Anions : CO₃²⁻, S²⁻, SO₃²⁻, NO₃⁻, CH₃COO⁻, Cl⁻, Br⁻, I⁻, NO₃⁻, SO₄²⁻, PO₄³⁻, BO₃³⁻, C₂O₄²⁻ F⁻

(Spot tests should be carried out wherever feasible)

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).

- a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
- b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

- a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
- b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
 - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
 - b. Saponification of ethyl acetate.
 - c. Compare the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate

Suggested Readings

1. Vogel, A. I. Qualitative Inorganic Analysis, Prentice Hall
2. Vogel, A. I. Quantitative Chemical Analysis, Prentice Hall
3. Khosla, B. D. Senior Practical Physical Chemistry, R. Chand & Co.

DEPARTMENT OF MATHEMATICS

Vision:

To elucidate the philosophy of Mathematical principles coupled with the exhibition of Mathematical laws in fundamental and frontier areas of science whereupon fostering an intuitive mathematical mind.

Mission:

1. To provide adequate understanding of Mathematical laws by means of both conventional techniques and skilful approaches.
2. To familiarize students as well as faculty members with the state-of-the-art by means of talks, workshops, symposia.
3. To invoke interest tinged with anxiety to facilitate further pursuit in terms of research pertaining advanced knowledge.

PROGRAM OUTCOMES FOR BSc PROGRAMME

1. Bachelor's degree in mathematics is the culmination of in-depth knowledge of algebra, calculus, geometry, differential equations and several other branches of mathematics. This also leads to study of related areas like computers science and statistics. Thus , this programme helps learners in building a solid foundations for higher studies in mathematics.
2. The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilized in modelling and solving real life problems.
3. Students undergoing this programme learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. They also share ideas insights while seeking and benefitting from knowledge and insight of others, which helps to learn behave responsibility in a rapidly changing interdependent society.
4. Students completing this prigramme will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians,
5. Completion of this programme will also enable the learners to join Teaching profession .
6. This programme will also help students to enhance their employability for government jobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

PROGRAM OUTCOMES FOR MSc PROGRAMME

At the successful completion of the program, a student will be able to

- Explain the role of Mathematics in almost every area of Science and Technology
- Understand a given complex problem and simplify the same using appropriate Mathematical theories
- Apply Mathematical principles to deal with problems in other related areas for example, applying Number theoretic to solve problems in Cryptography, Group theoretic properties to establish insolvability of a quintic etc.
- Formulate adequate Mathematical models to assess risk managements in financial markets.

- Demonstrate various physical situations using principles of applied Mathematics for instance predicting population growth using differential equations.
- Extend certain level of knowledge in a specific area of Mathematics to research in the same or related area.
- Effectively communicate the research works to entire Mathematical community by means of scientific publication, conference presentation etc.

DETAILED SYLLABUS

MADM0002: DISCRETE MATHEMATICS

(4 credits – 60 hours)

Objective: *The objective of this course is to introduce the student of Computer Applications to the principles of Discrete Mathematics and Probability Theory which have applications in Computer Science and the development of logical thinking. Discrete Mathematics exposes the student to algebraic structures, combinatorial mathematics and graph theory. The necessary abstract mathematical content is to be dealt with and explained in the context of its application to computer science to present to the students the foundations of many basic computer related concepts.*

Module I: Sets, Relations and Functions (13 Hours)

Sets, set operations; binary relations, types of relations, partitions; partial order relations, Hasse and lattice diagrams for posets; functions, types of functions, composition of functions, Congruences, Chinese Remainder theorem

Module II: Algebraic Structures (20 Hours)

Semi groups, products and quotients of semi groups; groups, cosets, normal subgroups, quotient groups, Lagrange's Theorem, products of groups; use of groups in coding of binary information and error detection, decoding and error correction.

Module III: Combinatorics and Recurrence Relations (12 hours)

Permutation and combination, principles of counting and enumeration; recurrence relations, the fibonacci sequence, solutions of recurrence relations by substitution and generating functions, solution of non-recurrence relations by conversion to linear recurrence relations.

Module IV: Introduction to Graph Theory (15 hours)

Introduction to graphs, representation of graphs, graph isomorphisms, subgraphs, directed and undirected graphs; Eulerian paths and circuits; Hamiltonian paths and circuits; change of sequence - coloring of graphs; trees.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the basic concepts associated with set theory, Group theory, Graph theory and combinatorics and develop their logical thinking. (Remembering)
- CO2:** Solve those problems by using the basic computer science. (Applying)
- CO3:** Apply these concepts in various theories of computer science like coding theory etc. (Applying)
- CO4:** Analyze methods to obtain the solution. (Analyzing)
- CO5:** Choose suitable mathematical concepts and logic in solving problems of computer science. (Evaluating)

CO6: Develop these concepts in a practical manner apart from having conceptual understanding of the already mentioned concepts. (Creating)

Suggested Readings

1. Kolman, R.C. Busby and S.C. Ross, Discrete Mathematical Structures, Prentice Hall of India, New Delhi, 2002.
2. Trembly and P. Manohar, Discrete Mathematical Structures With Applications to Computer Science, McGraw Hill.
3. J.L. Mott, A. Kandel and T.P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, New Delhi, 2004.
4. Somasundaran, Discrete Mathematical Structures, Prentice Hall of India, New Delhi, 2003.

E-resource for learning

Scilab,, www.spoken-tutorial.org

MABM0006: BASIC MATHEMATICS

(4 credits – 60 hours)

Objective: The primary objective of this course is to introduce students some of the mathematics through which they can develop some mathematical maturity, that is enhance their ability to understand and create mathematical arguments. The secondary objective of this course is to prepare students for mathematical oriented courses in computer science such as discrete mathematics, database theory, analysis of algorithms, etc.

Module I: Determinants and Matrices (12 Hours)

- a) Determinants: Definition, minors, cofactors, properties of determinants
- b) Matrices: Definition, types of matrices, addition, subtraction, scalar multiplication and multiplication of matrices, adjoint, inverse, Cramer's Rule, rank of matrix, linear dependence of vectors, Eigenvectors of a matrix, Cayley-Hamilton Theorem.

Module II: Limits and Continuity (15 Hours)

Limit of a function at a point, properties of limit, computation of limits of various types of functions, continuity of a function at a point, continuity over an interval, Intermediate value theorem

Module III: Differentiation (18 Hours)

Derivative of a function, derivatives of sum, difference, product and quotient of functions, chain rule, derivatives of composite functions, Rolle's theorem, mean value theorem, expansion of functions (Maclaurin's and Taylor's), indeterminate forms, L'Hospital's rule, maxima and minima.

Module IV: Integration (15 Hours)

Indefinite integrals, methods of integration: substitution, by parts, partial fractions; Integral as the limit of a sum, fundamental theorem of calculus.

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the fundamental concepts of calculus and matrix theory. (Remembering)
- CO2:** Demonstrate the practical implementations of these concepts. (Understanding)
- CO3:** Apply the mathematical notions to various aspects of computer Science. (Applying)
- CO4:** Analyze every problem, be it theoretical or computational in terms of its corresponding mathematical formulation. (Analyzing)
- CO5:** Determine suitable methods, first to formulate the problem and then to solve the same. (Evaluating)

CO6: Solve problems by virtue of a set of Hypothesis. (Creating)

Suggested Readings

1. B.S. Grewal, "Elementary Engineering Mathematics", 34th Ed., 1998. b) Shanti Narayan , "Integral Calculus", S. Chand and Company, 1999
2. H.K. Dass, "Advanced Engineering Mathematics", S. Chand and Company, 9th Revised Edition, 2001.
3. Shanti Narayan, "Differential Calculus", S.Chand and Company, 1998.

MAPT0008: PROBABILITY THEORY

(3 credits – 45 hours)

Objective: *The objective of this preliminary course in Probability Theory is to introduce the students of Computer Applications to the elementary principles of Probability Theory, random variables and probability distributions which have applications in the theory of Computing.*

Module I: Introduction to Probability Theory (11 Hours)

Sample space and events, probabilities of events and combinations of events, conditional probability, stochastic independence, Baye's theorem.

Module II: Random Variables (10 hours)

Random Variables, Discrete and continuous random variables, properties of random variables – expectation, mean, variance, moments

Module III: Probability Distributions (11 Hours)

Probability distributions – binomial, Poisson and hyper-geometric distributions; normal distribution, properties, examples, relation to Poisson approximation

Module IV: (13 hours)

- a) Random sampling – sampling with and without replacement, sample mean, sample variance
- b) Confidence intervals for a single population – parameters and statistics, confidence intervals for means, confidence intervals for variances.
- c) Hypothesis tests for a single population – testing of hypothesis about parameters, hypothesis tests for means, hypotheses tests for variances.

COURSE /LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables. (Remembering)
- CO2:** Illustrate the importance of probability and statistics in computing and research Develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries. (Understanding)
- CO3:** Utilize appropriate statistical methods in the analysis of simple datasets. (Applying)
- CO4:** Analyze how to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions. (Analyzing)
- CO5:** Interpret and clearly present output from statistical analyses in a clear concise and understandable manner. (Evaluating)
- CO6:** Create methodologies to translate real-world problems into probability models. (Creating)

Suggested Readings

1. Seymour Lipschutz and John Schiller, Introduction to Probability and Statistics, Tata McGraw-Hill Edition, 2005
2. William Feller, An Introduction to Probability Theory and its Applications, Vol 1, Wiley Eastern Pvt. Ltd., New Delhi, 1972.
3. E. Parzen, Modern Probability Theory and Its Applications, Wiley Eastern University Edition, California, 1960.
4. Papoulis, Probability and Statistics, Prentice Hall, 1990.

MACA0012: MATHEMATICS I - CALCULUS AND LINEAR ALGEBRA**(4 credit-60 hours) (L-T-P:3-1-0)**

Objective: *The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate differentiation and linear algebra. It aims to equip the students with standard concepts and tools from an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.*

Module I: Differential and Integral Calculus (23 hours)

- (a) Rolle's theorem, mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; maxima and minima.
- (b) Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; maxima, minima and saddle points; method of Lagrange multipliers.
- (c) Evolutes and involutes; evaluation of definite and improper integrals; beta and gamma functions and their properties; applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module II : Sequence and Series (11 hours)

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions; Fourier series: half range sine and cosine series, Parseval's theorem.

Module III: Linear Algebra (11 hours)

Vector space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, inverse of a linear transformation, rank nullity theorem, composition of linear maps, matrix associated with a linear map.

Module IV: Matrices (15 hours)

Matrices, linear systems of equations, linear independence, rank of a matrix, determinants, Cramer's rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination. eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Students will be able to define fundamental concepts of mathematical analysis and linear algebra viz. limit, continuity, differentiability, vector space, basis to name a few (Remembering)
- CO2:** Apart from remembering the already mentioned concepts, students will be able to relate the relevant concepts. (Understanding)

- CO3:** Students will be able to develop problems involving various physical situation and will be able to solve such problems. (Applying)
- CO4:** Students will be able to analyze certain problems which are not solvable initially whereupon suggesting possible conditions for the solution of the same. (Analyzing)
- CO5:** Students will be able to learn the fundamental distinction between various methods applied for the solution of the same problem and also when to apply which method. (Evaluating)
- CO6:** Students will be able compile the information and knowledge they gain to produce a new solution of a problem or replace an existing one. (Creating)

Suggested Readings

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

MAIN0013: MATHEMATICS II - MULTIPLE INTEGRALS, NUMERICAL METHODS AND DIFFERENTIAL EQUATIONS

(4 credit-60 hours) (L-T-P:3-1-0)

Objective: *The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and numerical techniques. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.*

Module I: Multiple Integrals (12 hours)

Gradient, curl and divergence, multiple integration: Double and triple integrals (cartesian and polar), change of order of integration in double integrals, change of variables (cartesian to polar), applications: areas and volumes by (double integration) Center of mass and gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, simple applications involving cubes, sphere and rectangular parallelepipeds.

Module II: Numerical Methods (23 hours)

- a. Solution of polynomial and transcendental equations – bisection method, Newton-Raphson method and Regula-Falsi method. finite differences, relation between operators, interpolation using Newton's forward and backward difference formulae. interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. numerical differentiation
- b. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predictor-corrector methods. partial differential equations: finite difference solution two dimensional Laplace equation and Poisson equation, implicit and explicit methods for one dimensional heat equation

Module III: Ordinary Differential Calculus (15 hours)

Exact, linear and Bernoulli's equations, Euler's equations, equations not of first degree: equations solvable for p , equations solvable for y , equations solvable for x and Clairaut's type. second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module IV: Introduction to Partial Differential Equations (10 hours)

First order partial differential equations, solutions of first order linear and non-linear PDEs. solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral methods.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Students will be able to recall the basic concepts associated with integration of a several variable function, differential equation and numerical methods etc. (Remembering)
- CO2:** Students will be able to illustrate the various physical significance of these concepts. (Understanding)
- CO3:** Students will be able to apply these concepts in numerous physical problems and will be able to tackle these problems efficiently. (Applying)
- CO4:** Students will be able to analyze the type of problems that does not possess any analytical solution whereby solving those problems through some other method like numerical method etc. (Analyzing)
- CO5:** Students will be able to decide which method of solution is applicable to what type or class of problems and the advantages and demerits of other methods leading to the solution of the same problem. (Evaluating)
- CO6:** Students will be able to combine the knowledge of various concepts gained so far to propose a new solution or methodology towards a problem or a process. (Creating)

Suggested Readings

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Ed., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
6. B.V.Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

MARA0014: REAL ANALYSIS**(4 Credits - 60 hours)**

Objective: The objective of this course is to introduce to a student various algebraic properties of the real number system. Moreover, the present course also serves as an introductory course on principles of real analysis that undertakes all the key notion of any form of Mathematical analysis.

Module I (14 hours)

Review of set theory, relations and functions, finite and infinite sets, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequence of real numbers, bounded sequence, limsup, liminf, Cauchy sequences, Series, convergence of series, root and ratio tests, absolute convergence.

Module II (8 hours)

Limit, Continuity, types of discontinuity, Intermediate value theorem, Fixed point theorem, uniform continuity, Monotonic functions.

Module III (14 hours)

Sequence and series of real valued functions, Point wise and uniform convergence, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration. Cauchy criteria for uniform convergence. Series of functions and convergence, Weierstrauss M-test.

Module IV (12 hours)

Riemann sums and Riemann integral, Riemann-Stieltjes Integrals, Improper Integrals Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems.

Module V (16 hours)

Open and closed sets, limit points, interior points, Euclidean space, compact spaces, Bolzano Weierstrass theorem, Heine Borel theorem in \mathbb{R} only.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the fundamental concepts of mathematical analysis like algebraic and order properties of real numbers, continuity, differentiability, integration etc. (Remembering)
- CO2:** Explain of the already mentioned concepts, students will be able to have a systematic understanding of the interface among these concepts. (Understanding)
- CO3:** Organize the problems involving numerous practical situations and will be able to solve such problems. (Applying)
- CO4:** Analyse roles played by each such concept in a certain problem and will be able to apply properties of the pertinent concept. (Analysing)
- CO5:** Perceive the fundamental distinction between various rules applied for the solution of a problem and also which method suits a certain problem the most. (Evaluating)
- CO6:** Build a clear understanding of where the hypothesis of a given problem undertakes such concepts whence solving the problem. (Creating)

Suggested Readings

1. Principles of Mathematical Analysis (5th edition) – W. Rudin, McGraw Hill Kogakusha Ltd., 2004.
2. Mathematical Analysis (5th edition) – T. Apostol, Addison-Wesley; Publishing Company, 2001.
3. Introduction to Real Analysis (3rd edition) – R. G. Bartle and D. R. Sherbert, John Wiley & Sons, Inc., New York, 2000.
4. The Elements of Real Analysis (3rd edition) – R. G. Bartle, Wiley International Edition, 1994.

MALAO015: LINEAR ALGEBRA**(4 Credits - 60 hours)**

Objective: *The objective of the present course is to introduce to a student the preliminaries of linear algebra. This course also intends to provide the students the knowledge of properties of matrices which is plays a key role in applicable as well as computational mathematics.*

Module I (10 hours)

Vector spaces, subspaces, quotient spaces, linear dependence, basis, dimension of a vector space, Linear Transformations.

Module II (20 hours)

Algebra of Matrices, trace of matrices, rank and determinant of matrices, system of linear equations. Eigenvalues and eigenvectors, relation between characteristic and minimal polynomial, Cayley-Hamilton theorem, Diagonalizability.

Module III (10 hours)

Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms.

Module IV (15 hours)

Inner product spaces, properties of inner products and norms, Cauchy-Schwarz inequality, Orthogonality and orthogonal complements, orthonormal basis, Gram-Schmidt process.

Module V (5 hours)

Quadratic forms, reduction and classification of quadratic forms.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the fundamental concepts associated with linear algebra and the role played by the theory of matrices. (Remembering)
- CO2:** Explain the key concepts of linear algebra; students will have the knowledge of the various physical significance of these concepts. (Understanding)
- CO3:** Apply concepts like linear independence, basis in various engineering problems and will be able to handle such problems in an efficient manner. (Applying)
- CO4:** Analyse for instance, the solvability of a system of linear equations in the form of a matrix and can infer important results. (Analysing)
- CO5:** Decide for example, under what condition a given linear transformation is diagonal and to what extent a given transformation can be diagonalized. (Evaluating)
- CO6:** Create the class of system of linear equations as consistent and inconsistent systems. (Creating)

Suggested Readings

1. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall, 1984.
2. G.E. Shilov, Linear Algebra, Prentice Hall, 1998.
3. Linear Algebra, A Geometric Approach – S. Kumaresan, Prentice-Hall of India Pvt. Ltd., NewDelhi,2001.

MAAB0016: ABSTRACT ALGEBRA

(4 Credits - 60 hours)

Objective: *The primary objective of the present course is to introduce to a student the basics of abstract mathematics, a notion that is inevitable in every branch of mathematics. Moreover, the present course also serves as the pre-requisite to topics like Galois theory and represent theory.*

Module I (15 hours)

Review of Groups, Cayley's theorem, class equations, Sylow theorems and its applications, Direct products of groups, Solvable groups, Jordan-Holder theorem

Module II (20 hours)

Rings, ideals, prime and maximal ideals, quotient rings, Euclidean domain. principal ideal domain, unique factorization domain, Polynomial ring over a field, reducible and irreducible polynomials, irreducibility criteria.

Module III (20 hours)

Fields, finite fields, field extensions, Algebraic extensions, Galois Theory.

Module IV (5 hours)

Fundamentals of representation theory.

MAAB0016: ABSTRACT ALGEBRA

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Show their understanding of the basic concepts associated with abstract algebra for example group, ring, field etc. (Remembering)
- CO2:** Relate these concepts to study the symmetries of a polygon, rotation of a cube etc. (Understanding)
- CO3:** Utilize these concepts in various problems arising in mathematical physics and many other theoretical problems like insolvability of a quintic. (Applying)
- CO4:** Analyse the problem by Analysing the properties of the related structure. (Analysing)
- CO5:** Classify the set of problems depending upon the underlying structure. (Analysing)
- CO6:** Propose the possible outcomes of the problem. (Creating)

Suggested Readings

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Limited, New Delhi, 1975.
2. N. S. Gopalakrishnan, University Algebra, Wiley Eastern, 1991.
3. J. A. Gallian, Contemporary Abstract Algebra, Narosa, 1995.
4. Dummit & Foote, Algebra, John Wiley & Sons, 2005.

MADE0017: DIFFERENTIAL EQUATIONS

(4 Credits-60 Hours)

Objective: *The present course aims to introduce to a student the theory of ordinary differential equation which plays a key role in almost every physical situation. Apart from that, the course can also be viewed as an introductory course on partial differential equation.*

Module I (12 hours)

Classification of Differential Equations, Their origin and solution; Exact differential equation and integrating factors, special integrating factors, linear equation and Bernoulli equations. existence and uniqueness for initial Value problem: Peano and Picard theorem

Module II (14 hours)

Second order Linear Differential equations, dimension of the solution space for homogeneous equations, general solution for non-homogeneous Equations.; method of undetermined coefficients, method of variation of parameters. Power series solution about an ordinary point, solution about singular points, Frobenius method BVP, Sturm-Liouville Problem, Orthogonality of Characteristic functions, Fourier series exp.

Module IV (26 hours)

Origin of Partial Differential Equation, Linear and quasi-linear partial differential equation, method of characteristics, Lagrange's and Charpit's method to solve first order PDE, Cauchy problem for first order PDE, Classification of PDEs(second order), Method of separation of variables for Heat(one and two dimension), Wave and Laplace equation.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the fundamental concepts associated with differential equations like linear and non linear differential equation, solution of a differential equation etc. (Remembering)
- CO2:** Extend of the above mentioned concepts and also have a conceptual insight of the underlying mathematical analysis. (Understanding)
- CO3:** Organize problems involving various physical situations and will be able to solve such problems. (Applying)
- CO4:** Analyse certain problems which are not solvable initially, whereupon suggesting possible conditions for the solution of the same. (Analysing)
- CO5:** Build a clear understanding of the necessity and sufficiency of the hypothesis related to the solution of a certain problem. (Creating)
- CO6:** Distinguish between various methods applied for the solution of the same problem and also decide when to apply which method. (Evaluating)

Suggested Readings

1. S. L. Ross, Differential Equations, 3rd Edition, Wiley-India.
2. W. Strauss, Partial Differential Equations an introduction, 2nd Edition, John Wiley and Sons, Ltd.
3. Tye Myint U and L. Debnath; Linear PDE for scientist and engineers, Fourth edition, Birkhauser Boston

MAMT0018: MATHEMATICAL METHODS I**(4 Credits-60 hours)**

Objective: *The present course basically deals with the various numerical and computational techniques of applied mathematics which are indispensable in other areas of Mathematics for instance, fluid dynamics, numerical linear algebra etc. Moreover, this course can also be viewed as an introduction to operation research.*

Numerical Analysis**Module I (10 hours)**

Numerical solution of algebraic and Transcendental equations: Bisection method, Regula-Falsi methods and Newton-Raphson method; Rate of convergence of these methods.

Solution of systems of linear algebraic equations: Gauss elimination method, Gauss-Jordan method, Gauss-Seidel methods, Error analysis.

Module II (6 hours)

Interpolation: Finite differences, Newton's forward and backward difference interpolations, Central difference interpolation, Lagrange's and Newton's divided difference interpolation, Hermite and spline interpolation.

Module III (15 hours)

Numerical differentiation and integration: Differentiation using interpolation formulae (Newton's forward and backward difference interpolation, Central difference interpolation, Lagrange's and Newton's divided difference interpolation), Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rule, Romberg method.

Module IV (14 hours)

Numerical solutions of ODE and PDE: Initial value problem for ODE of first and second order, Taylor series method, Picard's method, Euler and modified Euler methods, Runge-Kutta methods, Milne's and Adam's predictor and corrector methods, Finite difference solution of second order ODE and PDE.

Linear programming

Module V (15 hours)

Mathematical formulation of LPP, Solution of a LPP by graphical method, simplex method, Revised simplex method, Duality. Transportation and Assignment problem, Two person-zero sum games. Equivalence of Rectangular game and linear programming.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the basic methods associated with numerical integration and differentiation, linear programming problem etc. (Remembering)
- CO2:** Demonstrate the knowledge regarding the advantages and limitations of these methods. (Understanding)
- CO3:** Utilize these concepts in various engineering problems involving signal processing etc. to get the solution up to certain accuracy. (Applying)
- CO4:** Analyse various possible methods to obtain the solution. (Analysing)
- CO5:** Compare various methods of solution of a problem and predicting the degree of accuracy, to determine the suitability of a certain method for a certain problem. (Evaluating)
- CO6:** Predict the efficiency of one method over the other whereby relating various problems for which such methods are applicable. (Creating)

Suggested Readings

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical methods, Problems and solutions, NewAge International (P) Ltd., 1996.
2. S. D. Conte and Carl de Boor, Elementary Numerical Analysis - An Algorithmic Approach, 3rd Edition, McGraw Hill, 1980.
3. K. E. Atkinson, Introduction to Numerical Analysis, 2nd Edition, John Wiley, 1989.
4. H. A. Taha, Operations Research: an Introduction, Macmillan, 1982.
5. Kanti Swarup, P. K. Gupta and M. M. Singh, Operations Research, Sultan Chand and Sons, 1985.

MATF0019: TOPOLOGY AND FUNCTIONAL ANALYSIS**(4 Credits-60 hours)**

Objective: *The basic objective of the present course is to introduce to a student the notion of topology, the general framework under which every form of Mathematical analysis works. Apart from that, this course can also be treated as the beginner's course on functional analysis.*

Module I (11 hours)

Metric spaces, open and closed sets, limit points, interior points, convergence, Cauchy sequence, completeness, completion in metric spaces, separable spaces.

Module II (10 hours)

Topological Spaces, Basis for a topology, The order topology, The product topology, The subspace topology, Closed sets and limit points, convergent sequence, Continuous function, homeomorphism, metric topology.

Module III (8 hours)

Connected spaces, connected subspaces of real line, Components, local connectedness, Compact spaces, compact spaces of real line, limit point compactness, local compactness.

Module IV (8 hours)

The countability axioms, the separation axioms, Urysohn Lemma, Urysohn metrization theorem. Tychonoff's theorem, Stone-Cech Compactification.

Local finiteness, the Nagata-Smirnov Metrization theorem, paracompactness, the Smirnov Metrization theorem, space of continuous function.

Module VI (15 hours)

Normed linear spaces, properties of normed linear spaces, Banach space, Hahn-Banach theorem, Open mapping theorem, Closed graph theorem, Principle of uniform boundedness, Hilbert spaces, Orthogonal complements, orthonormal sets, the Reisz representation theorem, Bessel's inequality, Parseval's identity, The dual space, self –adjoint, normal and unitary operators.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the basic concepts like open and closed sets, norm of a vector etc. (Remembering)
- CO2:** Demonstrate the knowledge regarding for instance how to measure the distance between two vectors, length of a vector etc. (Understanding)
- CO3:** Apply these concepts in various fields of engineering and applied sciences. (Applying)
- CO4:** Analyse different topological spaces depending upon various properties possessed by these spaces. (Analysing)
- CO5:** Assess the criteria behind the classification of topological spaces and the necessity to have such classification. (Evaluating)
- CO6:** Propose suitable space to consider between topological and normed spaces, depending upon the classification, for a certain problem. (Creating)

Suggested Readings

1. G. F. Simmons, Introduction to topology and modern analysis, 2nd Edition, Tata-Mcgraw-Hill,
2. J. R. Munkres, Topology, 2nd Edition, Prentice Hall.
3. E. Kreyszig, Introductory functional analysis with application, John Willey and Sons.

MACA0020: COMPLEX ANALYSIS

(4 Credits-60 Hours)

Objective: *The basic objective of the present course is to familiarize a student about another form of Mathematical analysis called complex analysis. Apart from being one of the most important branches of analysis at its own, the notion of complex analysis is crucial for those who intends to pursue research in the field of Operator theory.*

Module I (10 hours)

Complex numbers and their properties, Complex Plane, Polar form of complex numbers, Powers and roots, set of points in the complex plane. Complex function, Special power functions, Reciprocal function.

Module II (15 hours)

Limits and Continuity, differentiability and analyticity, Cauchy-Reimann equations, Harmonic functions, Exponential and Logarithmic functions, complex powers, Trigonometric and Hyperbolic functions.

Module III (20 Hours)

Complex integrals, Cauchy-Goursat Theorem, Cauchy's integral formula and their consequences, Taylor and Laurent series, Zeroes and poles, Residues and residue theorem and consequences, evaluation of real improper integrals.

Module IV (15 hours)

Entire function, Liouville's theorem, Maximum modulus principle, Schwarz Lemma, Schwarz-Pick Lemma, Open Mapping theorem. Conformal Mapping, Linear Fractional Transformations, Cross Ratio.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the basic concepts associated with complex analysis like analytic function, complex integration etc. (Remembering)
- CO2:** Demonstrate conceptual understanding regarding the difference between real and complex function theory. (Understanding)
- CO3:** Utilize these concepts in various engineering problems involving circuit problems, fluid flow to name a few, whereby solving these problems. (Applying)
- CO4:** Analyse different complex functions defined over certain domains. (Analysing)
- CO5:** Evaluate various physical problems by means of the properties of complex functions and the associated domain. (Evaluating)
- CO6:** Create complex functions satisfying common properties. (Creating)

Suggested Readings

1. S. Ponnusamy, Foundation of Complex Analysis, 2nd Edition, Alphascience International.
2. J. B. Conway, Functions of one Complex variable I, 2nd Edition, Springer.
3. Schaum's outlines, Complex variable, 2nd Edition.

MAMP0021: MEASURE THEORY AND PROBABILITY THEORY**(4 Credits-60 hours)**

Objective: *The prime objective of this course is to introduce to a student the fundamentals of measure theory both as a general subject and as a framework of probability theory. Apart from that, this course may also be viewed as the introductory course on probability theory.*

Module I (12 hours)

Algebra of sets, Borel set, extension of measures, Lebesgue measure on \mathbb{R} : outer measure, measurable sets and Lebesgue measure. Extension of measure, Lebesgue-Stieltjes measures and distribution functions.

Module II (18 hours)

Measurable functions and Integration: Lebesgue integral, Monotone convergence theorem, extended monotone convergence theorem, Fatou's Lemma, dominated convergence theorem, Comparison of Riemann and Lebesgue integral. Radon-Nikodym Theorem and related results

Module II (10 hours)

Probability axioms, sample spaces, events, law of total probability, conditional probability, Bayes' theorem and independence.

Module IV (20 hours)

Random Variables, types of random variables, distribution functions, function of random variables, standard univariate discrete and continuous distributions and their properties; expectations, moments, moments generating functions; Chebyshev's inequality, joint, marginal and conditional distributions; covariance, correlation; Random vectors, functions of random vectors, strong and weak law of large numbers, central limit theorem.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the fundamentals of measure theory like measurable sets and functions etc. (Remembering)
- CO2:** Explain regarding how the axioms of measure theory provide a framework of probability theory. (Understanding)
- CO3:** Apply concepts of measurable spaces to define and understand random variables, probability density function. (Applying)
- CO4:** Analyse how the notion of measure to explain some famous paradox such as Banach Tariski paradox. (Analysing)
- CO5:** Create different measure spaces depending upon certain axioms. (Creating)
- CO6:** Formulate necessary framework while dealing with certain problem of probability theory depending upon axioms of measure. (Creating) depending upon axioms of measure (Evaluation)

Suggested Readings

1. R.B.Ash and C.Doleans Dade; Probability and Measure Theory, Academic press
2. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Edn., Wiley, 1968.
3. V. K. Rohatgi and A. K. Md. E. Saleh, An Introduction to Probability and Statistics, 2nd Edn., Wiley, 2001.
4. Royden, H.L. and Fitzpatrick, P. M., Real Analysis, 4th Edition, Pearson, 2010
5. Halmos, P. R. Measure Theory (Springer-Verlag, 1974).

MAMD0022: MATHEMATICAL METHODS II

(4 Credits - 60 hours)

Objectives: *The basic idea of this course is to introduce to a student the concepts pertaining advanced mathematical techniques. The notion of Laplace and Fourier transform not only constitute transform calculus but also play a key role in other branches of science like Mathematical physics and signal processing.*

Module I (10 hours)

Linear functional, minimal functional theorem, general variation of a functional, Euler- Lagrange equation, Necessary and sufficient conditions for extrema, strong extremum and weak extremum, broken extremum; Weirstras Erdmann corner conditions

Module II (8 hours)

Linear integral equation of the first and second kind of Fredholm and Volterra type Reduction of ordinary differential equations into integral equations, Solution of integral Equations with separable kernels, Characteristic numbers and eigen functions, resolvent kernel.

Module III (12 hours)

Fourier Transform. Properties of Fourier Transform, Fourier sine and cosine transform, Inverse Fourier Transform, Application of Fourier transform to ordinary and partial differential equations of initial and boundary value problems.

Module IV (12 hours)

Laplace Transform and its properties, Convolution theorem, Inverse Laplace Transform, Application of Laplace Transform to solution of ordinary and partial differential equations of initial boundary value problems.

Module V (18 hours)

General solution of Bessel equation, Recurrence relations, Orthogonal sets of Bessel functions, Modified Bessel functions, Applications. General solution of Legendre equation, Legendre polynomials, Associated Legendre polynomials, Rodrigues formula, Orthogonality of Legendre polynomial, Concept and calculation of Green's function, Approximate Green's function, Green's function method for differential equations.

COURSE /LEARNING OUTCOMES:

At the end of this course, students will be able to:

- CO1:** Recall the fundamental methods associated with calculus of variations and Integral Equations etc. (Remembering)
- CO2:** Illustrate the knowledge regarding the efficiency of such methods to tackle various practical problems. (Understanding)
- CO3:** Utilize concept like Laplace and Fourier transform in numerous problem occurring various disciplines of engineering science. (Applying)
- CO4:** Analyse and classify differential Equations. (Analysing)
- CO5:** Evaluate for instance which class of differential equation is to be solvable by applying transform calculus. (Evaluating)
- CO6:** Create different physical models depending upon the classification of the associated differential equations. (Creating)

Suggested Readings

1. Gelfand and Fomin: Calculus of Variation (Dover Publications,2000)
2. A.S. Gupta: Calculus of Variation with Applications, Prentice-Hall of India (1999).
3. R.P. Kanwal: Linear Integral Equations, Theory and Techniques, Academic Press, New York, 1971.
4. S.G. Mikhlin: Linear Integral Equations, (Trans.) Hindustan Book Agency, 1960..
5. M.R. Spiegel: Theory and Problems of Laplace Transform
6. F.B. Hilderbrand: Methods of Applied Mathematics, (Dover Publications,1992)
7. N.N. Levedev, Special functions and their applications, (Dover Publications,1972)
8. G.E. Andrews, R.A. Askey, and R. Roy: Special Functions (Cambridge University Press,1999).

MACL0023: CLASSICAL MECHANICS**(4 Credits - 60 Hours)**

Objective: *The fundamental objective of this course to familiarize a student with the notion of classical mechanics. Moreover, this course provides a much needed framework for those who intend to pursue research in other branches of Mathematics and Physics.*

Module I (15 hours)

Introduction to the ideas of constrained motion, Different classifications of constrains of motion, Holonomic and nonholonomic constraints, rhenomic and scleronomic dynamical constraints, Concept of degree of freedom.

Introduction to generalized coordinates, generalized velocities, Total Kinetic energy of a system of particles in terms of generalized velocity. Introduction to generalized momenta and generalized force. D"Alemberts principle and Lagrangian form of equation motion of a dynamical system of N particles. Calculus of variations, Euler-Lagrange equation, application of calculus of variations in dynamical problems

Module II (12 hours)

Two dimensional motion of rigid bodies, Euler's dynamical equations of motion for a rigidbody, Motion of a rigid body about an axis, motion about revolving axis, Eulerian angles, Eulers theorem on the motion of a rigid body, infinitesimal rotations, rate of change of a vector, Coriolis force, Euler's equations of motion, force free motion of a rigid body.

Module III (18 hours)

Hamilton's principle, Lagrange's equations from Hamilton's principle, extension of Hamilton's principle to non-conservative and non-holonomic systems, conservation theorems and symmetry properties. Hamilton's equations of motion, conservation theorems and physical significance of Hamiltonian, Hamilton's equations from variational principle, principle of least action.

Module IV (15 hours)

Hamilton Jacobi Method : Hamilton - Jacobi equation, Time independent Hamilton - Jacobi equation, canonical transformation generated by Hamilton characteristic function, application of Hamilton - Jacobi equation in solving problems of mechanics.

COURSE/LEARNING OUTCOMES:

At the end of this course students will be able to:

- CO1:** Recall the fundamental of classical mechanics. (Remembering)
- CO2:** Illustrate the conceptual understanding of such notions. (Understanding)
- CO3:** Apply concepts of classical mechanics to model various practical situations. (Applying)
- CO4:** Analyse various physical motions by first forming the mathematical model and then studying the properties of such model. (Analysing)

- CO5:** Evaluate various practical situations by discussing the properties of existing models. (Evaluating)
- CO6:** Create different motion posed by rigid bodies depending upon the properties of various motions like Lagrangian and Hamiltonian. (Creating)

Suggested Readings

1. Classical Mechanics (3rd edition) – H. Goldstein, Addison Wesley Publications, Massachusetts, 2002.
2. Lagrangian and Hamiltonian Mechanics by M.G. Calkin, World Scientific, Singapore. 1996
3. Takwale, R. G. & Puranik, P. S. Classical Mechanics (Tata-McGraw Hill, 1979, 41st reprint, 2010).
4. Yung-Kuo, L. Problems and Solutions on Mechanics (World Scientific, 1994)

MAPS0024: MATHEMATICS III -PROBABILITY AND STATISTICS

(2-credit-30 hours) (L-T-P:2-0-0)

Objective: *The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.*

Module I: Basic Probability and Continuous Probability Distributions (12 hours)

- a. Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.
- b. Continuous random variables and their properties, distribution function and densities, normal, exponential and gamma densities.

Module II: Bivariate Distribution (5 hours)

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module III: Applied Statistics (13 hours)

Measure of Central tendency: Moments, skewness and Kurtosis-Probability distribution: Binomial, Poisson and Normal-evaluation of statistical parameters for these three distributions, Correlation and regression-Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations. Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables. (Remembering)
- CO2:** Appreciate the importance of probability and statistics in computing and research Develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries (Understanding)
- CO3:** Use appropriate statistical methods in the analysis of simple datasets (Analysing)

- CO4:** How to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions (Applying)
- CO5:** Interpret and clearly present output from statistical analyses in a clear concise and Understandable manner (Evaluating)
- CO6:** How to translate real-world problems into probability models (Creating)

Suggested Readings

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, Jpn Wiley & Sons, 2006
2. P.G.Hoel, S.C.Port and C.J.Stone , Introduction to Probability Theory, Universal Book Stall, 2003(Reprint)
3. S.Ross, A first course in Probability, 6th Ed., Pearson Education India, 2002
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol.1. 3rd Ed., Wiley, 1968
5. N.P.Bali and Manish Goyal, A text boool of Engineering Mathematics, Laxmi Publications, Reprint, 2010
6. B.S.Grewal, Highere Engineering Mathematics , Khanna publishers, 35th Edition,2000
7. Veeranjan T., Engineering Mathematics , Tata McGraw-Hill, New Delhi, 2010

MADM0025: DISCRETE MATHEMATICS WITH APPLICATIONS

(4-credit-60 hours) (L-T-P:3-1-0)

Objective: Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following:

- Use mathematically correct terminology and notation.
- Construct correct direct and indirect proofs.
- Use division into cases in a proof.
- Use counterexamples
- Apply logical reasoning to solve a variety of problems.

Module I: Sets, Relation and Function (14 hours)

Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Module II: Introduction to Counting (8 hours)

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.

Module III: Propositional Logic (12 hours)

Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Module IV:Algebraic Structures and Morphism (14 hours)

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups,

Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Module V: Graphs and Trees (12 hours)

Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefixcodes, Bi-connected component and Articulation Points, Shortest distances.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall some basic concept of set theory and number theory and understand the concept of graph theory and Group theory. (Remembering)
- CO2:** Interpret logic sentence in terms of predicates, quantifiers, and logical Connectives (Understanding)
- CO3:** For a given a mathematical problem, classify its algebraic structure (Analyzing)
- CO4:** Derive the solution of a problem using deductive logic and prove the solution based on logical inference (Applying)
- CO5:** Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra (Evaluating)
- CO6:** Develop the given problem as graph networks and solve with techniques of graph theory. (Creating)

Suggested Readings

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications, 4th edition, Wadsworth Publishing Co. Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.
4. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science", TMG Edition, Tata McGraw-Hill
5. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press.
6. Discrete Mathematics, Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson, Tata McGraw - Hill

MATC0026: MATHEMATICS III - TRANSFORM CALCULUS, COMPLEX VARIABLE AND PROBABILITY AND STATISTICS)

(3-credit-45 hours) (L-T-P:2-1-0)

Objective: *The objective of this course is to introduce transform calculus with applications in engineering and to provide an overview of complex variable and Probability and Statistics. It aims to equip the students with standard concepts and tools from an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.*

Module I: Transform Calculus (14 hours)

- a. Polynomials-Orthogonal Polynomial-Lagrange's, Chebysev polynomials; Trigonometric polynomials; Laplace transform, Properties of Laplace transform, Laplace transform of

periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace transform method.

- b. Fourier series: convergence and sum of Fourier series, even and odd functions, cosine and sine Fourier series; Fourier Integrals: Fourier cosine and sine integrals; Fourier transforms, Z-transform and wavelet transform: properties, methods, inverses and their applications

Module II: Complex variable (15 hours)

- a. Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.
- b. Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy integral formula (without proof), Liouville's theorem and Maximum-modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.

Module III: Basic Probability (8 hours)

Probability spaces, conditional probability, independence; Discrete random variables, the multinomial distribution, Poisson approximation to the binomial distribution, Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution function and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module IV: Applied Statistics (8hours)

Measures of Central tendency: Moments, skewness and Kurtosis -Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

COURSE /LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the terminologies, properties and results of complex variable, Laplace transformation and probability theory . (Remembering)
- CO2:** Classify types of singularities and different probability distributions. (Understanding)
- CO3:** Apply Laplace transform for evaluation of integrals by and solving ODEs and PDEs. (Application)
- CO4:** Analyze different measures of central tendency and test of significance,. (Analysis)
- CO5:** Determine the solution of higher order differential equations and choose any test of significance for practical problems. (Evaluating)
- CO6:** Formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data. (Creating)

Suggested Readings

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. J.W.Brown and R.V.Churchill, Complex variables and Applications, 7th ED., Mc-Graw Hill, 2004
3. M.R.Spiegel, Theory and Problems of Complex Variable , Tata McGraw Hill Publishing Company Ltd., New Delhi 2005
4. M.R.spiegel, Fourier Analysis with Application to Boundary Value Problems, Tata McGraw Hill Publishing Company Ltd., New Delhi 2005

5. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010
6. B.S.Grewal, Highere Engineering Mathematics , Khanna publishers, 35th Edition,2000

MACS0027: MATHEMATICS III - (COMPLEX VARIABLE, TRANSFORM CALCULUS, PROBABILITY AND STATISTICS)

(4-credit-60 hours) (L-T-P:3-1-0)

Objective: *The objective of this course is to introduce transform calculus with applications in engineering and to provide an overview of complex variable, probability and statistics to engineers. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.*

Module I: Complex variable (18 hours)

- a. Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.
- b. Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy integral formula (without proof), Liouville's theorem and Maximum-modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, evaluation of certain improper integrals using the Bromwich contour.

Module II: Transform Calculus (10 hours)

Laplace transform, properties of Laplace of transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace transform method. Fourier Series and Fourier transform.

Module III: Basic probability (10 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution function and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module IV: Applied Statistics (12 hours)

Measure of Central tendency: Moments, skewness and Kurtosis-Probability distribution: Binomial, Poisson and Normal-evaluation of statistical parameters for these three distributions, Correlation and regression-Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves. Test of significance : Large sample test for single proportion, difference of proportions, test for single mean, difference of means and standard deviations. Test for ratio of variance-Chi-square test for goodness of fit and independence of attributes.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the terminologies, properties and results of complex variable, Laplace transformation and probability theory . (Remembering)

- CO2:** Classify types of singularities and different probability distributions. (Understanding)
- CO3:** Apply Laplace transform for evaluation of integrals by and solving ODEs and PDEs. (Application)
- CO4:** Analyze different measures of central tendency and test of significance,. (Analysis)
- CO5:** Determine the solution of higher order differential equations and choose any test of significance for practical problems. (Evaluating)
- CO6:** Formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data.. (Creating)

Suggested Readings

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, Jphn Wiley & Sons, 2006
2. P.G.Hoel, S.C.Port and C.J.Stone , Introduction to Probability Theory, Universal Book Stall, 2003(Reprint)
3. S.Ross, A first course in Probability, 6th Ed., Pearson Education India, 2002
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol.1. 3rd Ed., Wiley, 1968
5. J.W.Brown and R.V.Churchill, Complex variables and Applications, 7th ED., Mc-Graw Hill, 2004
6. M.R.Spiegel, Theory and Problems of Complex Variable , Tata McGraw Hill Publishing Company Ltd., New Delhi 2005
7. M.R.spiegel, Fourier Analysis with Application to Boundary Value Problems, Tata McGraw Hill Publishing Company Ltd., New Delhi 2005
8. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010
9. B.S.Grewal, Highere Engineering Mathematics , Khanna publishers, 35th Edition,2000
10. Veeranjan T., Engineering Mathematics , Tata McGraw-Hill, New Delhi, 200

MATD0028: MATHEMATICS III- TRANSFORM CALCULUS AND DISCRETE MATHEMATICS

(2-credit-30 hours) (L-T-P:2-0-0)

Objective: *The objective of this course is to familiarize the prospective engineers with techniques in transform calculus and discrete mathematics. It aims to equip the students with standard concepts and tools from an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.*

Module I: Transform Calculus (9 hours)

- a. Polynomials-Orthogonal Polynomial-Lagrange's, Chebyshev polynomials; Trigonometric polynomials; Laplace transform, Properties of Laplace transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different ODE methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace transform method.
- b. Fourier transforms, Z-transform and wavelet transform: properties, methods, inverses and their applications.

Module II: Discrete Mathematics: *Sets, relations and functions*: (10 hours)

- a. Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions, their compositions and inverses. Complete partial ordering.
- b. Basic counting techniques – inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relation and generating functions. Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees.

Module III: Basic Probability and Distributions: (11 lectures)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall some basic concept of set theory and understand the concept of graph theory and Group theory and the properties and results of Laplace transformation ,Fourier series and Z-transforms a (Remembering)
- CO2:** Appreciate the importance of probability and statistics in computing and research Develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries (Understanding)
- CO3:** Analyze various possible methods to obtain the solution (Analyzing)
- CO4:** Derive the solution of a problem using deductive logic and prove the solution based on logical inference (Applying)
- CO5:** Determine the suitability of a certain method for a certain problem, (Evaluating)
- CO6:** Develop the given problem as graph networks and solve with techniques of graph theory. (Creating)

Suggested Readings

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. P.G.Hoel, S.C.Port and C.J.Stone , Introduction to Probability Theory, Universal Book Stall, 2003(Reprint)
3. S.Ross, A first course in Probability, 6th Ed., Pearson Education India, 2002
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol.1. 3rd Ed., Wiley, 1968
5. M.R.spiegel, Fourier Analysis with Application to Boundary Value Problems, Tata McGraw Hill Publishing Company Ltd., New Delhi 2005
6. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010
7. B.S.Grewal, Highere Engineering Mathematics , Khanna publishers, 35th Edition,2000
8. Veeranjan T., Engineering Mathematics , Tata McGraw-Hill, New Delhi, 2008

MACP0029: MATHEMATICS III - COMPLEX VARIABLES, PDE AND PROBABILITY AND STATISTICS

(4-credit-60 hours)(L-T-P:3-1-0)

Objective: *The objective of this course is to introduce the solution methodologies for second order partial differential equations with applications in engineering and to provide an overview of complex variable, probability and statistics to engineers. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.*

Module I: Complex Variables (19 hours)

- a) Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

- b) Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy integral formula (without proof), Liouville's theorem and Maximum-modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, evaluation of certain improper integrals using the Bromwich contour.

Module II: Partial differential equations (17 hours)

Second order linear equations and their classification, initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Finite vibrating string problem and Fourier series. Heat diffusion and vibration problems, separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solution with Bessel functions and Legendre function. One dimensional diffusion equation and its solution by separation of variables.

Module III: Basic probability (12 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution function and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module IV: Applied Statistics (12 hours)

Measure of Central tendency: Moments, skewness and Kurtosis-Probability distribution: Binomial, Poisson and Normal-evaluation of statistical parameters for these three distributions, Correlation and regression-Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves. Test of significance : Large sample test for single proportion, difference of proportions, test for single mean, difference of means and standard deviations. Test for ratio of variance-Chi-square test for goodness of fit and independence of attributes.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables. (Remembering)
- CO2:** Appreciate the importance of probability and statistics in computing and research Develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries (Understanding)
- CO3:** Apply the methods of complex analysis to evaluate definite integrals and infinite series. (Analysing)
- CO4:** Apply partial derivative equation techniques to predict the behavior of certain phenomena. (Applying)
- CO5:** Analyse, synthesise, organise and plan projects in the field of study (Evaluating)
- CO6:** Prove basic results in complex analysis (Creating)

Suggested Readings

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. P.G.Hoel, S.C.Port and C.J.Stone , Introduction to Probability Theory, Universal Book Stall, 2003(Reprint)
3. S.Ross, A first course in Probability, 6th Ed., Pearson Education India, 2002

4. W. Feller, An Introduction to Probability Theory and its Applications, Vol.1. 3rd Ed., Wiley, 1968
5. J.W.Brown and R.V.Churchill, Complex variables and Applications, 7th ED., Mc-Graw Hill, 2004
6. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010
7. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, 35th Edition, 2000
8. Veeranjan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008

MADS0030: DISCRETE MATHEMATICS

(4-Credit-60 hours)

Objective: Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following:

- Use mathematically correct terminology and notation.
- Construct correct direct and indirect proofs.
- Use division into cases in a proof.
- Use counterexamples
- Apply logical reasoning to solve a variety of problems.

Module I: Set Theory (18 hours)

Sets and classes, relations and functions, Equivalence Relation, Partial Ordering Relation, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, Cardinal and ordinal numbers, Lattice; The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic

Module II: Logic (15 hours)

Propositional logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. Predicate Calculus

Module III: Combinatorics (12 hours)

Combinatorics: Mathematical induction, recursive mathematical definitions, basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function (closed form expression, properties of generating functions., solution of recurrence relation using generating functions, solution of combinatorial problem using generating functions)

Module IV: Graphs and Trees (15 hours)

Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges; trees

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall some basic concept of set theory and number theory and understand the concept of graph theory and Group theory. (Remembering)
- CO2:** Interpret logic sentence in terms of predicates, quantifiers, and logical Connectives (Understanding)

- CO3:** For a given a mathematical problem, classify its algebraic structure (Analysing)
- CO 4:** Derive the solution of a problem using deductive logic and prove the solution based on logical inference (Applying)
- CO5:** Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra (Evaluating)
- CO6:** Develop the given problem as graph networks and solve with techniques of graph theory. (Creating)

Suggested Readings:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
2. Susanna S. Epp, Discrete Mathematics with Applications, 4th edition, Wadsworth Publishing Co. Inc.
3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.
5. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science", TMG Edition, TataMcgraw-Hill
6. 5.Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press. Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson,
7. 6. Discrete Mathematics, Tata McGraw - Hill

MACP0031: COMPUTER PROGRAMMING IN C

(2 Credits-30 hours)

Objective: This first course in Computer Programming aims to develop the analytical skills of the students for creative problem solving using computers. Specifically this course will

- Discuss basic concepts of algorithms and programs
- Enable the student to develop solutions for common problems
- Familiarize the student with the syntax of C language and teach him/her to translate pseudo-code into C programs, understanding the steps involves in the execution of a C program
- Make the student well conversant with managing functions.
- Get introduced to arrays, structures and files in C.

Module I: Introduction to Algorithms and Programming Languages (8 hours)

Introduction to structured programming and problem solving methods: Algorithms, key features of algorithms, flowcharts, pseudocode, generation of programming languages, structured programming languages. Overview of C: Introduction to C, basic structure of a C program, compiling and executing C programs, comments, characteristics of a good program, character set, identifiers, keywords, data types, constants and variables, I/O statements, operators and expressions, precedence and associativity of operators, type conversion and typecasting.

Module II: Decision Control Statements, Loops and Functions (8 Hours)

Decision Control Statements and Loops: Introduction to decision control statements, conditional branching statements, goto statements, while loop, do-while loop, for loop, nested loops, break and continue statements Functions: Need for functions, function declaration and definition, user defined and library functions, passing parameters to function, return statement, scope of variables, storage classes, recursive functions.

Module III: Arrays (7 hours)

Arrays: One-dimensional arrays, passing array to function, multidimensional arrays and their applications, character arrays, dynamic memory allocation. Some algorithms and programs on theory of matrices and numbers like Sieve method for primality test, generation of twin primes, solution of congruence using complete residue system, addition, subtraction and multiplication of matrices, transpose, and determinant .

Module IV: Structures, Files (7 hours)

Structures and Unions: Declaration of structures and simple implementation of structures, unions, enumerated data types. Files: Introduction to files, file managements-open, close, input/output operations, command line arguments.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define and describe various terms and concepts of C programming language. (Remembering)
- CO2:** Comprehend or interpret information based on their understanding of the concepts of C language's syntax, data types, control statements, functions, pointers, arrays, structures and pointers in C. (Understanding)
- CO3:** Solve problems using standard algorithms and translate pseudo-codes into C programs and implement them. (Applying)
- CO4:** Apply their analytical skills for choosing the right data structure, function, data types and develop logic to solve various instances of problems. (Analysing)
- CO5:** Evaluate various algorithms used for searching, sorting etc. in terms of correctness and computation cost. (Evaluating)
- CO6:** Combine the various concepts and ideas learnt in C to plan, propose and develop a product. (Creating)

Suggested Readings

1. Thareja R., Computer Fundamentals and Programming in C, Oxford University Press, New Delhi
2. Rajaraman V., Computer Programming in C Prentice-Hall of India Pvt. Ltd., 2005.
3. Balagurusamy E., Computer Fundamental and C Programming, Tata McGraw Hill publishing company limited, New Delhi
4. Gottfried Byron S., Programming with C (Schaum's outlines series), Tata Mcgraw Hill publishing company limited, New Delhi
5. Goblin P., Primes and Programming – An Introduction to Number Theory with Programming – Cambridge University Press, 1993.

MARM0032: RESEARCH METHODOLOGY FOR MATHEMATICAL SCIENCES

(3 credits-45 hours)

Objective:

- *To understand the significance of research in mathematical sciences.*
- *To understand the research process and acquire the attitudes and skills essential for mathematical research.*
- *To develop skills for interpretation, documentation and presentation of results of the research.*
- *To familiarize with statistical/mathematical methods and techniques needed for research in mathematical sciences.*

Module I (12 hours)

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, literature survey of a research topic, Importance of knowing how Research is done, Research Process, Criteria of good Research, Problems encountered by Researchers in India.

Defining the Research problem: Selecting the Problem, Necessity of Defining the Problem, Techniques involved in defining a problem.

Module II (15 hours)

Report writing: Significance of Report writing, Difference steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Precautions for Writing Research Reports, Publishing a paper, Research proposal writing, Copyright issues, Ethics and plagiarism.

Module III (18 hours)

Research tools : MathSciNet, Scopus, ISI Web of Science, Impact factor, h-index, Google Scholar, ORCID, JStor, Online and open access journals, Virtual library of various countries.

Scientific writing and presentation: LaTeX, Beamer.

Software for Mathematics: Mathematica, Matlab.

COURSE /LEARNING OUTCOMES

- CO1:** Recall and understand some basic concepts of research and its methodologies (Remembering)
- CO2:** Compare different results and identify appropriate research topics with the help of literature review (Understanding)
- CO3:** Select and define appropriate research problem and parameters (Applying)
- CO4:** Prepare a project proposal (to undertake a project) (Analysing)
- CO5:** Organize and conduct research (advanced project) in a more appropriate manner (Evaluating)
- CO6:** Design and write a research report and thesis , write a research proposal (Creating)

Suggested Readings

1. C.R.Kothari, Research Methodology; New Age Publishers, 2004.
2. L. Lamport, LaTeX, a Document Preparation System, 2nd ed, Addison-Wesley, 1994.

MAFA0033: FIELD THEORY AND COMMUTATIVE ALGEBRA**(4-credits-60 hours)**

Objectives: *The objective of this course is to*

- *Discuss the notion of algebraic and transcendental elements.*
- *To introduce the construction with ruler and compass.*
- *To provide the knowledge of algebraic techniques used in field theory.*
- *To familiarize the idea of Galois extension.*

Module I (10 hours)

Field extensions. Simple extensions, algebraic and transcendental case. Minimum polynomial. Construction of simple algebraic extension from an irreducible polynomial. Classification of simple extensions.

Module II (15 hours)

Degree of extension. Algebraic elements and algebraic extensions; finite extensions. Algebraic numbers. Geometric constructions with ruler and compasses. The Galois group of an extension. Examples. Splitting field for a polynomial. Existence, uniqueness up to isomorphism. Normal extensions. Relation to splitting fields. Normality of intermediate extension. Normal closure.

Module III (15 hours)

Separability. Example of inseparable polynomial. Separability of all polynomials in characteristic zero. Separable extensions. Separability of intermediate extensions. Degree of the extension corresponding to a group of field automorphisms.

Module IV (12 hours)

Integral extension, integral closure of a ring, finitely generated modules, localization of a ring, construction, localization of modules, Dedekind domain, factorization ideals, unique factorization of ideals.

Module V (8 hours)

Galois groups of normal separable extensions, Galois extensions, factorization of prime ideals in Galois extensions, discrete valuation.

COURSE /LEARNING OUTCOMES

At the end of this course, students will be able to:

- CO1:** Define the key notions of field theory and outline their interrelation. (Remembering)
- CO2:** Demonstrate understanding of the key concepts by interpreting them under various hypothesis. (Understanding)
- CO3:** Give the details essential theorems by applying them in specific cases. (Applying)
- CO4:** Analyse the proof a theorem by imposing the rules of commutative algebra. (Analysing)
- CO5:** Evaluation of the validity of a problem such as insolvability of quintic by field theoretic techniques. (Evaluating)
- CO6:** Creating new results by correlating the existing ones (Creating)

Suggested Readings

1. J.B. Fraleigh, *A First Course in Abstract Algebra*, 5th edition, Addison-Wesley.
2. I. Stewart, *Galois Theory*, 2nd edition, Chapman and Hall.
3. Dummit D.S., Foote R. M., *Abstract Algebra*, 3rd edition, John Wiley
4. Atiyah M.F., Macdonald I.G., *Introduction to Commutative Algebra*, Addison-Wesley, 1969.

MANT0034: NUMBER THEORY

(4 Credit-60 hours)

Objectives: *This course provides students an opportunity to develop an appreciation of pure mathematics while engaged in the study of number theoretic results. The course is also designed to provide students an opportunity to work with conjectures, proofs and Analysing mathematics. Also, the course provides an introduction to some basic cryptographic techniques, with a main emphasis on asymmetric cryptography.*

Module I (15 hours)

Divisibility, Congruences, complete residue system, reduced residue system, Chinese remainder theorem., Arithmetic modulo p , Fermat's little theorem, Wilson's theorem.

Arithmetic functions-Mobius function, Euler function.

Module II (15 hours)

Quadratic residues and congruences of second degree in one unknown, Legendre symbol, Jacobi symbol, congruences of second degree with prime modulus and with composite modulus.

Module III (18 hours)

Primitive roots and indices, order, necessary and sufficient condition for the existence of primitive roots, construction of reduced residue system.

Continued fractions, simple continued fractions, approximation of irrational numbers by continued fractions, solution of Pell's equation.

Introduction to partitions, geometric representation, generating functions, Euler's Pentagonal number theorem,

Module IV (12 hours)

Basic of Cryptography: History of cryptography, terminologies used in cryptography; Substitution Techniques- The Caesar Cipher, One Time Pads, The Vernam Cipher, Book Cipher; Transposition Techniques-Encipherment/Decipherment Complexity, Public Key Cryptography: Characteristics of Public Key Syaytem; RSA Technique-Encryption –Method; Diffie-Hellman Scheme

COURSE/LEARNING OUTCOMES

At the end of this course, students will be able to:

- CO1:** Find quotients and remainders from integer division (Remembering)
- CO2:** Apply Euclid's algorithm and Euler-Fermat's Theorem to prove relations involving prime numbers (Applying)
- CO3:** Understand the basics of modular arithmetic, residue classes and least residues (Understanding)
- CO4:** Develop a deeper conceptual understanding of the theoretical basis of number theory and cryptography. (Creating)
- CO5:** Analyse hypotheses and conclusions of mathematical statements (Analysing)
- CO6:** Determine multiplicative inverses, modulo n and use to solve linear congruence (Evaluating)

Suggested Readings

1. M. Burton, *Elementary Number Theory*, 2nd edition, Universal Book Stall, New Delhi, 1994.
2. G. H. Hardy and E. M. Wright, *An Introduction to the Theory of Numbers*, 4th edition, Oxford, Clarendon Press, 1960.
3. G. E. Andrews, *Number Theory*, Hindustan Publishing Corporation, New Delhi, 1992.
4. S. G. Telang, *Number Theory*, Tata McGraw Hill Publishing Company Limited, New Delhi, 1996.

MAML0035: MATHEMATICAL LOGIC**(4 Credits-60 hours)**

Objectives: *The objective of this course is*

- *To familiarize a student with various direct and indirect method of proof.*
- *To discuss formal set theory on the basis of first order logic.*
- *To introduce the notion of completeness and consistency.*
- *To provide the knowledge of first incompleteness theorem.*

Module I (15 Hours)

Propositions, truth table, negation, conjunction and disjunction. Adequate set of connectives, propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Arguments and validity.

Module II (15 hours)

Formal definition of proof, various methods of proof, theorem and deduction, theory of L of statement calculus. Valuation and tautology in L, extensions of L, adequacy theorem of L.

Module III (15 hours)

First order logic, truth values of well formed formulas, first order systems with equality, first order arithmetic, formal set theory.

Module IV (15 Hours)

Completeness and compactness, notion of consistency, Boolean algebra, incompleteness, first incompleteness theorem, undecidability.

COURSE/LEARNING OUTCOMES

At the end of the course, a student would be able to

- CO 1: Define the notion of logic which is fundamental in every branch of Science. (Remembering)
- CO 2: Gain the knowledge of interpreting any Mathematical statement into the language of logic. (Understanding)
- CO 3: Apply the methodologies of sets in problems arising in other branches of Mathematics and Science like combinatorics and algebra. (Application)
- CO 4: Analyse the validity a problem by means of essential concepts such as completeness and consistency.(Analysing)
- CO 5: Determine the solvability of a problem by asserting the consistency.(Evaluating)
- CO 6: Formulate the fundamental arguments as a part of a proof of other results.(Creating)

Suggested Readings

1. Hamilton A. G., Logic for Mathematicians, Cambridge University press, 2000.
2. Mendelson E., Introduction to Mathematical Logic, 6th Edition, CRC Press, Taylor and Francis Group.
3. Hinman P. G., Fundamentals of Mathematical Logic, A.K. Peters, Wellesley 2005.
4. Ebbinghaus H.D., Flum J., Thomas W., Mathematical Logic, Springer-Verlag, Second edition.

MAFS0036: FUZZY SETS AND APPLICATIONS

(4 credit-60 hours)

Objective: This course provides an understanding of the basic mathematical elements of the theory of fuzzy sets. It provides also an emphasis on the differences and similarities between fuzzy sets and classical sets theories. The main objective of this course is to establish thorough background knowledge on evolutionary algorithms in post graduate students and enable them to pursue individual research in solving real world optimization problems.

Module I : (17 hours)

Fuzzy sets - Fuzzy numbers, fuzzy numbers in the set of Integers, arithmetic with fuzzy numbers. Definition of fuzzy sets, α -level sets, convex fuzzy sets. Basic operations on fuzzy sets, types of fuzzy sets, Cartesian products, algebraic products, bounded sum and difference, t-norms and t-conorms. Fuzzy sets in contrast of probability theory.

Module II (12 hours)

The extension principle - the Zadeh's extension principle, image and inverse image of fuzzy sets. Fuzzy relations, basic properties of fuzzy relations, fuzzy relations and approximate reasoning.

Module III (16 hours)

Fuzzy relations and fuzzy graphs, composition of fuzzy relations, min-max composition and its properties, fuzzy equivalence relations, fuzzy relational equations, fuzzy graphs.

Module IV (15 hours)

Possibility Theory: Fuzzy measures, evidence theory, necessity measure, probability measure, possibility measure, possibility distribution, possibility theory and fuzzy sets, possibility theory and probability theory.

COURSE /LEARNING OUTCOMES

At the end of this course, students will be able to:

- CO 1:** Basic knowledge of the theory of fuzzy sets and acquaints with their applications (Remembering)
- CO 2:** Understand crisp and fuzzy set theory
- CO 3:** Distinguish between the crisp set and fuzzy set concepts through the learned differences between the crisp set characteristic function and the fuzzy set membership function. (Analysing)
- CO 4:** Apply fuzzy set theory in modeling and Analysing uncertainty in a decision problem (Applying)
- CO 5:** Interpret fuzzy set theory and uncertainty concepts (Evaluating)
- CO 6:** Construct the appropriate fuzzy numbers corresponding to uncertain and imprecise collected data (Creating)

Suggested Readings

1. Klir, G. J. and Yuan, B. *Fuzzy Sets and Fuzzy Logic : Theory and Applications*, (Prentice Hall of India, New Delhi, 1997)
2. Zimmermann, H. J. *Fuzzy set theory and its Applications* (Allied publishers Ltd., New Delhi 1991)
3. G. Bojadziewe and M. Bojadziewe, *Fuzzy sets, fuzzy logic applications*, World Scientific, 1995

MAFD0037: FLUID DYNAMICS I**(4 Credits- 60 Hours)****Objectives:**

- *The course on fluid dynamics is devised to introduce fundamental aspects of fluid flow behaviour.*
- *Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.*

Module I (20 Hours)

Classification of fluids, Lagrangian and Eulerian methods. Equation of continuity. Irrotational flow, vorticity vector, equi-potential surfaces. Streamlines, pathlines, streak lines of the particles, stream tube and stream surface. Mass flux density, conservation of mass leading to equation of continuity. (Euler's form.) Conservation of momentum and its mathematical formulation: Euler's form. Integration of Euler's equation under different conditions. Bernoulli's equation, steady motion under conservative body forces.

Module II (15 Hours)

Boundary surface, Theory of irrotational motion, Kelvin's minimum energy and circulation theorems, potential theorems. Some two-dimensional flows of irrotational, incompressible fluids. Complex potential. Sources, sinks, doublets and vortices. Milne-Thomson circle theorem, Images with respect to a plane and circles. Blasius theorem.

Module III (10 Hours)

Vortex motion and its elementary properties. Wave motion in a gas. Speed of Sound. Equation of motion of a gas. Subsonic, sonic and supersonic flows of a gas. Isentropic gas flows. Flow through a nozzle. Normal and oblique shocks.

Module IV (15 Hours)

Three-dimensional flows. Sources, sinks, doublets. Axi-symmetric flow and Stokes stream function. Butler sphere theorem, Kelvin's inversion theorem and Weiss's sphere theorem. Images with respect to a plane and sphere. Axi-symmetric flows and stream function. Motion of cylinders and spheres.

COURSE/LEARNING OUTCOMES

At the end of this course, students will be able to:

- CO 1: Develop an appreciation for the properties of Newtonian fluids (Remembering)
- CO 2: Understand the dynamics of fluid flows and the governing non-dimensional parameters (Understanding)
- CO 3: Study analytical solutions to variety of simplified problems (Analysing)
- CO 4: Apply concepts of mass, momentum and energy conservation to flows (Applying)
- CO 5: Formulate the problems on buoyancy and solve them (Evaluating)
- CO 6: Grasp the basic ideas of turbulence (Creating)

Suggested Readings

1. W. H. Besant and A. S. Ramsey, A Treatise on Hydrodynamics, CBS
2. F. Chorlton : Text book of Fluid Dynamics , CBS 2004.
3. P.K. Kundu and I.M. Cohen, Fluid Mechanics, Academic Press, 2005.
4. L.M. Milne Thomson, Theoretical Hydrodynamics, The Macmillan company, USA, 1969.
5. N.E. Neill and F. Chorlton, Ideal and incompressible fluid dynamics, Ellis Horwood Ltd, 1986.
6. D.E. Rutherford: Fluid Dynamics, Oliver and Boyd Ltd, London, 1978.

MARC0038:RIEMANNIAN GEOMETRY AND TENSOR CALCULUS

(4 Credits- 60 Hours)

Objectives:

- Basic ideas of Riemannian geometry such as Riemannian metric, covariant differentiation, geodesics and curvature belong to the core of mathematical knowledge and are widely used in applications that range from general relativity in physics to mechanics and engineering.
- Besides that, this subject is one of the most beautiful in mathematics, containing such gems as Gauss's Theorem a Egregium and the Gauss-Bonnet Theorem providing a link with the topology of surfaces.

Module I (15 Hours)

Introduction to Tensor, space of n dimensions, subspaces; transformation of coordinates; scalar; contravariant (tangent) and covariant (cotangent) vectors; scalar product of two vectors; tensor space of rank more than one contravariant and covariant tensors; symmetric and skew-symmetric

tensors; addition and multiplication of tensors; contraction; composition of tensors; quotient law; reciprocal symmetric tensors of the second order, relative tensor, group properties.

Module II (15 Hours)

Riemannian space; fundamental tensor; length of a curve; magnitude of a vector; associated covariant and contravariant vectors; inclination of two vectors, orthogonal vectors; coordinate hypersurfaces; coordinate curves; field of normals to a hypersurface; principal directions for a symmetric covariant tensor of the second order; Euclidean space of n dimensions.

Module III (15 Hours)

Levi-Civita tensors; Christoffel symbols and second derivatives; need for covariant derivative; parallel transformations; covariant derivative of a contravariant and covariant vector; curl of a vector and its derivative; covariant differentiation of a tensor; divergence of a vector.

Module IV (15 Hours)

Gaussian curvature; Riemann curvature tensor; geodesics; differential equations of geodesics; geodesic coordinates; geodesic deviation; Riemannian coordinates; geodesic in Euclidean space; straight lines.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO 1:** Define Riemannian manifold M and calculate the length of a curve, and area of a domain in M (Remembering)
- CO 2:** Outline the Riemannian metric on surfaces embedded in E^3 (Understanding)
- CO 3:** Express problems from relevant areas of applications in a mathematical form suitable for further analysis (Analysing)
- CO 4:** Apply the properties of geodesics on a Riemannian manifold, and calculate the parallel transport of vectors along a geodesics for the sphere and cylinder in E^2 and for Lobachevski plane (Applying)
- CO 5:** Evaluate Riemann curvature tensor (Evaluating)
- CO 6:** Formulate important results and theorems covered by the course; Use the theory, methods and techniques of the course to solve problems. (Creating)

Suggested Readings

1. An Introduction to Riemannian Geometry and Tensor Calculus – C. E. Weatherburn, Cambridge university Press, 1986.
2. Aspects of Gravitational Interactions – S. K. Srivastava & K. P. Sinha, Nova Science publications Inc., Commack, NY, 1998.
3. Tensor Analysis – I. S. Sokolnikoff, John Wiley & Sons, Inc., 1964.
4. Tensor Calculus and Riemannian Geometry-D C Agarwal, Krishna Prakasahan Media(P) Ltd.

MAN50039: NUMERICAL SOLUTION OF PDE

(4 Credits-60 hours)

Objective: *The objective of this course is to introduce different numerical methods to find the numerical solution of partial differential equations along with stability and error analysis generated during numerical solution.*

Module I (10 hours)

Review normed linear spaces, matrix norm and related results, eigenvalues for tridiagonal matrices. Matrix stability.

Module II (20 hours)

Classification of PDEs, Finite difference approximations to partial derivatives. Solution of one dimensional heat conduction equation by Explicit and Implicit schemes (Schmidt and Crank Nicolson methods), CFL condition, stability and convergence criteria.

Module III (15 hours)

Hyperbolic equation, explicit/implicit schemes, method of characteristics. Solution of wave equation. Solution of 1st order Hyperbolic equation. Von Neumann stability.

Module IV (15 hours)

Finite difference method for stationary heat conduction, stability and convergence analysis.

COURSE/LEARNING OUTCOMES

At the end of this course students will able to:

- CO1:** Recall the numerical methods to solve PDEs . (Remembering)
- CO2:** Classify initial value problems (IVPs) and Boundary Value Problems (BVPs) . (Understanding)
- CO3:** Apply different numerical methods to PDEs. (Application)
- CO4:** Analyse accuracy of common numerical methods. (Analysis)
- CO5:** Apply different numerical methods in order to evaluate the approximate numerical solution of the PDEs. (Evaluating)
- CO6:** Formulate the physical problems into IVPs and BVPs and solve them numerically. (Creating)

Suggested Readings

1. J.C. Butcher, Numerical methods for Ordinary differential equations, John Wiley&Sons, New York, 2003
2. J.D. Lambert, Numerical methods for Ordinary differential systems: The initial value problem, John Wiley & Sons, New York, 1991
3. K. Atkinson, W. Han and D.E. Stewart, Numerical solution of ordinary differential equations, John Wiley, New York, 2009
4. G. D.Smith., Finite Difference Methods (Oxford Applied Mathematics & Computing Science Series)
5. Kendall E. Atkinson, Weimin Han, David E. Stewart. Numerical Solution of Ordinary Differential Equations(Wiley),
6. M K Jain, S R K Iyengar, R K Jain. Numerical Methods for Scientific and Engineering Computation (New Age International)

MACN0040: COMPUTATIONAL NUMBER THEORY

(4 Credits - 60 hours)

Objective: *This course provides an introduction to basic number theory, where the main focus is on computational aspects with applications in cryptography. Moreover, the course provides an introduction to some basic cryptographic techniques, with a main emphasis on asymmetric cryptography.*

Module I (10 hours)

Representation of integers and polynomials, Divisibility and the Euclidean algorithm, extended Euclidean algorithm, Congruences, Chinese Remainder theorem, Hensel's lifting lemma, Modular exponentiation - Some applications to factoring .

Module II (15 hours)

Finite Fields, Multiplicative generators, Uniqueness of fields with prime power elements, Quadratic residues and reciprocity

Module III (20 hours)

Primality Testing: Probabilities Primality testing, primality testing for numbers of a special form, AKS primality test including detecting perfect powers; Computing the Order of an element and generating primitive roots (and elements of a certain order), Computing Discrete Logarithms, Factoring Integers, factoring polynomials and tests constricting irreducible polynomials; Solving equations over Finite Fields including computing square roots.

Elliptic curves: The Geometry of elliptic curves, the Algebra of elliptic curves, elliptic curves over finite fields, The elliptic curve Discrete Logarithm Problem.

Module IV (15 hours)

Cryptosystems and basic cryptographic tools: Secret –key cryptosystems, Public-key cryptosystems, block and stream ciphers, message integrity; message authentication codes, Signature schemes, nonrepudiation, certificates, Hash functions; Some simple cryptosystems, Shift cipher, Substitution cipher, Affine cipher, Vigenère cipher, Hill cipher, Permutation cipher, Stream ciphers, Cryptanalysis of affine, substitution, Vigenère, Hill and LFSR stream ciphers. RSA cryptosystem and Rabin encryption.

COURSE LEARNING OUTCOMES

At the end of this course, students will be able to:

- CO1:** Recall the fundamental; number theoretic algorithms such as the Euclidean algorithm, the Chinese remainder Theorem, binary powering and algorithms for integer arithmetic. (Remembering)
- CO2:** Know about the aspects of number theory which are relevant to cryptography. (Understanding)
- CO3:** Analyse and implement cryptographic and number theoretic algorithms. (Analysing)
- CO4:** Apply Number theory and algebra in Cryptography. (Applying)
- CO5:** Compose, build and Analyse simple cryptographic solutions. (Creating)

Suggested Readings

1. Abhijit Das, Computational Number Theory, CRC Press 2013
2. Hans Riesel, Prime Numbers and Computer Method for Factorization , 2nd edition, Birkhauser, 2012
3. R.P. Brent and P.Zimmermann, Modern Computer Arithmetic, Cambridge University Press, 2010
4. Neal Koblitz (1994). *A Course in Number Theory and Cryptography* (2nd edition). Springer-Verlag
5. Menezes A, “Van Oorschot and Vanstone S.A, Hand book of Applied Cryptography”, CRC Press, 1996
6. Douglas R. Stinson & Maura B. Paterson (2019). *Cryptography Theory and Practice* (4th edition). Chapman & Hall/CRC Press, Taylor & Francis
7. Simon Rubinfeld-Salzedo (2018). *Cryptography*. Springer.
8. Jeffrey Hoffstein, Jill Pipher & Joseph H. Silverman (2014). *An Introduction to Mathematical Cryptography* (2nd edition). Springer.

MASC0041: SCIENTIFIC COMPUTING

(4 Credits-60 hours)

Objective: *The objective of this course is to introduce different numerical methods to find the numerical solution of ordinary differential equations along with stability and error analysis generated during numerical solution.*

Module I (13 hours)

Initial value problems (IVPs) for the system of ordinary differential equations (ODEs); Difference equations; Numerical methods; Local truncation errors, Stability analysis; Interval of absolute stability; Convergence and consistency

Module II (13 hours)

Single-step methods: Taylor series method; Explicit and implicit Runge-Kutta methods and their stability and convergence analysis; Extrapolation method; Runge-Kutta method for the second order ODEs; Stiff system of differential equations

Module III (16 hours)

Multi-step methods: Explicit and implicit multi-step methods; General linear multi-step methods and their stability and convergence analysis; Adams-Moulton method; Adams-Bashforth method; Nystorm method; Multi-step methods for the second order IVPs.

Module IV (18 hours)

Boundary value problems (BVPs): Two point non-linear BVPs for second order ordinary differential equations; Finite difference methods; Convergence analysis; Difference scheme based on quadrature formula; Difference schemes for linear eigenvalue problems; Mixed boundary conditions; Finite element methods; Assemble of element equations; Variational formulation of BVPs and their solutions; Galerkin method; Ritz method; Finite element solution of BVPs.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the numerical methods to solve ODEs . (Remembering)
- CO2:** Classify IVPs and BVPs . (Understanding)
- CO3:** Apply different numerical methods to ODEs. (Applying)
- CO4:** Analyse accuracy of common numerical methods. (Analysing)
- CO5:** Apply different numerical methods in order to evaluate the approximate numerical solution of the ODEs. (Evaluating)
- CO6:** Formulate the physical problems into IVPs and BVPs and solve them numerically. (Creating)

Suggested Readings

1. J.C. Butcher, Numerical methods for Ordinary differential equations, John Wiley&Sons, New York, 2003
2. J.D. Lambert, Numerical methods for Ordinary differential systems: The initial value problem, John Wiley & Sons, New York, 1991
3. K. Atkinson, W. Han and D.E. Stewart, Numerical solution of ordinary differential equations, John Wiley, New York, 2009
4. M K Jain, S R K Iyengar, R K Jain. Numerical Methods for Scientific and Engineering Computation (New Age International

MASF0042: SPECIAL FUNCTIONS**(4 Credit-60 hours)**

Objective: The objective of the course is to introduce some special functions such as Beta function, Gamma function, hypergeometric function, etc and discuss some theorems like, Kummer's theorem, Dixon's theorem etc.,

Module I (12 hours)

The Gamma and Beta Functions: Eulers' integral for $\Gamma(z)$, the beta function, factorial function, Legendre's duplication formula, Gauss's multiplication theorem, summation formula due to Euler, behaviour of $\log \Gamma(z)$ for large $|z|$.

Module II (18 hours)

The Hypergeometric function: An integral representation. Its differential equation and solutions, $F(a,b,c;1)$ as a function of the parameters, evaluation of $F(a,b,c;1)$, contiguous function relations, the hypergeometric differential equation, logarithmic solutions of the hypergeometric equation, $F(a,b,c;z)$ as a function of its parameters, Elementary series manipulations, simple transformations, relation between functions of $\Gamma(z)$ and, $\Gamma(1-z)$ quadratic transformations, theorem due to Kummer, additional properties.

Module III (18 hours)

The Confluent Hypergeometric function: Basic properties of ${}_1F_1$, Kummer's first formula. Kummer's second formula, Generalized Hypergeometric Series: The function ${}_pF_q$, the exponential and binomial functions, differential equation, contiguous function relations, integral representation ${}_pF_q$, with unit argument, Saalshutz' theorem, Whipple's theorem, Dixon's theorem, Contour integrals of Barnes' type.

Module IV (12 Hours)

Bessel Functions: Definition, Differential equation, differential recurrence relations, pure recurrence relation, generating function, Bessel's Integral, index half an odd integer, modified Bessel functions, Introduction to Legendre function, Meijer G-function and some basic properties.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the different special functions and their properties. (Remembering)
- CO2:** Classify differential equations by their singularities; to obtain properties of solutions of PDE by their symmetries. (Understanding)
- CO3:** Apply these special functions and their properties in the mathematical analysis, functional analysis etc. (Applying)
- CO4:** Analyse properties of special functions by their integral representations and symmetries. (Analysing)
- CO5:** Evaluate various representation of special functions and check their convergence. (Evaluating)
- CO6:** Formulate the special functions in different ways. (Creating)

Suggested Readings

1. Earl. D. Ranvillie, Special Functions, Macmillan, 1960.
2. L.C. Andrews, Special Functions of Mathematics for Engineers, SPIE Press, 1992.
3. Gabor Szego, Orthogonal Polynomials, American mathematical society, 1939.
4. L.J. Slater, Generalized Hypergeometric Functions, Cambridge University Press; Reissue edition, 2008.

MABM0043: BIO-MATHEMATICS

(4 Credits - 60 hours)

Objective: *This course is aimed to provide a rapid introduction to the mathematical and computational topics appropriate for understanding biological processes. The course extends the range of usage of mathematical models in biology, ecology and evolution.*

Module I (16 hours)

Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC), Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation.

Module II (22 hours)

Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario. Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population.

Module III (22 hours)

Discrete Models: Overview of difference equations, steady state solution and linear stability analysis, Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Involves the theory of multivariable calculus, ordinary differential equations, stochastic models and partial differential equations. (Remembering)
- CO2:** Explain how these techniques are applied in scientific studies and applied in ecology and epidemiology. (Understanding)
- CO3:** Apply techniques from partial differential equations to describe spread of genes, disease and other biological material (Applying)
- CO4:** Solve mathematically and interpret biologically. (Analysing)
- CO5:** Evaluate the mathematical models of evolution in terms of optimization and game theory problems (Evaluating)
- CO6:** Develop the ability to explain mathematical results in language understandable by biologists. (Creating)

Suggested Readings

1. L.E. Keshet, *Mathematical Models in Biology*, SIAM, 1988.
2. J. D. Murray, *Mathematical Biology*, Springer, 1993.
3. Y.C. Fung, *Biomechanics*, Springer-Verlag, 1990.
4. F. Brauer, P.V.D. Driessche and J. Wu, *Mathematical Epidemiology*, Springer, 2008.

MAMP0044: MATHEMATICAL PHYSICS**(4 Credits - 60 hours)**

Objective: The objective of the course is to make students familiar with basic mathematical methods for application to problems in physics and the formulation of physical theories in different disciplines of physics. Emphasis shall be laid upon the solution of numerous problems. The importance of this course is on applications in solving problems of interest to physicists.

Module I: Differential Equations and Special Functions (12 hours)

Differential operators, common partial differential equations of physics; techniques for solving partial differential equations; general solution; homogeneous and non-homogeneous equations; Poisson's eq.; solutions to $\nabla^2\Phi = 0$ in Cartesian, spherical and cylindrical coordinates; Series solution method; Fuchs's theorem, general solutions to: hypergeometric, confluent hypergeometric, associated Legendre, Legendre, associated Laguerre, Hermite, Bessel, and spherical Bessel equations; Hankel functions, gamma function; spherical harmonics ; Schrodinger equation for H atom.

Module II: Vector Analysis (10 hours)

Differential; directional derivative,; Taylor series expansion, physical interpretation of divergence and curl; line integrals; surface integrals , three dimensional integrals; divergence theorem; Stokes theorem, Helmholtz theorem (from curl and divergence of F), Maxwell's equations, Dirac delta function, charge densities for simple geometries; step function and its use.

Module III: Tensors (14hours)

Tensors in index notation, Kronecker and Levi Civita tensors, inner and outer products, contraction, symmetric and antisymmetric tensors, quotient law, metric tensors, covariant and contravariant tensors, simple applications to general theory of relativity and Klein-Gordon and Dirac equations in relativistic quantum mechanics.

Module IV: Vector Space (12 hours)

Linear independence, bases, orthogonality and completeness, Gram- Schmidt orthogonalization, Hilbert space, linear operators, change of basis, similarity transformation, dual spaces, applications to quantum mechanics.

Matrix diagonalization, eigenvalues and eigenvectors, orthogonal and unitary matrices, Pauli matrices.

Module V: Complex analysis (12 hours)

Cauchy-Riemann conditions, analyticity, Cauchy-Goursat theorem, Cauchy's integral formula, branch points and branch cuts, multivalued functions, residue theorem, applications of residue theorem, Jordan's lemma, Taylor and Laurent series, singularities and convergence, Conformal mapping and applications.

COURSE/LEARNING OUTCOMS

At the end of the course, students will be able to:

- CO1:** Define the fundamental concepts of a special topic in mathematical physics
- CO2:** Demonstrate accurate and efficient use of specific mathematical physics techniques.
- CO3:** Describe the importance of different field of Mathematics in Physics.
- CO4:** Know and Understand the concept of tensor calculus.
- CO5:** Recognize and using subject-specific theories, concepts and principals of mathematical physics.
- CO6:** Explain the special function on physic problems

Suggested Readings

G.B. Arfken and H.J. Weber, *Mathematical methods for Physicists*, Academic Press (1995).

1. Hung Cheng, *Advanced Analytic Methods in Applied Mathematics, Science, and Engineering*, Luban Press, 2006
2. K.F. Riley, M.P. Hobson and S.J. Bence, *Mathematical Methods for Physics and Engineering*, Cambridge University Press (1998).
3. T. Lawson, *Linear Algebra*, John Wiley and Sons (1996).
4. R.V. Churchill. *Complex variables and applications*, Mcgraw Hill (1990).
5. A.W. Joshi, *Matrices and Tensors in Physics*, New Age (1995).

MAMF0045: MATHEMATICAL FINANCE

(4 Credits-60 hours)

Objective :This course is about the active and practical use of mathematics, which includes probability theory, linear algebra, calculus, partial differential equations, and stochastic calculus, and numerical mathematics, with the main focus on three interrelated financial topics: asset pricing, portfolio allocation, and hedge for the asset.

Module I (10 hours)

Financial Management - An overview; Nature and Scope of Financial Management; Goals of Financial Management and main decisions of financial management; Difference between risk, speculation and gambling.

Module II (20 hours)

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money, inflation, net present value, Meaning of return; Return as Internal Rate of Return (IRR); Numerical Methods like Newton Raphson Method to calculate IRR; Measurement of returns under uncertainty situations., comparison of NPV and IRR. Bonds,bond prices and yields, Macaulay and modified duration, term structure of interest rates: spot andforward rates, explanations of term structure, running present value, floating-rate bonds,immunization, convexity, puttable and callable bonds.

Module III (20 hours)

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for one and two constraints), Two fund theorem, risk free assets, One fund theorem, capital market line, Sharpeindex. Capital Asset Pricing Model (CAPM), betas of stocks and portfolios, security market line,use of CAPM in investment analysis and as a pricing formula, Jensen's index.

Module IV (10 hours)

Taylor series and Bond Valuation; Calculation of Duration and Convexity of bonds.Financial Derivatives — Futures, Forward, Swaps and Options; Call and Put Option; Call and Put Parity Theorem; Pricing of contingent claims through Arbitrage and Arbitrage Theorem.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to

CO1: demonstrate knowledge of a range of specific mathematical techniques in finance

CO2: demonstrate a comprehensive understanding of the most common applications of mathematics in finance and recent extensions thereof

- CO3:** demonstrate the appropriateness of modelling or numerical solutions in analysing common problems in banks and other financial institutions;
- CO4:** ability to select and apply numerical methods appropriate for the solution of financial problems
- CO5:** select and apply numerical solutions in some areas of finance,
- CO6:** skills in the mathematical analysis of abstract problems,

Suggested Readings

1. David G. Luenberger, Investment Science, Oxford University Press, Delhi, 1998.
2. John C. Hull, Options, Futures and Other Derivatives, 6th Ed., Prentice-Hall India, Indian reprint, 2006.
3. Sheldon Ross, An Elementary Introduction to Mathematical Finance, 2nd Ed., Cambridge University Press, USA, 2003.
4. Aswath Damodaran, Corporate Finance - Theory and Practice, John Wiley & Sons, Inc.

MAAS0046: ADVANCED ANALYSIS

(4 Credits - 60 hours)

Objectives: The objective of this course is to introduce to a student

- The fundamental inequalities arising in function space.
- The important theorems like Radon-Nikodym theorem and Reisz representation theorem
- The notion of algebra and GNS construction.
- The concept of product measure.

Module I (15hours)

space, Holder inequality, Minkowski's inequality, convergence, completeness, bounded linear functional.

Module II (17 hours)

Banach Algebra, Gelfand theory, algebra, Gelfand-Naimark-Segal (GNS) construction, normal operators, spectral theorem, Fredholm operator, space, calculus for normal operators.

Module III (16 hours)

Signed measure, Hahn decomposition theorem, mutually singular measure, Radon-Nikodym theorem, Lebesgue decomposition, Reisz representation theorem.

Module IV (12 hours)

Outer measure, Caratheory theorem, product measure, Fubini's theorem.

COURSE /LEARNING OUTCOMES

At the end of this course students will be able to

- CO 1:** Define important concepts like Banach algebra, algebra, outer measure to name a few. (Remembering)
- Co 2:** Understand the correlation between spaces like space and space. (Understanding)
- CO 3:** Provide details of the important theorems like Hahn decomposition theorem, Radon-Nikodym theorem to mention a few. (Applying)
- Co 4:** Analyse the role played by the underlying space in the proof of important theorems and inequalities. (Analysing)
- CO 5:** Evaluate the validity of a theorem or inequality in the settings of a different space. (Evaluating)

CO 6: Prescribe new hypothesis under which existing results can be proved to be true.
(Creating)

Suggested Readings

1. Conway J.B., A first course in functional analysis, Springer,1985.
2. Douglas R.G., Banach algebra techniques in operator theory, Academic press, 1972.
3. Halmos P.R., Measure Theory, Springer-Verlag, 1974.
4. Barra G.de, Measure theory and integration, Wiley-Eastern, 1981.

MAGY0047: GRAPH THEORY

(4 credits-60 hours)

Objective: *The objective of the course is to explain basic concepts in graph theory and define how graphs serve as models for many standard problems and different algorithms to find the optimum solution of practical problems.*

Module I (13 hours)

Graph, Types of Graphs, Subgraphs, walk, paths, cycles and components, intersection of graphs, Degrees, Degree sequences. operations on graphs, subdivision (of cycles), incentification (of vertices) homomorphism and contraction (of edges)

Module II (18 hours)

Trees, Spanning trees, Kruskal's and Prim's algorithm for minimal spanning tree, cycles, cocycles, cycle space, cocycle spaces, Connectivity, cut vertices, cut edges and blocks, connectivity parameters, Menger's theorem. Matching and covers.

Module III (14 hours)

Eulerian and Traversable graphs : Characterization theorems, characterization attempts for Hamiltonian graphs: Two necessary and sufficient conditions for a graph to be Hamiltonian, Factorization; Basic concepts, 1- factorization, 2- factorization, coverings, critical points and lines.

Module IV (15 hours)

Planarity and colorability: Plane and planar graphs, outer planar graphs, Euler's Polynedron formula, Kuratowski's theorems. Chromatic number. Five colour theorem, Four Colour conjecture, chromatic polynomial. Adjacency matrix, Spectrum of a graph.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the terminologies, properties and results of graph theory . (Remembering)
- CO2:** Classify different types of graphs. (Understanding)
- CO3:** Apply different results and algorithms to find the optimum solution of the practical problems..(Applying)
- CO4:** Analyse different properties of graphs. (Analysing)
- CO5:** Determine different results and properties of graphs. (Evaluating)
- CO6:** Formulate the practical problems and solve them using graph theory. (Creating)

Suggested Readings

1. Graph Theory, F. Harary, Addition Wesley Publishing Co.
2. Introduction to graph theory, D. B. West, Prentice Hall, India (Pearson).
3. Algebraic Graph Theory, N. Biggs, Cambridge university press.

MACA0048: MULTIVARIABLE CALCULUS**(4 Credit-60 Hours)****Objectives:**

- To enable a student perform operations in three and higher dimensions by means of vectors.
- To make a student capable of interpreting partial derivatives and derivatives of a function of several variables using matrices.
- To familiarize a student with the techniques of integrating over curves and surfaces.
- To make a student learn about the fundamental theorems like Green's theorem, Stokes theorem, etc..

Module I (15 hours)

Vectors, dot product of vectors, projection, triangle and Cauchy-Schwarz inequality, cross product of vectors and determinants. Non-linear function, parametric equation of curves, level surfaces, vector fields.

Module II (20 hours)

Open sets in \mathbb{R}^n , sequences and closed sets, function of several variables, limit of a function of several variables, continuity, sequential continuity, partial and directional derivative, differentiability, chain rule, gradient, curl, divergence, Taylor's theorem, inverse function theorem, implicit function theorem, maximum value theorem, critical points, second derivative test.

Module III (15 hours)

Introduction to integration of a function of several variables, multiple integrals, iterated integral, Fubini's theorem, physical applications, determinant in n-dimensions, Jacobian and change of variables.

Module IV (10 hours)

Green's theorem, Stokes' theorem, Divergence theorem. Manifolds in \mathbb{R}^n , Differential forms.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO 1:** Systematically understand the operations involved with calculations in three and higher dimensions. (Remembering)
- CO 2:** Distinguish the difference between the notion of calculus of single variable and several variables by means of the properties of derivatives and integration. (Understanding)
- CO 3:** Apply the techniques involved with calculus of several variables to solve problems arising in other branches like Physics and non-commutative geometry. (Applying)
- CO 4:** Analyse a physical problem by means of the theories of calculus of several variables. (Analysing)
- CO 5:** Predict the outcome of a physical problem by studying the problem in the settings of several variable calculus. (Creating)
- CO 6:** Determine the efficiency of one method over the other by virtue of the hypothesis of the problem. (Evaluating)

Suggested Readings

1. Thomas G. B., Finney R.L., *Calculus and Analytic Geometry*, 9th edition, Pearson.
2. P. M. Fitzpatrick, *Advanced Calculus*, 2nd edition, AMS, Indian Edition, 2010.
3. Munkres J.R., *Analysis on Manifolds*, Addison Wesley.
4. Rudin W. *Principles of Mathematical analysis*, 3rd edition.

MAAY0049: ALGEBRAIC NUMBER THEORY

(4 Credits-60 hours)

Objectives:

- *To introduce the general theory of factorization of ideals in Dedekind domains as well as in the number field case.*
- *To give the details of the application of Kummer's theorem on lifting of prime ideals in extension fields.*
- *To introduce factorization of prime ideals in Galois extension.*
- *To discuss Artin-Whaples approximation theorem and Hensel's lemma.*

Module I (15 Hours)

Integral extension, integral closure of a ring, finitely generated modules, localization of a ring, construction, localization of modules, norm, trace, transitivity of trace and norm, quadratic extension of rationales, discriminant, Dedekind domain, factorization ideals, unique factorization of ideals, the ideal class group.

Module II (12 Hours)

Factorization of prime ideals in ring extensions, ramification, Ram-Rel identity, lifting of ideals, norms of ideals, norm of a prime ideal, lattices, Minkowski's theorem, the canonical embedding.

Module III (12 Hours)

The Logarithmic embedding, The Dirichlet's unit theorem, real and imaginary quadratic fields, units in quadratic fields, cyclotomic extensions, an integral basis of a cyclotomic extension.

Module IV (12 Hours)

Galois extensions, factorization of prime ideals in Galois extensions, decomposition of inertia groups, local fields, absolute values, discrete valuation.

Module V (9 Hours)

Artin-Whaples approximation theorem, completions, Hensel's lemma.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO 1:** Define the key notions of algebraic number theory and outline their interrelation. (Remembering)
- CO 2:** Demonstrate understanding of the key concepts by interpreting them under various hypothesis. (Understanding)
- CO 3:** Give an account of fundamental theorems by applying them in specific cases. (Applying)
- CO 4:** Analyse the role of Minkowski's theorem towards the proof of Four square theorem. (Analysing)
- CO 5:** Criticise the steps Kummer's theorem towards the proof of Fermat's theorem. (Evaluating)
- CO 6:** Study geometry of numbers elaborating the steps of Minkowski's theorem. (Creating)

Suggested Readings

1. Samuel P., Algebraic Theory of Numbers, Herman 1971.
2. Richard A. Mollin, Algebraic Number Theory, 2nd Edition, CRC Press, Taylor and Francis group
3. Stewart I., Tall D., Algebraic Number Theory, Chapman and Hall, 1987.
4. Esmonde J., Murthy M. R., Problems in Algebraic Number Theory, Springer 1999.
5. Janusz G.J., Algebraic Number Fields, AMS 1996.

MAFL0050: FLUID DYNAMICS II**(4 Credits- 60 Hours)****Objectives:**

- *Students will develop a basic understanding of viscous flows in general, and boundary layer flows, in particular.*
- *They will be capable of recognizing particular difficulties associated with these flows and conditions under which valid simplifications can be made so that solutions can be obtained of an appropriate accuracy.*

Module I (15 Hours)

Stress components in a real fluid. Relations between rectangular components of stress. Connection between stresses and gradients of velocity. Navier-stoke's equations of motion. Plane Poiseuille and Couette flows between two parallel plates, steady flow between concentric rotating cylinders, steady flow through cylindrical pipes; Reynolds' number. Theory of Lubrication. Flow through tubes of uniform cross section in form of circle, annulus, ellipse and equilateral triangle under constant pressure gradient. Unsteady flow over a flat plate.

Module II (12Hours)

Boundary layer concept, Boundary layer equations in two-dimensional flow, Boundary layer flow along the flat plates: Blasius solution. Shearing stress, momentum loss thickness, Boundary layer thickness and skin friction. Exact solution of the steady state boundary layer equations in two dimensional motion. Flow past a wedge. Flow in a convergent channel.

Module III (13 Hours)

Boundary layer on a surface with pressure gradient, Momentum integral theorems for Boundary layer, The Von Karman integral relation, Application of Momentum integral equation to Boundary layers: Von Karman-Pohlhausen method, Separation of boundary layer flow, Boundary layer control, Methods of Boundary layer control, Introduction to turbulent flow: Origin of turbulence, Reynold's modification of Navier- Stoke's equations for turbulent flow, Semi-empirical theory of turbulence.

Module IV (20 Hours)

Basic concepts of Magnetohydrodynamics, Maxwell's equations, Frame of reference, Lorentz force, Electromagnetic body force, Fundamental equations of MHD, Ohm's law for a moving conductor, Hall current, Conduction current, Kinematic aspect of MHD, Magnetic Reynolds number, MHD waves: alfvén's waves, MHD waves in compressible fluid, MHD approximations, Electromagnetic boundary conditions, One dimensional MHD flow, Hartmann flow, MHD Couette flow, MHD Stoke's flow, MHD Rayleigh's flow, Hartmann-Stoke's boundary layer, Alfvén's boundary layer, Two dimensional MHD flow (a) Aligned flow (b) Stagnation point flow, MHD flows in a rotating medium, Effects of Hall current on MHD flows in a rotating channel, MHD heat transfer.

COURSE/LEARNING OUTCOMES

After learning the course the students should be able to

- CO 1:** Learn how to use a variety of methods for solving viscous and boundary layer flow problems, including the adverse effects of phenomena such as the separation of the flow around an air foil (Remembering)
- CO 2:** Apply entropy principle to various thermal engineering applications (Understanding)
- CO 3:** Apply the concept of second law efficiency and exergy principle to various thermal engineering applications (Applying)
- CO 4:** Analyse steady state and transient heat conduction problems of real life Thermal systems (Analysing)

CO 5: Extended surface heat transfer problems and problems of phase change heat transfer like boiling and condensation (Evaluating)

CO 6: Use radiation heat transfer problems of various thermal systems (Creating)

Suggested Readings

1. Boundary Layer Theory: H. Schlichting, McGraw Hill Comp.
2. Laminar Boundary Layer : L. Rosenhead, Dover Pub.
3. Fluid Mechanics [Si Units]: Cengel, Tata McGraw-Hill Education
4. T. G. Cowling, Magnetohydrodynamics, Interscience Publishers New York, 1957.
5. J.A. Shercliff, A Text Book of Magnetohydrodynamics, Pergamon Press, Oxford, 1965.
6. S. I. Pai, Magnetohydrodynamics and Plasma Dynamics, Springer Verlag, New York, 1962.
7. K. R. Cramer and S. I. Pai, Magnetofluid Dynamics for Engineers and Applied Physicists, McGraw Hill, New York, 1973.

MACM0051: CONTINUUM MECHANICS

(4 Credits- 60 Hours)

Objective:

- *The purpose of the course is to expose the students to the basic elements of continuum mechanics in a sufficiently rigorous manner.*
- *The students should be able to appreciate a wide variety of advanced courses in solid and fluid mechanics.*

Module I (15 Hours)

Principles of continuum mechanics, axioms. Forces in a continuum. The idea of internal stress. Stress tensor, Cauchy's stress principle. Equations of equilibrium. Symmetry of stress tensor. Stress transformation laws. Principal stresses and principal axes of stresses. Stress invariants. Stress quadric of Cauchy. Shearing stresses. Mohr's stress circles.

Module II (20 Hours)

Deformation. Strain tensor. Finite strain components in rectangular Cartesian coordinates. Lagrangian and Eulerian descriptions, Infinitesimal strain components. Geometrical interpretation of infinitesimal strain components. Principal strain and principal axes of strain. Strain invariants, strain quadratic of Cauchy's. The compatibility conditions. Compatibility of strain components in three dimensions. Constitutive equations.

Module III (10 Hours)

Inviscid fluid. Circulation. Kelvin's energy theorem. Constitutive equation for elastic material and viscous fluid. Navier and Stokes equations of motion. Motion of deformable bodies.

Module IV (15 Hours)

Lagrangian and Eulerian approaches to the study of motion of continua. Material derivative of a volume integral. Equation of continuity. Equations of motion. Equation of angular momentum. Equation of Energy. Strain energy density function.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO 1:** Derive the governing equations of continuum mechanics from Lagrangian and Eulerian viewpoints using the divergence and Reynolds transport theorems (Remembering)
- CO 2:** Use the same principles to extend the derivations to previously unseen situations (Understanding)

- CO 3:** Determine whether particular vectors, tensors and derivatives are objective and explain the concept of objectivity (Analysing)
- CO 4:** Use the general theory to formulate and solve problems in linear and nonlinear elasticity and compressible and incompressible fluid mechanics (Applying)
- CO 5:** Solve idealised problems in continuum mechanics analytically in spherical, cylindrical and Cartesian coordinates (Evaluating)
- CO 6:** Convert the physical description of a problem in continuum mechanics into the appropriate governing equations and boundary conditions and, conversely, provide a physical interpretation for the solutions (Creating)

Suggested Readings

1. Mase, G.E, Schaum's Outline of Continuum Mechanics (Schaum's Outline series), Mc-Graw Hill, 1990.
2. Y.C. Fung : A first course in continuum mechanics.
3. L.I. Sedov : A course in continuum mechanics. Vol – I.
4. C. Truesdell, The elements of continuum Mechanics, Springer-Verlag, 2000.
5. Rabindranath Chatterjee, Mathematical Theory of Continuum Mechanics, Narosa, 1999.

MATR0052: THEORY OF RELATIVITY

(4 Credits- 60 Hours)

Objectives:

- *The students shall be familiar with the fundamental principles of the special and general theory of relativity.*
- *They shall know the meaning of basic concepts like the equivalence principles, inertial frames and how gravity is understood as a manifestation of a curved space-time.*
- *They shall also be familiar with some of the main contents of the theory: motion in the gravitational field, time dilation and frequency shifts, bending of light, gravitational waves and cosmological models with expanding space.*

Module I (20 Hours)

The special theory of relativity: inertial frames of reference; postulates of the special theory of relativity; Lorentz transformations; length contraction; time dilation; variation of mass; composition of velocities; relativistic mechanics; world events, world regions and light cone; Minkowski space-time; equivalence of mass and energy.

Module II (10 Hours)

Energy-momentum tensors: the action principle; the electromagnetic theory; energy-momentum tensors (general); energy-momentum tensors (special cases); conservation laws.

Module III (15 Hours)

General Theory of Relativity: introduction; principle of covariance; principle of equivalence; derivation of Einstein's equation; Newtonian approximation of Einstein's equations.

Module IV (15 Hours)

Solution of Einstein's equation and tests of general relativity: Schwarzschild solution; particle and photon orbits in Schwarzschild space-time; gravitational red shift; planetary motion; bending of light; radar echo delay.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Know the fundamental principles of the theory of relativity, meaning of basic concept like the equivalence principles, inertial frames and how gravity is understood as a manifestation of a curved-space time. (Remembering)
- CO2:** Describe physical phenomena in different coordinate systems and to transform from one coordinate system to another (Understanding)
- CO3:** Familiar with covariant derivative and covariant Lagrangian dynamics, geodesic curves, and be able to calculate the components of the Riemann curvature tensor from a given line element (Analysing)
- CO4:** Solve Einstein's field equations for static spherically symmetric problems and for isotropic and homogeneous cosmological models (Applying)
- CO5:** Evaluate the relativistic frequency shifts for sources moving in a gravitational field, as well as the bending of light passing a spherical mass distribution (Evaluating)
- CO6:** Give a mathematical description of gravitational waves, as well as cosmological models in the context of general relativity (Creating)

Suggested Readings

1. The Theory of Relativity (2nd edition) – R.K. Pathria, Hindustan Publishing co. Delhi, 1994.
2. General Relativity & Cosmology (2nd edition) – J.V. Narlikar, Macmillan co. of India Limited, 1988.
3. Aspects of Gravitational Interactions – S. K. Srivastava and K. P. Sinha, Nova Science Publishers Inc. Commack, New York, 1998.
4. Essential Relativity – W. Rindler, Springer-Verlag, 1977.
5. General Relativity – R.M. Wald, University of Chicago Press, 1984.

MAFE0053: FINITE ELEMENT METHODS

(4 Credits-60 hours)

Module I (15 hours)

Integral formulations and variational methods: Weighted integral and weak formulations of boundary value problems, Rayleigh-Ritz method, Method of weighted residuals.

Module II (15 hours)

Finite element analysis of one - dimensional problems: Discretization of the domain, Derivation of element equations, Connectivity of elements, Imposition of boundary conditions, Solution of equations, Applications.

Module III (15 hours)

Time dependent problems in one dimension : Formulation of eigenvalue problem, Finite element models, Applications of semi discrete finite element models for time-dependent problems, Applications to parabolic and hyperbolic equations.

Module IV (15 hours)

Finite element analysis of two- dimensional problems : Interpolation functions – Evaluation of element matrices, Assembly of element equations, Imposition of boundary conditions, Solution of equations, Applications to parabolic and hyperbolic equations.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall some basic concept of vibrational methods and understand the basic concept of finite element method. (Remembering)
- CO2:** Relate simple problems into finite elements. (Understanding)
- CO3:** Develop finite element models. (Applying)
- CO4:** Analyse finite element method in two dimensional problems.(Analysing)
- CO5:** Appreciate the importance of finite element methods for solving real life problems arising in various fields of science and engineering (Evaluating)
- CO6:** Estimate the stresses and strain in soil through FE analysis for given physical problem. (Creating)

Suggested Readings

1. Reddy J.N., "An Introduction to the Finite Element Method", Tata McGraw Hill, New Delhi, 3rd Edition, 2005.
2. Buchanen G.R. and Rudhramoorthy R., "Finite Element Analysis", Schaum's Outline Series, Tata McGraw Hill, New Delhi, 2006.
3. Huttan D.V., "Fundamentals of Finite Element Analysis", Tata McGraw Hill, New Delhi, 2005.

MADN0054: DESIGN AND ANALYSIS OF ALGORITHMS

(4 credits-60 hours)

Objective: *The study of algorithms is at the heart of computer science. In recent years, a number of advances have been made in the field of designing of algorithms. This course is meant to give students an in-depth knowledge to Analyse and design a better algorithm before its actual implementation.*

Module I (16 hours)

- a) Model of computations: Algorithms and their complexity, Random access machines, Computational complexity of RAM programs, A stored program model, abstraction of RAM, A primitive model of computation: Turing machine, relationship between Turing machine and RAM model.
- b) Algorithms Analysis Techniques: Efficiency of algorithms, analysis of recursive programs, solving recurrence equations, a general solution for large class of recurrences.
- c) Algorithms Design Techniques: Data structures: List, queues and stacks; Set representations, Graphs, Trees, Divide and Conquer algorithms, dynamic programming, Greedy algorithms, Backtracking, Local search algorithms, Balancing

Module II (10 hours)

- a) Sorting and Order Statistics: The sorting problem, Radix sorting, Sorting by comparison, Heapsort-an $O(n \log n)$ comparison sort, quicksort-an $O(n \log n)$ expected time sort, Order Statistics, Expected time of order statistics.
- b) Data structures for set Manipulation problems: Fundamental operations on set, Hashing, Binary search, Binary search trees, Optimal binary search trees, A simple-disjoint set union algorithm, tree structures for UNION –FIND problem, Application and extensions of the UNION-FIND algorithm, Balanced tree schemes, Dictionaries and priority queues, Mergeable heaps, Concatenable queues, Partitioning.

Module III (14 hours)

- a) Algorithms on Graphs: Minimum-cost spanning trees, Depth-first search, Bi-connectivity, Depth-first search of a directed graph, strong connectivity, Path-finding problems, A transitive closure algorithm, A shortest path algorithm, Path problems and matrix multiplication, Single-source problems, Dominators in a directed acyclic graph.
- b) Matrix multiplications and related Operations: Basics, Strassen's matrix multiplication algorithm, Inversion of matrices, LUP decomposition of matrices, Application of LUP decomposition, Boolean matrix multiplication.

Module IV (10 hours)

- a) NP-Complete Problems: Nondeterministic Turing machine, The class P and NP, Languages and problems, NP-completeness of the satisfiability problem, Additional NP-Complete problem, Polynomial space-bound problems.
- b) Some Provably Intractable Problems: Complexity hierarchies, The space hierarchy for deterministic Turing machine. A problem requiring exponential time and space, A non-elementary problem.

Module V: (10 hours)

Data structures and Algorithms for External Storage: A model for External computation, External sorting, Storing information in files, External search trees. Memory Management: The issues in memory management, Managing equal-sized blocks, Garbage collection algorithms for equal-sized blocks, storage allocation for objects with mixed sizes, Buddy systems, Storage compaction.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the formal definition of algorithms, importance of analysis of an algorithm and their asymptotic bounds. Students would get familiar with different types of problem and their solutions. (Remembering)
- CO2:** Outline different design strategies such as brute force, divide and conquer, dynamic programming, greedy and backtracking used for the design of algorithms (Understanding)
- CO3:** Develop and Analyse algorithms for given problems (Applying)
- CO4:** Compare and analysis different design strategies (Analysing)
- CO5:** Assess various algorithms in terms of correctness, computation cost and memory space used (Evaluating)
- CO6:** Design new algorithms for given problems by using most appropriate algorithmic strategy considering the problem domain. (Creating)

Suggested Readings

1. Alfred V Aho, John E Hopcroft and Jeffrey D Ullman, The Design and Analysis of Computer Algorithms, Addison Wesley, 2001 (modules I,II,III and IV)
2. Alfred V Aho, John E Hopcroft and Jeffrey D Ullman, Data Structures and Algorithms, Addison Wesley, 2000 (modules I,V)
3. V Manbar, Introduction to algorithms- A Creative approach, Addison Wesley, 2000
4. Ellis Harwitz, Sartaz Sahani, Fundamentals of Computer Algorithms, Computer Science Press, 2000

MAIC0055: INTRODUCTION TO CRYPTOGRAPHY**(4 Credits - 60 hours)**

Objective: The objective of this course is to introduce the student to the areas of cryptography and cryptanalysis. The aim of this course is to develop a workable knowledge of the mathematics used in cryptology .

Module I (14 hours)

Introduction to Cryptography, classical cryptosystem, cryptanalysis on Substitution Cipher, Play Fair Cipher, Block Cipher. Data Encryption Standard (AES), Triple DES, Modes of Operation, Stream Cipher, Pseudorandom Sequence;

Module II (16 Hours)

LFSR based stream cipher; Modular inverse, Extended Euclid Algorithm, Fermat's Little Theorem, Euler Phi-Function, Euler's theorem, Quadratic Residue , Polynomial Arithmetic.

Advanced Encryption Standard(AES), Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange, Knapsack Cryptosystem, RSA Cryptosystem.

Module III (18 hours)

Primality Testing: Probabilities Primality testing, primality testing for numbers of a special form, AKS primality test including detecting perfect powers; Computing the Order of an element and generating primitive roots (and elements of a certain order), Computing Discrete Logarithms, Factoring Integers, factoring polynomials and tests constricting irreducible polynomials; Solving equations over Finite Fields including computing square roots. ElGamal Cryptosystem;

Module IV (12 hours)

Cubic curves, singular points, Discriminant, Elliptic curves, Elliptic Curve over the Reals, Elliptic Curve Modulo a Prime. Generalized ElGamal Public Key Cryptosystem, Chinese Remainder Theorem, Rabin Cryptosystem, Legendre and Jacobi symbol.

COURSE/LEARNING OUTCOMES

At the end of this course, students will be able to:

- CO1:** Learn the fundamentals of cryptography, including Data and Advanced Encryption Standards (DES & AES) and RSA. (Remembering)
- CO2:** Recognize and explain aspects of number theory which are relevant to cryptography. (Understanding)
- CO3:** Illustrate the compare between symmetric and public key cryptography (Analysing)
- CO4:** Account for the cryptographic theories, principles and techniques that are used to establish security properties (Applying)
- CO5:** Evaluate cryptographic primitives and their implementations for correctness, efficiency, and security. (Evaluating)
- CO6:** Combine Number Theory and Cryptography. (Creating)

Suggested Readings

1. A Course in Number Theory and Cryptography, Neal Koblitz, (Springer 2006)
2. An Introduction to Mathematical Cryptography, Jill Pipher, Jeffrey Hoffstein, Joseph H. Silverman (Springer, 2008)
3. An Introduction to theory of numbers, Niven, Zuckerman and Montgomery, (Wiley 2006)
4. Elliptic curves: number theory and cryptography, Lawrence C. Washington, (Chapman & Hall/CRC 2003)
5. An Introduction to Cryptography, R.A. Mollin (Chapman & Hall, 2001)

6. Rational Points on Elliptic Curves, Silverman and Tate (Springer 2005)
7. Guide to elliptic curve cryptography Hankerson, Menezes, Vanstone (Springer, 2004)
8. Elementary Number Theory, Jones and Jones (Springer, 1998)

MAMM0056: MATHEMATICAL MODELLING

(4 Credits - 60 hours)

Objective: This course provides introduction of mathematical modeling and analysis of mathematical models inspired by real life problems. The course will present several modelling techniques and the means to Analyse the resulting systems.

Module I (20 hours)

Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to initial value problem up to second order.

Module II (20 Hours)

Overview of mathematical modeling and types of mathematical models, Introduction to population dynamics, solution methods of linear difference equations and discrete time model. Linear system theory, stability analysis, role of eigen values & vectors and phase diagrams. Single-species population model, Allee effect, Predator-Prey model, Lotka-Volterra model and SIR model

Module III (20 Hours)

Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence, Queuing Models: harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis

COURSE/LEARNING OUTCOMES

At the end of this course, students will be able to:

- CO1:** Define a mathematical model for a range of physical situations. (Remembering)
- CO2:** Extend their experiences of working both independently and collaboratively within the discipline to each other (Understanding)
- CO3:** Analyse specific problems and identify the appropriate mathematics to realize a solution. (Analysing)
- CO4:** Apply mathematical methodologies to open-ended real-world problems. (Applying)
- CO5:** Perform the calculations needed to obtain a solution or a suitable approximation. (Evaluating)
- CO6:** Formulate and solve abstract mathematical problems. (Creating)

Suggested Readings

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.
2. Frank R. Giordano, Maurice D. Weir and William P. Fox, *A First Course in Mathematical Modeling*, Thomson Learning, London and New York, 2003.
3. J.N. Kapur, *Mathematical Models in Biology and Medicine*, East-West Press Private limited.
4. Leah, Edelstein, Keshet, *Mathematical Models in Biology*, SIAM publications.
5. J.D. Murray, *Mathematical Biology Vol. I, II*, 3rd edition, Springer publications.

MAMY0057: MATHEMATICS IN ECONOMISTS AND GAME THEORY

Objective: *The aim of this course is to develop students' ability to apply mathematical techniques in solving economic problems. This course provides fundamental mathematical skills that are essential for the study and practice of economics and in game theory. Also, the course provides an introduction to the study of game theory which has found wide applications in economics, political science, sociology, engineering apart from disciplines like mathematics and biology*

Module I (10 hours)

Linear Programming and Input Output Analysis (12) Linear programming: Concept and formulation of LP problems, Solutions: Graphical and Simplex methods, Dual formulation and interpretation, Duality theorems, Shadow prices and their uses; Static Input-Output Analysis: Open and closed models.

Module II (15 hours)

Optimization, Maxima and Minima – One and more than one choice variables, unconstrained and constrained functions; Applications: Multiproduct firm, Price discrimination, Utility maximization, Least-cost input combination; Homogeneous and homothetic functions: Cobb-Douglas and C.E.S production functions.

Module III (17 hours)

Differential and Difference Equations, Solutions of first and second order linear and non-linear differential equations- homogeneous and nonhomogeneous cases; Applications: Dynamic market model, Domar growth model, Phase diagram, Time path, Market model with price expectation. Solutions of first order and second order difference equations; Applications: Cobweb model, Market model with inventory, Phase diagram, Market model with price ceiling.

Module IV (28 hours)

Game Theory: Concepts of individualism, rationality and mutual dependence; Cooperative and noncooperative game theory, static and dynamic game theory, Zero and Non-zero Sum game, Prisoners' dilemma, Solution of Zero Sum game: Minimax-Maximin principle, Algebraic method, Graphical method, Linear programming method, Solution of Non Zero Sum game: Rules of Dominance, Nash equilibrium, and Mixed strategy Nash equilibrium.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to

- CO1:** Knowledge of basic concepts and techniques in econometrics and mathematical economics.
- CO2:** Understand the mathematical methods that are most widely used in economics
- CO3:** Apply mathematical methods and techniques that are formulated in abstract settings to concrete economic applications
- CO4:** Knowledge of game theory would help to understand and analyse real life situations such as market behaviour or voting in elections
- CO5:** Ability to communicate economic ideas and make economic arguments in writing.
- CO6:** An ability to make use of the mathematical approach in formulating and Analysing problems in economics and in game theory and recognition of its limitations.

Suggested Readings

1. Chiang, A.C. and K. Wainwright (2013): Fundamental Methods of Mathematical Economics, McGraw Hill.
2. Dorfman, Samuelson and Solow (1958): Linear Programming and Economic Analysis, McGraw Hill.

3. Hoy, L., McKenna, Rees and Stengos (2004): Mathematics for Economics, Prentice Hall.
4. Sydsaeter, K., P.J. Hammond and A. Strom (2014): Essential Mathematics for Economic Analysis, Pearson.
5. Young, H.P. and S. Zamir (eds.) (2015): Handbook of Game Theory with Economic Applications, Elsevier.
6. Budnick, F.S. (1997): Applied Mathematics for Business, Economics and Social Sciences, McGraw Hill. 7. Handry, A.T. (2016): Operation Research: An Introduction, Prentice Hall.
8. Nicholson, R.H. (1986): Mathematics for Business and Economics, McGraw Hill. 4. Sydsaeter, K., and P.J. Hammond (2012): Mathematics for Economic Analysis, Pearson.

MASI0058: STATISTICAL INFERENCE

(4 Credits - 60 hours)

Objective: This course aims at giving the foundation knowledge of Probability and Statistical Inference. In particular, it gives details of theory of Estimation and testing of hypothesis. Both theoretical aspect will be discussed and practical problems will be dealt with in great detail.. This course will also serve as a foundation course for students working on Machine Learning.

Module I (10 hours)

Revision of Probability, Different Discrete and Continuous Distributions, Functions of Random Variables and their distributions, T, Chi-sq, F distributions and their Moments, Introduction of statistics and the distinction between Data and its properties, and probabilistic models

Module II (15 hours)

Estimation: Concepts of estimation, unbiasedness, sufficiency, consistency and efficiency. Factorization theorem. Complete statistic, Minimum variance unbiased estimator (MVUE) and Rao-Blackwell theorem with applications. Cramer-Rao inequality and MVB estimators (statement and applications). Methods of Estimation: Method of moments, method of maximum likelihood estimation.

Module III (10 hours)

Principles of test of significance: Null and alternative hypotheses (simple and composite), Type-I and Type-II errors, critical region, level of significance, size and power, best critical region, most powerful test, uniformly most powerful test,

Module IV (10 hours)

Neyman Pearson Lemma (statement and applications to construct most powerful test). Likelihood ratio test and relevant problems, properties of likelihood ratio tests (without proof).

Module V (15 hours)

Interval estimation - Confidence interval for the parameters of various distributions, Confidence interval for Binomial proportion, Confidence interval for population correlation coefficient for Bivariate Normal distribution, Pivotal quantity method of constructing confidence interval, Large sample confidence intervals.

COURSE/LEARNING OUTCOMES

At the end of the course, students will be able to:

- CO1:** Basic theoretical knowledge about fundamental principles for statistical inference.
- CO2:** Perform point estimation, hypothesis testing and interval estimation under a large variety of discrete and continuous probability models.
- CO3:** Evaluate the properties of these estimators and test for both finite sample sizes and asymptotically as the sample size tends to infinity.

CO4: Select optimal estimators.

CO5: Illustrate computational skills to implement various statistical inferences approaches.

CO6: Interpreting and communicating the results of statistical analysis, orally and in writing.

Suggested Readings

1. Goon A.M., Gupta M.K.: Das Gupta.B. (2005), Fundamentals of Statistics, Vol. I, World Press, Calcutta. 2. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
3. Miller, I. and Miller, M. (2002) : John E. Freund's Mathematical Statistics (6th addition, low price edition), Prentice Hall of India.
4. Dudewicz, E. J., and Mishra, S. N. (1988): Modern Mathematical Statistics. John Wiley & Sons.
5. Mood A.M, Graybill F.A. and Boes D.C.; Introduction to the Theory of Statistics, McGraw Hill.
6. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997) Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.
7. Snedecor G.W and Cochran W.G.(1967) Statistical Methods. Iowa State University Press.
8. Bhattacharjee, D. & Das, K. K.(2008) A Treatise on Statistical Inference and Distributions, Asian Books, New Delhi.

MACS0101: CALCULUS

(6 Credits- 60 hours Theory + 30 hours Tutorial)

Objective: *The objective of the present course is to introduce to a student the fundamental notions of calculus, for instance, integration and differentiation in case of function of a single variable. Apart from that, analogous notion in case of vector valued function will also be introduced.*

Module I (18 + 7 hours)

Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.

Module II (16 + 7 hours)

Reduction formulae, derivations and illustrations of reduction formulae of the type, volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

Module III (12 + 6 hours)

Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminates, polar equations of conics.

Module IV (14 + 10 hours)

Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration, modeling ballistics and planetary motion, Kepler's second law.

LIST OF PRACTICALS (using any software)

- (i) Plotting of graphs of function $+ b$, $\log(ax + b)$, $1/(ax + b)$, $\sin(ax + b)$, $\cos(ax + b)$, $|ax + b|$ and to illustrate the effect of a and b on the graph.
- (ii) Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
- (iii) Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).

- (iv) Obtaining surface of revolution of curves.
- (v) Tracing of conics in Cartesian coordinates/ polar coordinates.
- (vi) Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using Cartesian coordinates.
- (vii) Matrix operation (addition, multiplication, inverse, transpose).

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Systematically understand the fundamental concepts and principles of differential and integral calculus (Remembering)
- CO2:** Understanding of the already mentioned concepts, students will be able to have some idea on curve tracing, conics and vector function with properties (Understanding)
- CO3:** Apply these mathematical concepts in various physical problems and will be able to solve such problems (like application of integration in finding volumes) (Applying)
- CO4:** Analyse certain problems which are not solvable initially whereupon suggesting possible conditions the solution of the same (Analysing)
- CO5:** Have a clear understanding of the necessity and sufficiency of the hypothesis related to a the solution of a certain problem (Creating)
- CO6:** Learn the fundamental distinction between various methods applied for the solution of the same problem and also when to apply which method (Evaluating)

Suggested Readings

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
3. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
4. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.

MAAG0102: ALGEBRA

(6 Credits- 60 hours Theory + 30 hours Tutorial)

Objective: *The objective of this course is to familiarize a student with the fundamentals of complex numbers and arithmetic inequalities. This course also introduces to a student the basic properties of matrices along with their application in various physical situations.*

Module I (12 + 5 hours)

Polar representation of complex numbers, n th roots of unity, De Moivre's theorem for rational indices and its applications.

Module II (12 + 7 Hours)

Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

Module III (14 + 8 hours)

Inequalities involving arithmetic, geometric and harmonic means, Cauchy Schwarz inequality, relations between roots and coefficients of polynomial equation of degree n , roots of symmetric functions, Cardon's methods solution of cubic equation.

Module IV (22 + 10 hours)

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax=b$, solution sets of linear systems, applications of linear systems, linear independence. Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n , dimension of subspaces of R^n and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Learn and understand the fundamental concepts associated with complex number, set theory, number theory, linear algebra (*Remembering*)
- CO2:** Recognize the various physical significance of these concepts (*Understanding*)
- CO3:** Apply these concepts in various problems and will be able to use the basic properties of matrices along with their application in various physical situation (*Applying*)
- CO4:** Analyse methods to obtain the solution (*Analysing*)
- CO5:** Solve those problems by using the basic concept and logical thinking (*Creating*)
- CO6:** Decide which method of solution is applicable to what type or class of problems and the advantages and demerits of other methods leading to the solution of the same problem (*Evaluating*)

Suggested Readings

1. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P Ltd., Indian Reprint, 2005.
3. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007

MAER0103: ELEMENTARY REAL ANALYSIS**(6 Credits- 60 hours Theory + 30 hours Tutorial)**

Objective: The objective of this course is to introduce to a student various algebraic properties of the real number system. Apart from that, the present course also serves as an introductory course on principles of Mathematical analysis and their application in various other discipline.

Module I (20 + 10 hours)

Review of Algebraic and Order Properties of R , neighbourhood of a point in R , Idea of countable sets, uncountable sets and uncountability of R . Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R , The Archimedean Property, Density of Rational (and Irrational) numbers in R , Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

Module II (20+ 10 hours)

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.

Module III (20 + 10 hours)

Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Gauss test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Learn and understand the basic concept associated with real number system, fundamental and principles of mathematical analysis (*Remembering*)
- CO2:** Interpret these concepts in a practical manner apart from having conceptual understanding of the already mentioned concepts (*Understanding*)
- CO3:** Use these concepts in various other disciplines (*Applying*)
- CO4:** Analyse various possible methods to obtain the solution (*Analysing*)
- CO5:** Solve those problems by using the basic concept and logical thinking (*Creating*)
- CO6:** Predict which method suits a certain problem the most (*Evaluating*)

Suggested Readings

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
4. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1

MADQ0104: DIFFERENTIAL EQUATIONS

(6 Credits- 60 hours Theory + 30 hours Tutorial)

Objective: *The present course aims to introduce to a student the theory of ordinary differential equation which plays a key role in almost every physical situation. The course focuses not only at how to formulate a physical problem using differential equation but also at different methods of solution.*

Module I (18 + 10 hours)

Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

Module II (20 +10 hours)

Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting.

Module III (22 + 10 hours)

General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.

Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

List of Practical (using any software)

1. Plotting of second order solution family of differential equation.

2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
9. Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).
10. Battle model (basic battle model, jungle warfare, long range weapons).
11. Plotting of recursive sequences.
12. Study the convergence of sequences through plotting.
13. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot
14. Cauchy's root test by plotting n th roots.
15. Ratio test by plotting the ratio of n th and $(n+1)$ th term.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Systematically understand the theory of differential equation (*Remembering*)
- CO2:** Understanding of the already mentioned concepts, students will be able to have a systematic understanding of the relationship among these concepts (*Understanding*)
- CO3:** Formulate a physical problems using differential equation and find solution (*Applying*)
- CO4:** Analyse certain problems which are not solvable initially whereupon suggesting possible conditions for the solution of the same (*Analysing*)
- CO5:** Have a clear understanding of the necessity and sufficiency of the hypothesis related to a the solution of a certain problem (*Creating*)
- CO6:** Learn the fundamental distinction between various methods applied for the solution of the same problem and also when to apply which method (*Evaluating*)

Suggested Readings

1. Belinda Barnes and Glenn R. Fulford, Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab, 2nd Ed., Taylor and Francis group, London and New York, 2009.
2. C.H. Edwards and D.E. Penny, Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education India, 2005.
3. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
4. Martha L Abell, James P Braselton, Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004

MACD0105: CALCULUS AND DIFFERENTIAL EQUATIONS

(6 Credits- 60 hours Theory + 30 hours Tutorial)

Objective: The objective of this course is to familiarize a graduate student with techniques in multivariable calculus and differential Equations. It aims to equip the students with standard

concepts and tools from an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Module I (17 + 10 hours)

- a) Derivatives, higher order derivatives, successive differentiation and Leibnitz's rule and its applications; Mean value Theorem, Taylor's Theorem, tangents and normals, concavity and inflection points, curvature, L' Hospital's rule
- b) Partial differentiations, partial derivative as a slope, partial derivative as a rate, higher order partial derivatives (two and three variables), Euler's theorem on homogeneous functions. Maxima, minima and saddle points; Method of Lagrange multipliers.

Module II (11 +5 hours)

Standard methods of integration, integration of irrational function, reduction formulae, derivations and illustrations of the type

Module III (7 + 5 hours)

Applications of Integrals: Area of plane curves, volume and surface area of solids of revolution, parametrization of a curve, arc length of parametric curves.

Module IV (12+5 hours)

Differential equations; general, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

Module V (13 + 5 hours)

General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Systematically understand the fundamental concepts like limits, continuity, differentiability, integrality and theory of differential equation (Remembering)
- CO2:** Understanding of the already mentioned concepts, students will be able to have a systematic understanding of the relationship among these concepts (*Understanding*)
- CO3:** Apply these mathematical concepts in various physical problem and will be able to solve such problems. (like application of integration in finding volumes. Students also will be able to formulate a physical problems using differential equation and find solution (Applying)
- CO4:** Analyse certain problems which are not solvable initially whereupon suggesting possible conditions for the solution of the same (Analysing)
- CO5:** Have a clear understanding of the necessity and sufficiency of the hypothesis related to a the solution of a certain problem (Creating)
- CO6:** Learn the fundamental distinction between various methods applied for the solution of the same problem and also when to apply which method (Evaluating)

Suggested Readings

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi

2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi
3. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India

MALG0106: ALGEBRA

(6 Credits- 60 hours Theory + 30 hours Tutorial)

Objective: *The objective of this course is to familiarize a student with the fundamentals of complex numbers and arithmetic inequalities. This course also introduces to a student the basic properties of matrices along with their application in various physical situations.*

Module I (12 + 5 hours)

Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications.

Module II (12 + 7 hours)

Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic

Module III (14 + 8 hours)

Inequalities involving arithmetic, geometric and harmonic means, Cauchy Schwarz inequality, relations between roots and coefficients of polynomial equation of degree n, roots of symmetric functions, Cardon's methods solution of cubic equation.

Module IV (22 + 10 hours)

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax=b$, solution sets of linear systems, applications of linear systems, linear independence. Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R_n , dimension of subspaces of R_n and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Learn and understand the fundamental concepts associated with complex number, set theory, number theory, linear algebra (Remembering)
- CO2:** Recognize the various physical significance of these concepts (Understanding)
- CO3:** Apply these concepts in various problems and will be able to use the basic properties of matrices along with their application in various physical situation (Applying)
- CO4:** Analyse methods to obtain the solution (Analysing)
- CO5:** Solve those problems by using the basic concept and logical thinking (Creating)
- CO6:** Decide which method of solution is applicable to what type or class of problems and the advantages and demerits of other methods leading to the solution of the same problem (Evaluating)

Suggested Readings

1. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
3. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint,

MAAL0107: ALGEBRA AND NUMERICAL METHODS

(6 Credits- 60 hours Theory + 30 hours Tutorial)

Objective: *The objective of the present course is to introduce to a student the fundamentals of algebra and the basic properties of matrices along with their application in various physical situation. Also, this course gives a complete procedure for solving different kinds of problem that occur in their discipline numerically.*

Module I (14 + 5 hours)

Polar representation of complex numbers, n th roots of unity, De Moivre's theorem for rational indices and its applications; expansion of $\cos x$, $\sin x$ and $\tan x$ in positive integral powers of x , exponential and trigonometric function of a complex variable, Euler's expansion for cosine and sine; Gregory's series; Hyperbolic functions

Module II (13 + 7 hours)

Matrices, elementary matrices, row reduction and echelon forms, rank of matrix, linear independence, inverse of matrix, system of linear equations, the matrix equation $Ax=b$, solution sets of linear systems, applications of linear systems, characteristic equation of a matrix. Eigen values, Eigen Vectors, Diagonalizing matrices

Module III (17 + 10 hours)

Binary operations, associative and commutative binary operations; Groups; elementary properties of groups; subgroups and examples of subgroups, permutation groups, cyclic groups and properties of cyclic groups, cosets, order of groups, Lagrange's theorem of finite group, normal subgroups, quotient groups, homomorphism and isomorphism of groups.

Module IV (16 + 8 hours)

Transcendental and Polynomial Equation: Bisection method, Regula Falsi method, Newton's method; Interpolation: Lagrange and Newton's methods, finite difference operators, Gregory forward and backward difference interpolation; Numerical Integrations: Trapezoidal rule, Simpson's rule, Simpson 3/8th rule, finding eigenvalues by iteration.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Learn and understand the fundamentals of algebra and basic properties of matrices, Groups and methods for finding roots numerically (Remembering)
- CO2:** Interpret these concepts in a practical manner apart from having conceptual understanding of the already mentioned concepts (Understanding)
- CO3:** Use these concepts in various other disciplines (Applying)
- CO4:** Analyse various possible methods to obtain the solution (Analysing)
- CO5:** Solve those problems by using the basic concept and logical thinking (Creating)
- CO6:** Predict which method suits a certain problem the most (Evaluating)

Suggested Readings

1. J. A. Gallian: Contemporary Abstract Algebra, Brooks Cole.
2. J. B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson
3. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint
4. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall

5. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical methods for Scientific and Engineering Computation, 6th Ed. NewAge International (P) Ltd.

MADV0108: DIFFERENTIAL EQUATIONS, VECTOR CALCULUS AND GEOMETRY

(6 Credits- 60 hours Theory + 30 hours Tutorial)

Objective: The objective of the present course is to introduce to a student the theory of partial differential equation, vector calculus and geometry. It aims to equip the students with standard concepts and tools from an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Module I (20 + 10 hours)

Transformation of coordinate axis, pair of straight lines Parabola, parametric coordinates, tangent and Normal, Ellipse and conjugate diameters with properties; general conics: tangents, condition of tangency, pole and polar, centre of a conic, equation of pair of tangents, reduction to standards forms, central conics, equation of axes and length of the axes, polar equation of a conic.

Module II (20 +10 hours)

Scalar triple product, vector triple product; Introduction to vector functions, operations with vector valued functions, limits and continuity of vector functions, differentiation and integration of vector functions; partial derivatives of vector point function, gradient, curl and divergence

Module III (20 +10 hours)

Simultaneous linear differential equations, total differential equations. Partial differential equations of first order, Lagrange's solutions, some special types of equations which can be solved by methods other than the general method, Charpit's general methods of solution.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Systematically understand the theory of differential equations, vector calculus and coordinate geometry. (Remembering)
- CO2:** Understanding of the already mentioned concepts, students will be able to have a systematic understanding of the relationship among these concepts (Understanding)
- CO3:** Formulate a physical problems using differential equation and find solution (Applying)
- CO4:** Analyse certain problems which are not solvable initially whereupon suggesting possible conditions for the solution of the same (Analysing)
- CO5:** Have a clear understanding of the necessity and sufficiency of the hypothesis related to a the solution of a certain problem (Creating)
- CO6:** Learn the fundamental distinction between various methods applied for the solution of the same problem and also when to apply which method (Evaluating)

Suggested Readings

1. Differential Equation, H.T.H. Piaggio Differential Equations G.Bell & Sons Ltd. 1921
2. Analytical Geometry of two and three dimension and vector calculus , R.M.Khan
3. Ordinary and partial differential equations, M.D.Raisinghania, S.Chand and Co.

MARF0109: THEORY OF REAL FUNCTIONS

(6 Credits- 60 hours Theory + 30 hours Tutorial)

Objective: The objective of this course is to introduce to a student various algebraic properties of the real number system. Moreover, the present course also serves as an introductory course on

principles of real analysis that undertakes all the key notion of any form of Mathematical analysis.

Module I (22 hours + 10 hours)

Limits of functions (approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

Module II (22 hours + 10 hours)

Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor's theorem to inequalities.

Module III (22 hours + 10 hours)

Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\ln(1 + x)$, $1/ax+b$ and $(1 + x)^n$.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Systematically understand the fundamental concepts of mathematical analysis like algebraic and properties of real numbers, continuity, differentiability, integration etc. (Remembering)
- CO2:** Understanding of the already mentioned concepts, students will be able to have a systematic understanding of the interface among these concepts (Understanding)
- CO3:** Formulate the problems involving numerous practical situations and will be able to solve such problems (Applying)
- CO4:** Analyse roles played by each such concept in a certain problem and will be able to apply properties of the pertinent concept (Analysing)
- CO5:** Have a clear understanding of where the hypothesis of a given problem undertakes such concepts whence solving the problem (Creating)
- CO6:** Learn the fundamental distinction between various rules applied for the solution of a problem and also which method suits a certain problem the most (Evaluating)

Suggested ReadingS

1. R. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons, 2003.
2. K.A. Ross, *Elementary Analysis: The Theory of Calculus*, Springer, 2004.
3. A. Mattuck, *Introduction to Analysis*, Prentice Hall, 1999.
4. S.R. Ghorpade and B.V. Limaye, *A Course in Calculus and Real Analysis*, Springer, 2006

MAGT0110:GROUP THEORY I

(6 Credits-60 hours: Theory +30 hours Tutorials)

Objectives: *The objective of this course is :*

- *To make a student familiar with the notion of algebraic structures which plays a key role in many physical problems.*

- To make a student capable to study the symmetries of certain geometric objects.
- To make a student Analyse a problems by associating it to a certain algebraic structure.
- To make a student capable enough to infer about the outcome of the problem depending on the properties of the associated algebraic structure.

Module I (12+7) hours

Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.

Module I (18+9) hours

Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups. Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

Module III (15+8) hours

External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

Module IV (15+8) hours

Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

COURSE/LEARNING OUTCOMES

At the end of the course, a student would be able to

- CO 1:** Understand the nature and properties of various algebraic structures. (Remembering)
- CO 2:** Relate a given problem with a suitable structure. (Understanding)
- CO 3:** Apply these concepts to various other problems occurring in many branches of Mathematics and Science for instance coding theory and geometric constructions. (Applying)
- CO 4:** Analyse the problem by Analysing the properties of the related structure. (Analysing)
- CO 5:** Classify problems in accordance with the underlying structure.(Creating)
- CO 6:** Infer the outcome of a problem on the basis of the properties of the related structure. (Evaluating)

Suggested Readings

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, New Delhi, 1999.
4. Joseph J. Rotman, *An Introduction to the Theory of Groups*, 4th Ed., Springer Verlag, 1995.
5. I.N. Herstein, *Topics in Algebra*, Wiley Eastern Limited, India, 1975

MAMC0111: MULTIVARIABLE CALCULUS

(6 Credits-60 hours Theory+30 hours Tutorials)

Objectives:

- To enable a student perform operations in three and higher dimensions by means of vectors.

- To make a student capable of interpreting partial derivatives and derivatives of a function of several variables using matrices.
- To familiarize a student with the techniques of integrating over curves and surfaces.
- To make a student learn about the fundamental theorems like Green's theorem, Stokes theorem.

Use of Scientific calculator is allowed.

Module I (17 +10) hours

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl

Module II (15 + 7) hours

Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates.

Module III (15 +7) hours

Change of variables in double integrals and triple integrals. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

Module IV (13+ 6)hours

Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Systematically understand the operations involved with calculations in three and higher dimensions. (Remembering)
- CO2:** Distinguish the difference between the notion of calculus of single variable and several variables by means of the properties of derivatives and integration.(Understanding)
- CO3:** Apply the techniques involved with calculus of several variables to solve problems arising in other branches like Physics and non-commutative geometry.(Applying)
- CO4:** Analyse a physical problem by means of the theories of calculus of several variables. (Analysing)
- CO5:** Predict the outcome of a physical problem by studying the problem in the settings of several variable calculus. (Creating)
- CO6:** Determine the efficiency of one method over the other by virtue of the hypothesis of the problem.(Evaluating)

Suggested Readings

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba and A. Weinstein, *Basic Multivariable Calculus*, Springer (SIE), Indian reprint, 2005.

4. James Stewart, *Multivariable Calculus, Concepts and Contexts*, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

MALS0113: LOGIC AND SETS

(2 Credits-30 hours)

Objectives: *The objective of this course is*

- *To familiarize a student with the fundamentals of logic, connectives and quantifiers.*
- *To make a student learn about various methods of proving a Mathematical statement viz. direct, indirect and by method of contradiction.*
- *To make a student learn about various operations involved with sets and collection of sets.*
- *To familiarize a student about equivalence relation and equivalent classes and the application of the same in various other problems.*

Module I (14 hours)

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Module II (7 hours)

Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Module III (9 hours)

Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, binary relations.

COURSE/LEARNING OUTCOMES

At the end of this course, a student would be able to:

- CO 1:** Gain the knowledge of interpreting any Mathematical statement into the language of logic. (Remembering)
- CO 2:** Understand the notion of logic and set which is fundamental in every branch of Science. (Understanding)
- CO 3:** Apply the methodologies of sets in problems arising in other branches of Mathematics and Science like combinatorics and algebra. (Applying)
- CO 4:** Analyse validity of a given statements by means of principles of logic. (Analysing)
- CO 5:** Determine a method of proof among all possible methods that is most efficient for the given problem. (Creating)
- CO 6:** To evaluate a given problem for its utility by first verifying the validity of the same. (Evaluating)

Suggested Readings

1. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
2. P.R. Halmos, *Naive Set Theory*, Springer, 1974.
3. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.

MAPC0112: PROGRAMMING IN C

(2-Credits: 30 hours)

Objective: The objective of the course is to introduce the fundamentals of C programming language and develop the skill for solving problems using computers. After completion of this course, a student will be able to

- Understand and use the process of abstraction using a programming language such as C
- Enable the student to develop solutions for common problems.
- Familiarize the student with syntax of C language and teach him/her to translate pseudo-code into C programs, understanding the steps involved in the execution of a C program.
- Get introduced to pointers, arrays, structures and files in C.

Module I (5 Hours)

C Fundamentals:-Elementary data types, variables, constants and identifiers. Integer, character floating point and string constants. variable declarations. Syntax and semantics. Reserved word. Initialization of variable during declarations Constant data types.

Module II (7 Hours)

Expression, precedence and associativity of operators, unary, binary and ternary operators. Arithmetic operators, assignment operators, relational operators, logical operators and bit-wise operators, Expression statement.

Module III (10 Hours)

Conditional Statement-if, if-else. Iterative Statement-while, do-while, for. Other Statement –break, continue, goto, return, switch. Structures and Unions.

Module IV (8 Hours)

Functions,-call by value, call by reference. Array – declaration and use, 2D Array-declaration and use.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define and describe various terms and concepts of C programming language. (Remembering)
- CO2:** Comprehend or interpret information based on their understanding of the concepts of C language's syntax, data types, control statements, functions, pointers, arrays, structures, files using C (Understanding)
- CO3:** Solve problems using standard algorithms and translate pseudo-code into C programs and implement them (Applying)
- CO4:** Apply their analytical skills for choosing the structure, function, data types and develop logic to solve various instances of problems (Analysing)
- CO5:** Combine the various concepts and ideas learnt in C to plan, propose and develop a product. (Creating)
- CO6:** Evaluate various algorithms used for searching, sorting etc. in terms of correctness and computation cost. (Evaluating)

Suggested Readings

1. Thareja, R., Computer Fundamentals and Programming in C, Oxford University Press, New Delhi
2. Balaguruswamy E.; Computing Fundamentals and C programming; Tata McGraw Hill

Publishing Company Limited New Delhi

3. Kanetkar Y, Let us C; BPB Publications, New Delhi

MAPE0114: Partial Differential Equations

(6 Credits-60 hours Theory+30 hours Tutorials)

Objective: The objective of this course is to present the main results in the context of partial differential equations that allow learning about the different methods of solving practical problems along with numerical methods for the approximation of their solution.

Module I (14+8) hours

Review of first order ODE .Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, Pfaffian diff equations

Module II (18+8) hours

Partial Differential Equations – Basic concepts and Definitions, Mathematical Problems. First-Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

Module III (10+6) hours

Derivation of Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

Module IV (18+8) hours

The Cauchy problem, the Cauchy-Kowaleewskaya theorem, Cauchy problem of an infinite string. Initial Boundary Value Problems, Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end, Equations with non-homogeneous boundary conditions, Non-Homogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem, Solving the Heat Conduction problem

List of Practicals (using any software)

- (i) Solution of Cauchy problem for first order PDE.
- (ii) Finding the characteristics for the first order PDE.
- (iii) Plot the integral surfaces of a given first order PDE with initial data.

(iv) Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

- (a) $u(x, 0) = \phi(x), u_t(x, 0) = \psi(x), x \in \mathbb{R}, t > 0$
- (b) $u(x, 0) = \phi(x), u_t(x, 0) = \psi(x), u(0, t) = 0, x \in (0, \infty), t > 0$
- (c) $u(x, 0) = \phi(x), u_t(x, 0) = \psi(x), u_x(0, t) = 0, x \in (0, \infty), t > 0$
- (d) $u(x, 0) = \phi(x), u_t(x, 0) = \psi(x), u(0, t) = 0, u(1, t) = 0, 0 < x < 1, t > 0$

(v) Solution of wave equation $\frac{\partial u}{\partial t} - k^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

- (a) $u(x, 0) = \phi(x), u(0, t) = a, u(l, t) = b, 0 < x < l, t > 0$
- (b) $u(x, 0) = \phi(x), x \in R, 0 < t < T$
- (c) $u(x, 0) = \phi(x), u(0, t) = a, x \in (0, \infty), t \geq 0$
- (d) $u(x, 0) = \phi(x), u_t(x, 0) = \psi(x), u(0, t) = 0, u(1, t) = 0, 0 < x < 1, t > 0$

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1: Systematically understand the theory of Partial Differential equations and classify partial differential equations and transform into canonical form. (Remembering)
- CO2: Understanding of the already mentioned concepts, students will be able to have a systematic understanding of the relationship among these concepts (Understanding)
- CO3: Apply partial derivative equation techniques to predict the behaviour of certain phenomena and formulate the physical problems using partial differential equation and find solution. (Applying)
- CO4: Analyse certain problems which are not solvable initially whereupon suggesting possible conditions for the solution of the same (Analysing)
- CO5: Have a clear understanding of the different forms, properties and methods to find the solution of a certain problem (Creating)
- CO6: Learn the fundamental distinction between various methods applied for the solution of the same problem and also when to apply which method (Evaluating)

Suggested Readings

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equations for Scientists and Engineers*, 4th edition, Springer, Indian reprint, 2006.
2. S.L. Ross, *Differential equations*, 3rd Ed., John Wiley and Sons, India, 2004.
3. Martha L Abell, James P Braselton, *Differential equations with MATHEMATICA*, 3rd Ed., Elsevier Academic Press, 2004.

MANM0115: NUMERICAL METHODS

(6 Credits-60 hours Theory+30 hours Tutorials)

Objective: *The present course basically deals with the various numerical and computational techniques of applied mathematics which are indispensable in other areas of Mathematics for instance, fluid dynamics, numerical linear algebra etc.*

Use of Scientific Calculator is allowed.

Module I (20+10) hours

Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method. Rate of convergence of these methods.

Module II (22 +10) hours

System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.

Module III (18+10) hours

Numerical Integration: Trapezoidal rule, Simpson's rule, Simpsons 3/8th rule, Boole's Rule.

Midpoint rule, Composite Trapezoidal rule, Composite Simpson's rule.

Ordinary Differential Equations: Euler's method. Runge-Kutta methods of orders two and four.

List of practicals (based on module I,II,III) (using any software)

- (i) Calculate the sum $1/1 + 1/2 + 1/3 + 1/4 + \dots + 1/N$.
- (ii) To find the absolute value of an integer.
- (iii) Enter 100 integers into an array and sort them in an ascending order.
- (iv) Bisection Method.
- (v) Newton Raphson Method.
- (vi) Secant Method.
- (vii) Regulai Falsi Method.
- (viii) LU decomposition Method.
- (ix) Gauss-Jacobi Method.
- (x) SOR Method or Gauss-Siedel Method.
- (xi) Lagrange Interpolation or Newton Interpolation.
- (xii) Simpson's rule.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Understand the concept of error and difficulty of solving problems analytically and the need to use numerical approximations for their resolution. (Remembering)
- CO2:** Learn to derive numerical method for various mathematical operation. (Understanding)
- CO3:** Apply numerical methods to obtain approximate solutions to mathematical problems. (Applying)
- CO4:** Analyse and evaluate the accuracy of common numerical methods. (Analysing)
- CO5:** Solve problems by using the basic concept and numerical methods.(Creating)
- CO6:** Formulate and solve some mathematical problems using numerical methods in the field of Industrial application (Evaluating)

Suggested Readings

1. Brian Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6th Ed., New age International Publisher, India, 2007.
3. C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis*, Pearson Education, India, 2008.
4. Uri M. Ascher and Chen Greif, *A First Course in Numerical Methods*, 7th Ed., PHI Learning Private Limited, 2013.
5. John H. Mathews and Kurtis D. Fink, *Numerical Methods using Matlab*, 4th Ed., PHI Learning Private Limited, 2012.

MAMC0116: MECHANICS**(6 Credits-60 hours Theory+30 hours Tutorial)**

Objectives: *In the present course, students will learn a process for analysis of static objects; concepts of force, moment, and mechanical equilibrium; how to Analyse forces and moments in two and three dimensions; and how to Analyse distributed forces and internal loads. They will be able to Analyse forces in various systems such as frames, machines, trusses, beams and cables.*

Module I (18+9) hours

Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

Module II (22+11) hours

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centers, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

Module III (20+10) hours

Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles, translation and rotation of rigid bodies, Chasles' theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain relative motion, Inertial and non inertial reference frames, center of mass and moment of inertia tensor, Coriolis acceleration, instant center of rotation, degrees of freedom. (Remembering)
- CO2:** Construct free body diagrams of an object or a system of connected objects. Describe conditions of equilibrium and their associated component equations. (Understanding)
- CO3:** Use conditions of equilibrium and known forces and moments to solve for unknown external and internal forces and moments present in an object of system of connected objects. Application of the vector theorems of mechanics and interpretation of their results. (Applying)
- CO4:** Analyse and demonstrate the stability conditions of mechanical equilibrium. Analyse certain problems which are not solvable initially whereupon suggesting possible conditions the solution of the same (Analysing)
- CO5:** Have a clear understanding of the necessity and sufficiency of the hypothesis related to a the solution of a certain problem (Creating)
- CO6:** Learn the fundamental distinction between various methods applied for the solution of the same problem and also when to apply which method (Evaluating)

Suggested Readings

1. I.H. Shames and G. Krishna Mohan Rao, *Engineering Mechanics: Statics and Dynamics*, (4th Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
2. R.C. Hibbeler and Ashok Gupta, *Engineering Mechanics: Statics and Dynamics*, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

MACG0117: COMPUTER GRAPHICS**(2Credits-30 hours)****Objectives:** *The objective of this course is*

- *To enable a student learn about the basics of computer graphics input and output devices.*
- *To provide a student the knowledge of various techniques involved with colour display.*
- *To familiarize a student with the programs to display an image to a given specification.*
- *To give a student a first hand knowledge regarding algorithms.*

Module I (14 hours)

Development of computer Graphics: Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices.

Module II (16 hours)

Points, lines and curves: Scan conversion, line-drawing algorithms, circle and ellipse generation, conic-section generation, polygon filling antialiasing. Two-dimensional viewing: Coordinate systems, linear transformations, line and polygon clipping algorithms.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO 1:** Design program to implement standard graphic models using standard approaches. (Remembering)
- CO 2:** Understand the functioning of graphic processors. (Understanding)
- CO 3:** Compare various graphic devices to get the best output.(Applying)
- CO 4:** Analyse graphics devices to produce a graphics image of desired quality.(Analysing)
- CO 5:** Predict the efficiency of devices depending upon the environment.(Creating)
- CO 6:** Evaluate the utility of a certain graphics model by writing a program. (Evaluating)

Suggested Readings

1. D. Hearn and M.P. Baker, *Computer Graphics*, 2nd Ed., Prentice–Hall of India, 2004.
2. J.D. Foley, A van Dam, S.K. Feiner and J.F. Hughes, *Computer Graphics: Principals and Practices*, 2nd Ed., Addison-Wesley, MA, 1990.
3. D.F. Rogers, *Procedural Elements in Computer Graphics*, 2nd Ed., McGraw Hill Book Company, 2001.
4. D.F. Rogers and A.J. Admas, *Mathematical Elements in Computer Graphics*, 2nd Ed., McGraw Hill Book Company, 1990.

MAGY0118: GRAPH THEORY**(2 Credit 30 hours)**

Objective: *The objective of the course is to explain basic concepts in combinatorial graph theory Define how graphs serve as models for many standard problems and different algorithms to find the optimum solution of practical problems.*

Module I (15 hours)

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles.

Module II (15 hours)

The adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Systematically understand the terminologies of graph theory (Remembering)
- CO2:** Understanding of the already mentioned concepts, students will be able to have a systematic understanding of the relationship among these concepts (Understanding)
- CO3:** Find an optimum solution of physical problems using terminologies and algorithms. (Applying)
- CO4:** Analyse certain problems which are not solvable initially whereupon suggesting possible conditions for the solution of the same (Analysing)
- CO5:** Have a clear understanding of the concepts and properties of the graph invariants to have the solution of a certain problem (Creating)
- CO6:** Learn the different algorithms applied for the solution of the same problem and also when to apply which method (Evaluating)

Suggested Readings

1. B.A. Davey and H.A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.
3. Rudolf Lidl and Gunter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

MARS6001: RESEARCH SEMINAR

(2 Credits)

Objective: Objective of the Research seminar is to conduct a research literature survey which may lead to the development of a proposed project model to be executed in the 4th semester. This will help the students to familiarize themselves with the current literature on recent trends in the chosen area.

- Tasks to be performed by the students will include
- Literature survey on the chosen topic
- Presentation on the chosen topic, comprising the following components:
- Presentation
- Report
- Viva Voce examination

COURSE/LEARNING OUTCOMES

At the end of the Research seminar students will be able to

- CO 1:** Find the steps required to do research and projects (Remembering)
- CO 2:** Illustrate the methodology of research and journaling. (Understanding)
- CO 3:** Apply the research presentation skills in seminars and conferences. (Applying)
- CO 4:** List topics to pursue research in the field of pure and applied mathematics. (Analysing)
- CO 5:** Defend their research dissertations and reports. (Evaluating)
- CO 6:** Develop research topics and present the research ideas. (Creating)

MACP6002: COMPUTER PROGRAMMING IN C LAB**(1 credit)**

1. Introduction to OS; file handling, directory structures, creating and editing simple C programs
2. C programming using variables, assignment and simple arithmetic expressions.
3. Determination of roots of quadratic equations, $ax^2+bx+c=0$, $a \neq 0$
4. Arranging given set of numbers in increasing/decreasing order, calculation of Mean
5. Calculation of GCD/LCM of two integers.
6. Evaluation of factorial of a positive integer and evaluation of binomial coefficients.
7. Evaluation of factorial of binomial coefficients mod 2.
8. Sieve method for primality test.
9. Generation of twin primes.
10. Solution of congruence using complete residue system.
11. Addition, subtraction and multiplication of matrices.
12. Transpose, determinant

MARP6003: RESEARCH PROJECT**(8 credits)**

The objective of research project is to train students to carry out research/investigation on a field that is of relevance to the Mathematical science. During the project period, students will start a research project/investigation applying the knowledge acquired in the first three semesters and also incorporating the recent trends in the chosen area. In the project course, the student should be able to undertake detailed literature review as a way of information search, carry out detailed investigations as a way of solving project problem, write and put together a detailed report of the investigations carried out at the end of the fourth semester.

The mode and components of evaluation, supervisors and the weightages attached to them shall be published by the Department at the beginning of the semester.

COURSE/LEARNING OUTCOMES

- CO 1:** Identify different areas of research in the field of Mathematical sciences or in computing. (Remembering)
- CO 2:** Explain the importance of research in the chosen topic of interest. (Understanding)
- CO 3:** Apply theoretical knowledge to find out an appropriate topic of importance for research in the graduate level. (Applying)
- CO 4:** Analyse when a chosen approach does not yield the expected result. (Analysing)
- CO 5:** Evaluate the project and present in an appropriate form. (Evaluating)
- CO 6:** Learn to choose a methodology or technique or approach to fulfill a set of objectives or prove or disprove a hypothesis. (Creating)

SCHOOL OF LIFE SCIENCES
DEPARTMENT OF BIOSCIENCES
MASTER OF SCIENCE
IN BIOCHEMISTRY BIOTECHNOLOGY AND MICROBIOLOGY
(2019-2021 BATCH)

SEMESTER I					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BCBM0008	Biomolecules	SC/DC	4	331
	BTPE0009	Thermodynamics and Enzymology	SC/DC	3	344
	MBCG0001	Cell Biology and Genetics	SC/DC	4	350
	BCAT0009	Analytical Techniques for Biological Sciences	SC/DC	3	322
Lab	BCBM6001	Biomolecules Lab	SC/DC	1	332
	BCAT6002	Analytical Techniques Lab	SC/DC	1	333
	BTPE6009	Thermodynamics and Enzymology Lab	SC/DC	1	349
	MBCG6001	Cell Biology and Genetics Lab	SC/DC	1	359
Total Credits				18	

SEMESTER II					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BTCA0010	Computer Applications and Bioinformatics	SC/DC	3	345
	BCMB0003	Molecular Biology	SC/DC	4	323
	BTRM0003	Research Methodology and Biostatistics	SC/DC	4	336
	MBBM0007	Basic Microbiology	SC/DC	3	357
Lab	BTCA6010	Computer Applications and Bioinformatics Lab	SC/DC	2	350
	BCMB6003	Molecular Biology Lab	SC/DC	2	333
	MBBM6002	Basic Microbiology Lab	SC/DC	1	359
Total Credits				19	

SEMESTER III: BIOCHEMISTRY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BCMB0010	Medical Biochemistry	DC	2	
	BCPY0011	Physiology	DC	3	
	BCBM0012	Bioenergetics and Metabolism			
	BTGE0005	Genetic Engineering	DC	3	
	BTIM0006	Immunology	DC	3	
Lab	BCIM6004	Medical Biochemistry Lab	DC	1	
	BCPY6005	Physiology lab	DC	1	
	BCBM6006	Bioenergetics and Metabolism Lab	DC	1	
	BTGE6004	Genetic Engineering Lab	DC	1	
	BTIM6005	Immunology	DC	1	
	BCDI6007	Dissertation Phase I	DC	2	
Total Credits				21	

SEMESTER IV: BIOCHEMISTRY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BCAC0007	Advances in Biochemistry	DC	4	
Lab	BCDI6008	Dissertation Phase II	DC	16	
Total Credits				20	

SEMESTER III: BIOTECHNOLOGY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BTPB0011	Plant Biotechnology	DC	3	
	BTAB0012	Animal Biotechnology	DC	2	
	BTGE0005	Genetic Engineering	DC	3	
	BTIM0006	Immunology	DC	3	
	BTBE0007	Bioprocess Engineering	DC	3	
Lab	BTAP6003	Animal and Plant Biotechnology Lab	DC	2	
	BTGE6004	Genetic Engineering Lab	DC	1	
	BTIM6005	Immunology Lab	DC	1	
	BTBE6006	Bioprocess Engineering Lab	DC	1	
	BTDI6007	Dissertation Phase I	DC	2	
Total Credits				20	

SEMESTER IV: BIOTECHNOLOGY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BTAB0008	Advances in Biotechnology	DC	4	
Lab	BTDI6008	Dissertation Phase II	DC	16	
Total Credits				20	

SEMESTER III: MICROBIOLOGY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	MBVM0008	Virology and Mycology	DC	3	
	MBEM0009	Environment Microbiology	DC	3	
	BTGE0005 Genetic Engineering		DC	3	
	BTIM0006	Immunology	DC	3	
	MBMM0010	Medical Microbiology	DC	2	
Lab	MBVM6008	Virology and Mycology Lab	DC	1	
	MBEM6009	Environment Microbiology Lab	DC	1	
	BTGE6004	Genetic Engineering Lab	DC	1	
	BTIM6005	Immunology Lab	DC	1	
	MBMM6010	Medical Microbiology Lab	DC	1	
	MBDI6006	Dissertation Phase I	DC	2	
Total Credits				21	

SEMESTER IV: MICROBIOLOGY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	MBAM0006	Advances in Microbiology	DC	4	
Lab	MBDI6007	Dissertation Phase II	DC	16	
Total Credits				20	

(2018-2020 BATCH)					
SEMESTER III: BIOTECHNOLOGY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BTAP0004	Animal and Plant Biotechnology	DC	4	337
	BTGE0005	Genetic Engineering	DC	3	339
	BTIM0006	Immunology	DC	3	340
	BTBE0007	Bioprocess Engineering	DC	3	342
Lab	BTAP6003	Animal and Plant Biotechnology Lab	DC	2	347
	BTGE6004	Genetic Engineering Lab	DC	1	347
	BTIM6005	Immunology Lab	DC	1	348
	BTBE6006	Bioprocess Engineering Lab	DC	1	348
	BTDI6007	Dissertation Phase I	DC	2	349
Total Credits				20	

SEMESTER IV: BIOTECHNOLOGY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BTAB0008	Advances in Biotechnology	DC	4	343
Lab	BTDI6008	Dissertation Phase II	DC	16	349
Total Credits				20	

SEMESTER III: BIOCHEMISTRY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BCIM0004	Immunology and Medical Biochemistry	DC	4	324
	BTGE0005	Genetic Engineering	DC	3	339
	BCPY0005	Physiology	DC	3	326
	BCBM0006	Bioenergetics and Metabolism	DC	3	327
Lab	BCIM6004	Immunology and Medical Biochemistry Lab	DC	2	334
	BTGE6004	Genetic Engineering Lab	DC	1	347
	BCPY6005	Physiology lab	DC	1	334
	BCBM6006	Bioenergetics and Metabolism Lab	DC	1	335
	BCDI6007	Dissertation Phase I	DC	2	335
Total Credits				20	

SEMESTER IV: BIOCHEMISTRY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BCAC0007	Advances in Biochemistry	DC	4	329
Lab	BCDI6008	Dissertation Phase II	DC	16	336
Total Credits				20	

SEMESTER III: MICROBIOLOGY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	MBVB0003	Virology, Bacteriology and Mycology	DC	5	351
	MBDE0004	Microbial Diversity and Ecology	DC	2	353
	BTGE0005	Genetic Engineering	DC	3	339
	MBIM0005	Immunology and Medical Microbiology	DC	3	354

Lab	MBMT6003	Microbiology Techniques Lab	DC	2	360
	MBDE6004	Microbial Diversity and Ecology Lab	DC	1	361
	BTGE6004	Genetic Engineering lab	DC	1	347
	MBIM6005	Immunology and Medical Microbiology Lab	DC	1	361
	MBDI6006	Dissertation Phase I	DC	2	362
Total Credits				20	

SEMESTER IV: MICROBIOLOGY					
Type	Course Code	Course Name	Category	Credits	Page
Theory	MBAM0006	Advances in Microbiology	DC	4	356
Lab	MBDI6007	Dissertation Phase II	DC	16	362
Total Credits				20	

DEPARTMENT OF ZOOLOGY

BACHELOR OF SCIENCE IN ZOOLOGY

SEMESTER I				
Types of Course/Category	Course Code	Course Name	Credits	Page
Core course-1 (Theory)/DC	ZGPP0101	Non-chordates I: Protista to Pseudocoelomates	4-0-0	401
Core course-2 (Theory)/DC	ZGPE0102	Perspectives in Ecology	4-0-0	402
Core course-1 (Lab)/DC	ZGPP6101	Non-chordates I: Protista to Pseudocoelomates Lab	0-0-2	416
Core course-2 (Lab)/DC	ZGPE6102	Perspectives in Ecology Lab	0-0-2	417
Ability Enhancement Compulsory Course-1 /IC	LSEC0018	English Communication	2-0-0	657
Generic Elective -1 /SE (Chemistry) Theory	CHAH0105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4-0-0	189
	CHCK0120	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics	4-0-0	209
Generic Elective -1 Lab/SE (Chemistry) Lab	CHAH6105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons Lab	0-0-2	220
	CHCK6114	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics Lab	0-0-2	228
Total Credits			20	
SEMESTER II				
Core course-3 (Theory)/DC	ZGCL0103	Non-chordates II: Coelomates	4-0-0	402
Core course-4 (Theory)/DC	ZGCB0104	Cell Biology	4-0-0	403
Core course-3 (Lab)/DC	ZGCL6103	Non-chordates II: Coelomates Lab	0-0-2	417
Core course-4 (Lab)/DC	ZGCB6104	Cell Biology Lab	0-0-2	417
Ability Enhancement Compulsory Course-2 /IC	CHES0002	Environmental Studies	2-0-0	143
Generic Elective -2 /SE (Chemistry) Theory	CHOS0119	Chemical Energetics, Equilibria & Functional Organic Chemistry	4-0-0	207
Generic Elective -2 Lab/SE (Chemistry) Lab	CHOS6113	Chemical Energetics, Equilibria & Functional Organic Chemistry- Lab	0-0-2	227
Total Credits			20	
SEMESTER III				
Types of Course/Category	Course Code	Course Name	Credits	Page
Core course-5 (Theory)/DC		Diversity of Chordates	4-0-0	
Core course-6 (Theory)/DC		Animal Physiology: Controlling and Coordinating systems	4-0-0	
Core course-7 (Theory)/DC		Fundamentals of Biochemistry	4-0-0	

Core course-5 (Lab)/DC		Diversity of Chordates Lab	0-0-2	
Core course-6 (Lab)/DC		Animal Physiology: Controlling and Coordinating systems Lab	0-0-2	
Core course-7 (Lab)/DC		Fundamentals of Biochemistry Lab	0-0-2	
Skill Enhancement Course-2		Research Methodology	2-0-0	
Generic Elective -3 /SE (Botany)		Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4-0-0	
		Plant Ecology and Taxonomy	4-0-0	
Generic Elective -3 Lab/SE (Botany)		Biodiversity (Microbes, Algae, Fungi and Archegoniate) Lab	0-0-2	
		Plant Ecology and Taxonomy Lab	0-0-2	
Total Credits			26	
SEMESTER IV				
Core course-8 (Theory)/DC		Comparative Anatomy of Vertebrates	4-0-0	
Core course-9 (Theory)/DC		Animal Physiology: Life Sustaining Systems	4-0-0	
Core course-10 (Theory)/DC		Biochemistry of Metabolic Processes	4-0-0	
Core course-8 (Lab)/DC		Comparative Anatomy of Vertebrates Lab	0-0-2	
Core course-9 (Lab)/DC		Animal Physiology: Life Sustaining Systems Lab	0-0-2	
Core course-10 (Lab)/DC		Biochemistry of Metabolic Processes Lab	0-0-2	
Skill Enhancement Cours-2		Sericulture / Aquarium Fish Keeping	2-0-0	
Generic Elective -4 /SE (Botany)		Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4-0-0	
		Plant Ecology and Taxonomy	4-0-0	
Generic Elective -4 Lab/SE (Botany)		Biodiversity (Microbes, Algae, Fungi and Archegoniate) Lab	0-0-2	
		Plant Ecology and Taxonomy Lab	0-0-2	
Total Credits			26	

SEMESTER V				
Types of Course/ Category	Course Code	Course Name	Credits	Page
Core course-11 (Theory)/DC		Molecular Biology	4-0-0	
Core course-12 (Theory)/DC		Principles of Genetics	4-0-0	
Core course-11 (Lab)/DC		Molecular Biology Lab	0-0-2	
Core course-12 (Lab)/DC		Principles of Genetics Lab	0-0-2	
Discipline Specific Elective-1/DE		Wildlife Conservation and Management	4-0-0	
		Wildlife Conservation and Management Lab	0-0-2	

		Animal Behaviour and Chronobiology	4-0-0	
		Animal Behaviour and Chronobiology Lab	0-0-2	
Discipline Specific Elective-2/DE		Computational Biology	4-0-0	
		Computational Biology Lab	0-0-2	
		Animal Biotechnology	4-0-0	
		Animal Biotechnology Lab	0-0-2	
Total Credits			24	
SEMESTER VI				
Core course-13 (Theory)/DC		Developmental Biology	4-0-0	
Core course-14 (Theory)/DC		Evolutionary Biology	4-0-0	
Core course-13 (Lab)/DC		Developmental Biology Lab	0-0-2	
Core course-14 (Lab)/DC		Evolutionary Biology Lab	0-0-2	
Discipline Specific Elective-3/DE		Immunology	4-0-0	
		Immunology Lab	0-0-2	
		Parasitology	4-0-0	
		Parasitology Lab	0-0-2	
Discipline Specific Elective-4/DE		Fish and Fisheries	4-0-0	
		Fish and Fisheries Lab	0-0-2	
		Biology of Insecta	4-0-0	
		Biology of Insecta Lab	0-0-2	
Total Credits			24	

MASTER OF SCIENCE IN ZOOLOGY

(Batch 2019- 2021 Batch)

SEMESTER I					
Type	Course Code	Course Name	Category	Credits	Page
Theory	ZGBE0027	Biosystematics and Evolution	DC	4	388
	ZGCI0028	Cell Biology and Immunology–Theory and Applications	DC	4	390
	ZGBG0029	Molecular Biology and Genetics	DC	4	391
	ZGAP0030	Animal Physiology	DC	4	393
	ZGEE0031	Ecology and Environmental Biology	DC	4	394
Lab	ZGBE6019	Biosystematics and Environmental Biology Lab	DC	2	415
	ZGCI6020	Cell Biology, Genetics and Basic Bioinformatics Lab	DC	2	415
Total Credits				24	

SEMESTER II					
Type	Course Code	Course Name	Category	Credits	Page
Theory	ZGDB0005	Developmental Biology	DC	4	364
	ZGEB0032	Endocrinology and Biochemistry	DC	4	396
	ZGAZ0033	Applied Zoology	DC	4	398
	ZGEP0034	Ethology and Population Genetics	DC	4	400
Lab	ZGDB6021	Developmental Biology and Biochemistry Lab	DC	2	416
	ZGEP6022	Ethology and Population Genetics Lab	DC	2	416
	ZGPR6004	Project Management, Reporting and Documentation	IC	2	407
Total Credits				22	

SEMESTER III					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BTRM0003	Research Methodology and Biostatistics	SC	4	336
	Specialization 1: Entomology and Environmental Biology				
	ZGIF0008	Insects- Structure & Function	DE	4	366
	ZGIP0009	Insect Physiology	DE	4	367
	ZGEE6011	Specialization Lab I- Entomology and Environmental Biology	DE	2	411
	Specialization 2: Cell and Molecular Biology				
	ZGCB0010	Cell and Molecular Biology –I	DE	4	368
	ZGIY0011	Immunology I	DE	4	370
	ZGCM6012	Specialization Lab I- Cell and Molecular Biology	DE	2	412
	Specialization 3: Fishery Science				
	ZGTF0012	Taxonomy and Functional Anatomy	DE	4	371
	ZGAF0013	Aquaculture and Fish Genetics	DE	4	373
	ZGFS6013	Specialization Lab I - Fishery Science	DE	2	412
	Specialization 4: Animal Ecology and Wildlife Biology				
	ZGEB0014	Animal Ecology and Biogeography	DE	4	375
	ZGWM0015	Wildlife Conservation and Management	DE	4	376
	ZGAW6014	Specialization Lab I- Animal Ecology and Wildlife Biology	DE	2	413
Project	ZGDI6006	Dissertation (Phase I)	DC	4	NA
	ZGJP6007	Introduction to Journalism and Photography	IC	2	410
Total Credits				20	

SEMESTER IV					
Type	Course Code	Course Name	Category	Credits	Page
Theory	Specialization 1: Entomology and Environmental Biology				
	ZGIG0017	Insect Ecology	DE	4	379
	ZGPM0018	Principles of Pest Management	DE	4	379
	ZGEE6015	Specialization Lab II- Entomology and Environmental Biology	DE	2	413
	Specialization 2: Cell and Molecular Biology				
	ZBMB0019	Cell and Molecular Biology –II	DE	4	380
	ZGIM0020	Immunology II	DE	4	382

	ZGCM6016	Specialization Lab II- Cell and Molecular Biology	DE	2	414
	Specialization3: Fishery Science				
	ZGCP0021	Capture fishery and Post-harvest Technology	DE	4	383
	ZGLF0022	Limnology, Fishery economics, Ornamental Fishery and Fish pathology	DE	4	384
	ZGFS6017	Specialization Lab II - Fishery Science	DE	2	414
	Specialization4: Animal Ecology and Wildlife Biology				
	ZGRE0025	Wildlife Resource management, Laws and Techniques in population study	DE	4	386
	ZGWC0026	Techniques in Wildlife study, Wildlife Health, Forensics and Conflict	DE	4	387
	ZGAW6018	Specialization Lab II- Animal Ecology and Wildlife Biology	DE	2	414
Project	ZGDS6009	Dissertation(Phase II)	DC	8	NA
	ZGTM6010	Teaching Methodology and Class room Management	IC	2	411
	Total Credits			20	

MASTER OF SCIENCE IN ZOOLOGY

(2018- 2020 Batch)

SEMESTER III						
Type	Course Code	Course Name	Category	Credits	Page	
Theory	ZGAZ0007	Applied Zoology I	DC	4	365	
	Specialization 1: Entomology and Environmental Biology					
	ZGIF0008	Insects- Structure & Function	DE	4	366	
	ZGIP0009	Insect Physiology	DE	4	367	
	ZGEE6011	Specialization Lab I- Entomology and Environmental Biology	DE	2	411	
	Specialization 2: Cell and Molecular Biology					
	ZGCB0010	Cell and Molecular Biology –I	DE	4	368	
	ZGIY0011	Immunology I	DE	4	370	
	ZGCM6012	Specialization Lab I- Cell and Molecular Biology	DE	2	412	
	Specialization 3: Fishery Science					
	ZGTF0012	Taxonomy and Functional Anatomy	DE	4	371	
	ZGAF0013	Aquaculture and Fish Genetics	DE	4	373	
	ZGFS6013	Specialization Lab I - Fishery Science	DE	2	412	
	Specialization 4: Animal Ecology and Wildlife Biology					
	ZGEB0014	Animal Ecology and Biogeography	DE	4	375	
	ZGWM0015	Wildlife Conservation and Management	DE	4	376	
	ZGAW6014	Specialization Lab I- Animal Ecology and Wildlife Biology	DE	2	413	
	Project	ZGDI6006	Dissertation(Phase I)	DC	4	NA
		ZGJP6007	Introduction to Journalism and Photography	IC	2	410
		Total Credits			20	

SEMESTER IV						
Type	Course Code	Course Name	Category	Credits	Page	
Theory and Lab	ZGAZ0016	Applied Zoology II	DC	4	377	
	Specialization 1: Entomology and Environmental Biology					
	ZGIG0017	Insect Ecology	DE	4	379	
	ZGPM0018	Principles of Pest Management	DE	4	379	
	ZGEE6015	Specialization Lab II- Entomology and Environmental Biology	DE	2	413	
	Specialization 2: Cell and Molecular Biology					
	ZBMB0019	Cell and Molecular Biology –II	DE	4	380	
	ZGIM0020	Immunology II	DE	4	382	
	ZGCM6016	Specialization Lab II- Cell and Molecular Biology	DE	2	414	
	Specialization 3: Fishery Science					
	ZGCP0021	Capture fishery and Post-harvest Technology	DE	4	383	
	ZGLF0022	Limnology, Fishery economics, Ornamental Fishery and Fish pathology	DE	4	384	
	ZGFS6017	Specialization Lab II - Fishery Science	DE	2	414	
	Specialization 4: Animal Ecology and Wildlife Biology					
ZGRE0025	Wildlife Resource management, Laws and Techniques in population study	DE	4	386		
ZGWC0026	Techniques in Wildlife study, Wildlife Health, Forensics and Conflict	DE	4	387		
ZGAW6018	Specialization Lab II- Animal Ecology and Wildlife Biology	DE	2	414		
Project	ZGDS6009	Dissertation(Phase II)	DC	8	NA	
	ZGTM6010	Teaching Methodology and Class room Management	IC	2	411	
Total Credits				24		

DEPARTMENT OF BOTANY

BACHELOR OF SCIENCE IN BOTANY

Type of Course/Category	Course Code	Course Name	Credits	Page
SEMESTER I				
Core Paper1 (Theory)/DC	BOAM0101	Algae and Microbiology	4-0-0	430
Core Paper2 (Theory)/DC	BOBC0102	Biomolecules and Cell Biology	4-0-0	431
Core Paper1 (Lab)/DC	BOAM6101	Algae and Microbiology Lab	0-0-2	435
Core Paper2 (Lab)/DC	BOBC6102	Biomolecules and Cell Biology Lab	0-0-2	436
Ability Enhancement compulsory Course -1/IC	LSEC0018	English Communication	2-0-0	657
General Elective –I /SE (Zoology) Theory	ZGAD0105	Animal Diversity	4-0-0	404
	ZGEP0106	Environment and Public Health		406
General Elective –I/SE (Zoology) Lab	ZGAD6105	Animal Diversity Lab	0-0-2	418
	ZGEP6106	Environment and Public Health Lab		418
Total Credits			20	
SEMESTER II				
Core Paper3 (Theory)/DC	BOMP0103	Mycology and Phytopathology	4-0-0	432
Core Paper4 (Theory)/DC	BOAR0104	Archegoniate	4-0-0	433
Core Paper3 (Lab)/DC	BOMP6103	Mycology and Phytopathology Lab	0-0-2	436
Core Paper4 (Lab)/DC	BOAR6104	Archegoniate Lab	0-0-2	437
Ability Enhancement compulsory Course –2/IC	CHES0002	Environmental Studies	0-0-2	143
General Elective –II /SE (Zoology) Theory	ZGAD0105	Animal Diversity	4-0-0	404
	ZGEP0106	Environment and Public Health		406
General Elective –II/SE (Zoology) Lab	ZGAD6105	Animal Diversity Lab	0-0-2	418
	ZGEP6106	Environment and Public Health Lab		418
Total Credits			20	
SEMESTER III				
Core Paper5 (Theory)		Morphology and Anatomy	4-0-0	
Core Paper6 (Theory)		Economic Botany	4-0-0	
Core Paper7 (Theory)		Genetics	4-0-0	
Core Paper5 (Lab)		Morphology and Anatomy Lab	0-0-2	
Core Paper6 (Lab)		Economic Botany Lab	0-0-2	
Core Paper7 (Lab)		Genetics Lab	0-0-2	
Skill Enhancement Course 1(Elective)		Nursery and Gardening	2-0-0	
		Floriculture	2-0-0	
General Elective –III (Chemistry)	CHAH0105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4-0-0	
	CHCK0120	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics	4-0-0	

General Elective –III (Chemistry) Lab	CHAH6105	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons Lab	0-0-2	
	CHCK6114	Chemistry of S- And P- Block Elements, States of Matter and Chemical Kinetics Lab	0-0-2	
Total Credits			26	
SEMESTER IV				
Core Paper8 (Theory)		Molecular Biology	3-1-0	
Core Paper9 (Theory)		Plant Ecology and Phytogeography	3-1-0	
Core Paper10 (Theory)		Plant Systematics	3-1-0	
Core Paper8 (Lab)		Molecular Biology Lab	0-0-2	
Core Paper9 (Lab)		Plant Ecology and Phytogeography Lab	0-0-2	
Core Paper10 (Lab)		Plant Systematics Lab	0-0-2	
Skill Enhancement Course 2 (Elective)		Medicinal Botany	2-0-0	
		Ethnobotany		
General Elective –IV (Chemistry)	CHCF0106	Chemical Energetics, Equilibria & Functional Organic Chemistry	4-0-0	
	CHOS0119	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy		
General Elective –IV (Chemistry) - Lab	CHCF6106	Chemical Energetics, Equilibria & Functional Organic Chemistry- Lab	0-0-2	
	CHOS6113	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy - Lab		
Total Credits			26	
SEMESTER V				
Core Paper11 (Theory)		Reproductive Biology of Angiosperms	4-0-0	
Core Paper12 (Theory)		Plant Physiology	4-0-0	
Core Paper11 (Lab)		Reproductive Biology of Angiosperms Lab	0-0-2	
Core Paper12 (Lab)		Plant Physiology Lab	0-0-2	
Discipline Specific Elective I		Analytical Techniques in Plant Sciences	4-0-0	
		Bioinformatics		
		Analytical Techniques in Plant Sciences	0-0-2	
		Bioinformatics Lab	0-0-2	
Discipline Specific Elective II		Plant Breeding Lab	4-0-0	
		Natural Resource Management		
		Plant Breeding Lab	0-0-2	
		Natural Resource Management Lab		
Total Credits			24	
SEMESTER VI				
Core Paper13 (Theory)		Plant Metabolism	4-0-0	
Core Paper14 (Theory)		Plant Biotechnology	4-0-0	
Core Paper13 (Lab)		Plant Metabolism Lab	0-0-2	

Core Paper14 (Lab)		Plant Biotechnology Lab	0-0-2	
Discipline Specific Elective III		Horticultural Practices and Post-Harvest Technology	4-0-0	
		Research Methodology	4-0-0	
		Horticultural Practices and Post-Harvest Technology Lab	0-0-2	
		Research Methodology Lab	0-0-2	
Discipline Specific Elective IV		Industrial and Environmental Microbiology	4-0-0	
		Biostatistics	4-0-0	
		Industrial and Environmental Microbiology Lab	0-0-2	
		Biostatistics Lab	0-0-2	
Total Credits			24	
Total Programme Credits			140	

MASTER OF SCIENCE IN BOTANY

SEMESTER I					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BOPH0003	Phycology	DC	3	422
	BOMY0004	Mycology	DC	3	422
	BOBA0005	Bryophytes, Pteridophytes and Gymnosperms	DC	3	423
	BOAN0006	Angiosperms	DC	4	424
Lab	BOPM6001	Phycology & Mycology Lab	DC	2	433
	BOBA6002	Bryophytes, Pteridophytes and Gymnosperms & Angiosperms Lab	DC	2	434
Total Credits				17	
SEMESTER II					
Type	Course Code	Course Name	Category	Credits	Page
Theory	BOPE0007	Plant Ecology	DC	3	425
	BOMI0008	Microbiology	DC	3	426
	BOCB0009	Cytogenetics and Plant Breeding	DC	3	427
	BOPP0010	Plant Physiology	DC	3	429
Lab	BOPM6003	Plant Ecology & Microbiology Lab	DC	2	434
	BOCP6004	Cytogenetics and Plant Breeding & Plant Physiology Lab	DC	2	435
Total Credits				16	
SEMESTER III					
Type	Course Code	Course Name	Category	Credits	Page
Theory		Plant Biochemistry and Biotechnology	DC	3	
		Cell and Molecular Biology	DC	4	
		Environmental Management, Research Methodology and Biostatistics	DC	4	
		Biochemical, Molecular Techniques and Bioinformatics	DC	4	

Lab		Plant Biochemistry and Biotechnology & Cell and Molecular Biology Lab	DC	2	
		Environmental Management, Research Methodology and Biostatistics & Biochemical, Molecular Techniques and Bioinformatics Lab	DC	2	
		Dissertation Phase I	DC	2	
Total Credits				21	
SEMESTER IV					
Type	Course Code	Course Name	Category	Credits	Page
Theory		Microbial Genetics and Applied Microbiology		4	
		Plant Cell and Tissue Culture		3	
		Plant Pathology and Plant Protection		2	
		Bio-fertilizer Technology		2	
		Herbal Medicine		2	
		Biodiversity and its Conservation		2	
Lab		Microbial Genetics and Applied & Plant Cell and Tissue Culture Lab		2	
		Field Study		2	
		Dissertation Phase II		15	
Total Credits				23	
Total				82	

SCHOOL OF LIFE SCIENCES

DEPARTMENT OF BIO SCIENCES

Vision

To produce globally competent academicians and researchers who are committed to contribute to nation building.

Mission

To discover, develop and disseminate knowledge in life sciences through:

- Imparting the elements of scientific and critical thinking to young minds
- Creating a vibrant learning community
- Converting the challenges into an opportunity for innovation
- Molding individuals dedicated towards the betterment of society

MASTER OF SCIENCE

IN BIOCHEMISTRY, BIOTECHNOLOGY AND MICROBIOLOGY

DETAILED SYLLABUS

THEORY COURSES

BIOCHEMISTRY

BCAT0009: ANALYTICAL TECHNIQUES FOR BIOLOGICAL SCIENCES

(3 credits - 45 hours)

Objective: *The aim of this course is to expose students to the basic principles of modern analytical techniques and their recent applications in biological sciences.*

Module I (15 Hours)

Spectroscopy - Concepts of spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry, Visible and UV spectroscopy, ORD, CD, X-ray diffraction, X-ray absorption, IR and NMR.

Chromatography – Principles and applications of paper, thin layer, ion exchange, affinity, gel permeation, adsorption and partition chromatography, HPLC and FPLC.

Module II (15 Hours)

Centrifugation – Principle of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation.

Electrophoretic techniques – Principles of electrophoretic separation, Types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, Pulse field gel electrophoresis.

Module III (15 Hours)

Electron microscopy – Transmission and scanning, freeze fracture techniques, specific staining of biological materials.

Autoradiography - Principle and applications of Autoradiography

Viscosity – Viscosity of macromolecules, relationship with conformational changes.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Define the basic principles of modern analytical techniques (Remembering)
- CO2:** Illustrate recent applications in biological sciences (Understanding)
- CO3:** Plan protocol for separation and analysis of biological sample (Applying)
- CO4:** Classify different spectroscopic techniques based on their principles (Analysing)
- CO5:** Compare various chromatographic and electrophoretic methods (Evaluating)
- CO6:** Design a protocol for the characterization of biomolecules (Creating)

Suggested Readings

1. H.H. Willard, L.L. Merritt Jr. and others, Instrumental Methods of Analysis. 6th Edition, 1986, CBS Publishers and Distributors.

2. Chatwal G and Anand, S., Instrumental Methods of Chemical Analysis, 1989, Himalaya Publishing House, Mumbai.
3. Williams, B.L. and Wilson, K., A Biologist's Guide to Principles and Techniques of Practical Biochemistry, 1975
4. B.B. Straughan and S. Walker Eds., Spectroscopy, Volume 1, Chapman and Hall Ltd.
5. Hanes, Gel Electrophoresis of Proteins - A Practical Approach
6. James Miller, Chromatography: Concepts and Contrasts, 1988, John Wiley and Sons Inc., New York.
7. Holme, Analytical Biochemistry
8. R.J. Hamilton and P.A. Sewell, Introduction to High Performance Liquid Chromatography
9. B.P. Straughan and S. Walker, Spectroscopy
10. Gordon M. Message, Practical aspects of Gas Chromatography and Mass Spectrometry, 1984, John Wiley and Sons, New York.
11. Tibor Kremmery, Gel Chromatography, Wiley Publications.
12. C.C. Thornburn, Isotopes and radiations in Biology, Butterworth and Co. Ltd., London.
13. J.M. Chapman and G. Ayrey, The Use of Radioactive Isotopes in the Life Sciences, George Allen and Unwin Ltd., London.

BCMB0003: MOLECULAR BIOLOGY

(4 Credits – 60 hours)

Objective: *Molecular biology is the study of biological macromolecules and the processes in which they are involved. It includes the molecular structure, chemistry and physics of DNA, RNA, and protein to understand their functions in the living system.*

Module I: Replication Biology (15 Hours)

Nucleic acid as genetic material: it's proof; Different modes of replication (conservative, semi-conservative and dispersive); DNA replication in prokaryotes, eukaryotes and virus (rolling circle model): General features and enzymology; detailed mechanisms of initiation, elongation and termination; experiments underlying each step and role of individual factors; proofreading and processivity of DNA polymerase; telomerases: mechanism of replication, maintenance of integrity and role in cancer; effect of different inhibitors on replication.

Module II: Transcription Biology (15 Hours)

Basic concepts of promoter, operator, terminator, enhancer; RNA polymerases and its sub Modules; different sigma factors and their relation to stress, viral infections etc; initiation, elongation and termination (rho-dependent and independent) mechanism of RNA synthesis; post transcriptional modification of RNA - capping, splicing and poly A tailing; effect of different inhibitors on prokaryotic and eukaryotic transcription.

Module III: Translation Biology (20 Hours)

The genetic code and its nature; structure of t-RNA, ribosomal structure; activation of amino acids; initiation, elongation and termination mechanism of polypeptide chain synthesis; role of r-RNA in polypeptide chain synthesis; differences between prokaryotic and eukaryotic translational processes; post-translational modification of peptide, its transportation; non- ribosomal peptide synthesis with special reference to cyclic polypeptide antibiotics synthesis in bacteria; effect of different inhibitors on protein synthesis in both prokaryotes and eukaryotes.

Module IV: Gene regulation (10 Hours)

Positive and negative control; catabolite regulation-definition and mechanism; effect of anti-termination and attenuation on the process of gene regulation; various protein motifs involved in DNA-protein interactions during gene regulation. Epigenetics - definition and mechanism.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Illustrate the structural and functional properties of biological macromolecules (Understanding)
- CO2:** Develop idea on Central dogma from Replication of DNA till Translation of protein (Applying)
- CO3:** Analyze regulation of gene action (Analyzing)

Suggested Readings

1. Krebs JE, Kilpatrick ST, Goldstein ES. Lewin's Genes, Jones and Bartlett Learning.
2. Watson JD, Baker TA, Bell SP, Gann AAF, Levine M, Losick RM. Molecular Biology of the Gene, Benjamin Cummings.
3. Weaver RF. Molecular Biology, McGraw-Hill Higher Education.
4. Clark DP. Molecular Biology, Academic Press Inc.
5. Freifelder D. Molecular Biology, Narosa.

BCIM0004: IMMUNOLOGY AND MEDICAL BIOCHEMISTRY**(4 Credits - 60 hours)**

Objectives: *This course is designed to equip students with the theoretical knowledge and understanding of practical applications of immunology and medical biochemistry. The course includes immune system of the body and various disorders of the metabolism and chronic diseases.*

PART A: Immunology**Module I: General Immunology (15 hours)**

History and scope of immunology, hematopoietic stem cells, stromal cells, haematopoiesis, lymphoid tissues and organs (primary and secondary), B-lymphocytes and their activation, Thymus derived lymphocytes and their activation, antigen presenting cells, natural killer cells, dendritic cells, macrophages, structure and functions of Class I and II Major Histocompatibility complex (MHC) molecules, types of immunity: innate and acquired, active and passive, humoral and cell mediated, immunoglobulin: structure and function, clonal selection theory, generation of antibody diversity, organization and expression of immunoglobulin genes, antigens: T dependent and T independent antigens, adjuvant (definition, examples, function), antigen antibody reactions, cross reactivity, cytokines-definition, types, antigenic processing and presentation, circulation and homing of immune cells, regulation of immune response.

Module II: Advanced Immunology (10 hours)

The complement systems: definition, function, activation of complement, complements receptors and classical and alternate pathway, transplantation: organ transplantation and HLA tissue typing, autoimmunity, hypersensitivity reactions, immunological tolerance, immune suppression and immunotherapy, vaccine: definition, classification and function.

PART B: Medical Biochemistry**Module III: Metabolic disorders (15 hours)**

- a) Introduction of Medical Biochemistry;
- b) Disorders of Carbohydrate Metabolism: Diabetes mellitus, glucose tolerance tests, sugar levels in blood, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia.

- c) Disorders of Lipids metabolism: Plasma lipoproteins, cholesterol, triglycerides and phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies.
- d) Abnormalities in Nitrogen Metabolism: Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance. Disorders of liver and kidney: Jaundice, fatty liver.

Module IV (10 hours)

- a) Digestive diseases: Maldigestion, malabsorption, creatorrhoea, diarrhoea and steatorrhoea.
- b) Diagnostic Enzymes: Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays – SGOT, SGPT, CPK, cholinesterase, LDH.
- c) Water-Electrolytes and acid-base balance: Distribution of body water and electrolyte in the body, normal water and electrolyte balance, regulatory mechanisms, abnormal water and electrolyte metabolism, Acid base balance in normal health, acidosis, alkalosis.

Module V (10 hours)

- a) Biochemistry of cancer: Cancer causative agents and control of cancer and carcinogenesis, viral etiology.
- b) Biochemistry of AIDS: Structure and molecular features of HIV, Retroviral background, diagnosis of AIDS modes of transmission, immunological response in AIDS, Anti-retroviral therapy.
- c) Biochemistry of Ageing: Definition of ageing, Life span and life expectancy, oxygen radicals, antioxidants and ageing, DNA repair, Heat shock proteins, role of dopamine receptors in ageing.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- C01:** Explain the properties, structural and functional aspects of the different kinds of stem cells involved in the defense mechanism of immune cells
- C02:** Understand the mechanism of complement systems, organ transplantation, hypersensitivity reactions, immunosuppression and immunotherapy
- C03:** Understand and describe the different disorders of the body related to carbohydrate metabolism, lipid metabolism, Nitrogen metabolism and digestive disorders
- C04:** Explain biochemistry, causative agents, mechanisms involved behind the working of AIDS, Cancer and Aging

Suggested Readings

1. Kuby, J. Immunology. W. H. Freeman and Co.
2. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I. M. Roitt's Essential Immunology. Wiley-Blackwell
3. Abbas, A. K., Lichtman, A. H. H., Pillai, S. Cellular and Molecular Immunology. Elsevier
4. Franklin, T. J. and Snow, G. A. Biochemistry of Antimicrobial Action. Chapman and Hall, London
5. Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. Microbiology. Tata McGraw Hill
6. Chatterjee, M. N., Shinde, R. Medical Biochemistry JAYPEE Publications
7. Stryer, L. Biochemistry Freeman and Co.
8. Elkeles, R., and Tavill, A. Biochemical aspects of human diseases Blackwell Science Ltd
9. Devlin, T. M. Text-book of Biochemistry with clinical correlations J. Wiley and Sons.
10. Guyton. A.C. and Hall, J. E. Textbook of Medical Physiology Elsevier Health Sciences

BCPY0005: PHYSIOLOGY**(3 Credits - 45 hours)**

Objective: To teach students the basic concepts of plant and human physiology. At the end of the course the students will have a thorough understanding of the mechanisms of plant and human physiology.

Part A: Plant Physiology**Module I (13 Hours)**

- a) **Electron transport system in plants** - Oxidative phosphorylation, mitochondrial respiratory complexes, order and organization of electron carriers, electrochemical gradient, chemiosmotic theory, ATP synthase and mechanism of ATP synthesis.
- b) **Nitrate assimilation** - Structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation.
- c) **Photosynthesis** – Photosynthetic apparatus, pigments of photosynthesis, role of carotenoids, photosystems I and II, their location; Hill reaction, photosynthetic electron transport and generation of NADPH & ATP, cyclic and non-cyclic photo-phosphorylations, complexes associated with thylakoid membranes; light harvesting complexes, path of carbon in photosynthesis – C₃ and C₄ pathway of carbon reduction and its regulation, Photorespiration.

Module II (10 Hours)

- a) **Special features of secondary plant metabolism** - Terpenes (classification, biosynthesis), lignin, tannins, pigments, phytochrome, waxes, alkaloids, biosynthesis of nicotine, functions of alkaloids, cell wall components.
- b) **Toxins of plant origin** – Mycotoxins, phytohemagglutinins, lathrogens, nitriles, protease inhibitors, protein toxins.
- c) **Stress metabolism in plants** - Environmental stresses, salinity, water stress, heat, chilling, anaerobiosis, pathogenesis, heavy metals, radiations and their impact on plant growth and metabolism, criteria of stress tolerance.
- d) **Antioxidative defence system in plants** – Reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defense mechanism.

Part B: Human Physiology**Module III (12 Hours)**

- a) **Blood and Circulatory system** - Composition and functions of plasma, erythrocytes including Hb, Leucocytes and thrombocytes, plasma proteins. Blood Coagulation – mechanism and regulation. Transfer of blood gases–Oxygen and carbon dioxide, role of 2,3-diphosphoglycerate, Bohr effect and chloride shift.
- b) **Digestive system** – Composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins, & nucleic acids.
- c) **Respiratory system** – Air passages and lung structure, pulmonary volumes, alveolar surface tension, work of breathing and its regulation.

Module IV (10 Hours)

- a) **Endocrine system** – Secretion and functions of hormones of thyroid, pituitary and gonads. Role of hormones in reproduction. Mechanism of action of hormones.

- b) **Nervous system**-Muscle proteins, molecular mechanisms of muscle contraction (skeletal and smooth), nerve conduction, chemical regulation of synapses, neurotransmitters, neurons, resting membrane potential and action potential.
- c) **Excretory system** – Structure of nephron, glomerular filtration, tubular reabsorption of glucose, water and electrolytes. Tubular secretion. Homeostatic regulation of water and electrolytes, Acid-base balance.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Define and have an enhanced knowledge of the fundamentals of physiology by recalling and relating (Remembering)
- CO2:** Summarize how the separate systems interact to yield integrated physiological responses (Understanding)
- CO3:** Utilize the acquired knowledge of the various mechanisms in executing and constructing experiments and apply in their day to day life (Applying)
- CO4:** Analyze and report on experiments and observations in physiology (Analyzing)
- CO5:** Evaluate by presenting and defending opinions by making judgments about the mechanisms and functioning of organs and organ systems (Evaluating)
- CO6:** Compile and generate new ideas on physiology (Creating)

Suggested Readings

1. Murray R.K. et al., Harper's Illustrated Biochemistry, McGraw Hill Lange Med. Publ.
2. Devlin T. M. Textbook of Biochemistry with clinical correlations, Wiley-Liss Publ.
3. Barrett, K.E. et al Ganong's Review of Medical Physiology, Tata McGraw-Hill. Ed.
4. Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology, Saunders, Elsevier
5. Voet D. et al Principles of Biochemistry, John Wiley and Sons Inc.
6. Nelson D.L. and Cox M.M. Lehninger's Principles of Biochemistry, Freeman and Co, New York
7. Bhagavan N. V. Medical Biochemistry, Jones and Bartlett Publ.
8. Garret R.H. and Grisham C.M. Biochemistry, Saunders College Publ.

BCBM0006: BIOGENETICS AND METABOLISM

(3 Credits - 45 hours)

Objectives: To introduce students to (i) concepts of energy transformation in living systems and (ii) principles of biochemical processes essential for the sustenance of life

A. BIOENERGETICS

Module I (10 Hours)

- a) Concept of free energy, standard free energy, determination of ΔG for a reaction.

Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions. Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials and free energy change (derivations and numericals included). High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high ΔG . Energy charge.

Module II (15 Hours)

- a) Chemotaxis and chemoreceptors chemo-osmotic theory, ion transport across energy transducing membranes. Influx and efflux mechanisms. Proton circuit and electrochemical

gradient, the transport and distribution of actions, anions and ionophores. Uniport, antiport and symport mechanisms, shuttle systems.

- b) The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization. The Qcycle and the stoichiometry of proton extrusion and uptake; P/O and H/P ratios. Reversed electron transfer, respiratory controls and oxidative phosphorylation, uncouplers and inhibitors of energy transfer. Fractionation and reconstitution of respiratory chain complexes.

ATP -synthetase complex. Microsomal electron transport, partial reduction of oxygen, superoxides.

Module III (15 Hours)

Intermediary Metabolism – Approaches for studying metabolism.

Coenzymes and Cofactors – Role and mechanism of action of NAD⁺/NADP⁺, FAD, lipoic acid, thiamine pyrophosphate, tetrahydrofolate, biotin, pyridoxal phosphate, B₁₂ coenzymes and metal ions with specific examples.

Carbohydrates – Glycolysis, various forms of fermentations in micro-organisms, citric acid cycle, its function in energy generation and biosynthesis of energy rich bond, pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gamma aminobutyrate shunt pathways, Cori cycle, anaplerotic reactions, Entner-Doudoroff pathway, glucuronate pathway. Metabolism of disaccharides. Hormonal regulation of carbohydrate metabolism. Energetics of metabolic cycle.

Amino Acids – General reactions of amino acid metabolism - Transamination, decarboxylation, oxidative and non-oxidative deamination of amino acids. Special metabolism of methionine, histidine, phenylalanine, tyrosine, tryptophan, lysine, valine, leucine, isoleucine and polyamines. Urea cycle and its regulation.

B. METABOLISM

Module IV (10 Hours)

Lipids – Introduction, hydrolysis of tri-acylglycerols, α -, β - and ω - oxidation of fatty acids. Oxidation of odd numbered fatty acids – fate of propionate, role of carnitine, degradation of complex lipids. Fatty acid biosynthesis, Acetyl CoA carboxylase, fatty acid synthase, ACP structure and function, Lipid biosynthesis, biosynthetic pathway for tri-acylglycerols, phosphoglycerides, sphingomyelin and prostaglandins. Metabolism of cholesterol and its regulation. Energetics of fatty acid cycle.

Nucleotides – Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway. Role of ribonucleotide reductase. Biosynthesis of deoxyribonucleotides and polynucleotides including inhibitors of nucleic acid biosynthesis.

Module V (10 Hours)

Biosynthesis of vitamins – Ascorbic acid, thiamine, pantothenic acid and folic acid.

Biochemistry of biological nitrogen fixation.

Porphyryns – Biosynthesis & degradation of porphyryns. Production of bile pigments.

Plant Hormones – Growth regulating substances and their mode of action, molecular effects of auxin in regulation of cell extension, effects of gibberellic, abscisic acids and cytokinins in the regulation of seed dormancy, germination, growth and development.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the basic concepts of free energy, standard free energy, redox potential and other thermodynamic concepts about biological systems (Remembering)
- CO2:** Demonstrate understanding of the principle of transmembrane transport and its various types with special emphasis to mitochondrial respiratory chain and its carriers (Understanding)
- CO3:** Apply the acquired knowledge to understand the metabolism of breakdown, synthesis of carbohydrate by various pathways and also synthesis of various amino acids in biological system (Applying)
- CO4:** Analyze and infer the pathways involved in lipids metabolism and nucleotide biosynthesis (Analyzing)
- CO5:** Interpret the importance of biosynthesis of vitamins, nitrogen fixation in environment, porphyrins and plant hormones (Evaluating)
- CO6:** Compile and generate new ideas on metabolism (Creating)

Suggested Readings

1. M. Berg, J. L. Tymoczko, L. Stryer, Biochemistry, Freeman Publication
2. Voet and Voet, Biochemistry John Wiley and Sons
3. Nicholls and Ferguson, Bioenergetics, Elsevier
4. Lowen, Alexander, Bioenergetics Penguin Books
5. Brown and Cooper, Bioenergetics: A practical approach, paperback, Oxford University Press

BCAC0007: ADVANCES IN BIOCHEMISTRY

(4 credits - 60 hours)

Objectives: *This paper will review principles and procedures of advanced techniques in Biochemistry. In this course students will be taught principles, applications and advances of techniques that are widely used in the field of biochemistry. They will also be required to do presentations and submit an assignment on the most recent developments in the field of biochemistry from the latest peer-reviewed journals.*

Module I: Genomics and Transcriptomics (15 hours)

- a) Mapping and sequencing genomes: Genetic and physical mapping, Sequencing genomes different strategies, High-throughput sequencing, next-generation sequencing technologies, comparative genomics, population genomics, epigenetics, Human genome project, pharmacogenomics, genomic medicine, applications of genomics to improve public health, drug discovery and agriculture
- b) Transcriptome, analysis of gene expression - ESTs, SAGE, recent developments in RNA sequencing; metatranscriptomics, applications in gene regulation: alternative splicing, non-coding RNA

Module II: Proteomics and Metabolomics (15 hours)

- a) Introduction to proteomics, techniques to study proteomics such as 1D and 2D PAGE, X-ray crystallography, Mass spectrometry including MALDI-TOF, protein microarrays. protein database analysis, comprehensive analysis of protein-protein interactions in different cell types

- b) Metabolomics, metabolome and metabolite, Structural diversity, number of metabolites in biological system, basic concept of metabolic channelling or metabolons, new approaches to analyse metabolic pathways, Sample preparation, strategy and techniques used for metabolomic studies viz. GC-MS, LC-MS, NMR; data analysis (PDA, PLSDA)

Module III: Technical writing, Bioinformatics and Biostatistics tools (15 hours)

- a) Technical writing: Preparation of scientific report. Thinking and planning, information, ideas, order of paragraph writing; Presentation of a review, Objective, design of the experiment, parameters used, data obtained, interpretation, summary. Case studies derive from scientific literature (genomics, transcriptomics, proteomics and metabolomics) including comparisons between healthy and diseased tissues
- b) Bioinformatics: Databases, sequence alignments, phylogenetic tree, analysis of -omics data using advanced tools of bioinformatics
- c) Systems biology – complex biological data, computational and mathematical models, recent developments in network analysis
- d) Biostatistics tools: Data analysis with excel and software

Module IV: Intellectual Property Rights (15 hours)

Introduction to intellectual property: patents, types, trademarks, copyright and related rights, industrial design and rights, traditional knowledge, geographical indications, Protection of new varieties of plants and plant breeder's rights patentables and non-patentables, patenting life, legal protection of biotechnological inventions, wWorld intellectual property rights organization (WIPO), Indian Patent Act 1970 Rules and recent amendments,. IP in biotechnology; Drafting and filing patent applications; management and practical use of IP rights, including licensing, enforcement and ethics. Entrepreneurship in biosciences

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall mapping and sequencing of genomes, transcriptome, proteome and metabolome (Remembering)
- CO2:** Illustrate the different sequencing techniques (Understanding)
- CO3:** Apply the tools of bioinformatics to analyse biological data (Applying)
- CO4:** Analyse the data with biostatistics software (Analysing)
- CO5:** Decide the type of spectroscopic method for sample analysis (Evaluating)
- CO6:** Construct phylogenetic tree after analysis of biological samples (Creating)

Suggested Readings

1. Twyman, R. M., Principles of Proteomics, 2004
2. Villas-Boas, S. G., Roessner, U., Hansen, M. A. E., Smedsgaard, J., Nielsen, J. Metabolome Analysis: An introduction
3. Langauer, T, Mannhold, R., Kubinyi, H., Timmerman, H. Bioinformatics - From genomes to drugs
4. Primrose, S. B., Twyman, R. M., Old, R. W. Principles of gene manipulation
5. Tringali, C. (ed.), Natural products as lead compounds in drug discovery CRC Press
6. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi
7. Kankanala C. (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
8. Goel D., Prashar S. IPR, Biosafety and Bioethics. (2013).Pearson

BCBM0008: BIOMOLECULES**(4 credits - 60 hours)**

Objective: *The objective of the course is to give the students a sound understanding of the structural and functional aspects of biomolecules.*

Module I: Basic concepts (6 Hours)

Introduction to Biochemistry, water as biological solvent, weak acids and weak bases, pH and pK, buffers, Henderson-Hasselbalch equation, physiological buffers, fitness of the aqueous environment for living organisms

Module II: Carbohydrates (14 Hours)

- Classification, basic chemical structure, general reactions and properties, biological significance, Sugar derivatives, deoxy sugars, amino sugars, and sugar acids. Mutarotation of sugar. Anomeric effect of sugar (Methylation effect). Inversion (hydrolysis) of cane sugar.
- Polysaccharides - occurrence, structure, isolation, properties and functions of homoglycans - starch, glycogen, cellulose, dextrin, inulin, chitins, xylans, arabinans, galactans.
- Occurrence, structure, properties, and functions of heteroglycans - bacterial cell wall polysaccharides, glycoaminoglycans, agar, alginic acid, pectins, blood group substances and sialic acids. Glycoprotein and their biological applications. Lectins structure and functions.

Module III: Lipids (14 Hours)

- Definition and Classification - (simple, complex, derived lipids - structure and example). Saturated and unsaturated fatty acids, Nomenclature of fatty acids, General chemical reactions of fatty acids – esterification, hydrogenation and halogenations
- Phospholipids - classification, structure and functions, Ceramides and Sphingomyelins, Eicosanoids, structure and functions of prostaglandins, thromboxanes, leukotrienes, Types and functions of plasma lipoproteins. Amphipathic lipids - membranes, micelles, emulsions and liposomes.
- Steroids - cholesterol structure and biological role - bile acids, bile salts.
- General chemical reactions of fats: Hydrolysis, Saponification number, I_2 number, acetylation, acetyl number, and volatile fatty acid number, Rancidity of fat.

Module IV: Porphyrins (4 Hours)

Porphyryns: the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome.

Module V: Nucleic acids (10 Hours)

- Watson-Crick Model of DNA structure: A, B and Z – DNA. Chemical Properties: Hydrolysis (acid, alkali), enzymatic hydrolysis of DNA.
- Cruciform structure in DNA, formation and stability of cruciform, HDNA, palindrome, secondary and tertiary structure of RNA, hnRNA, si RNA, Cot value curve, hypochromic and hyperchromic effect, DNA-protein interactions, Viscosity, Buoyant density, T_m .

Module VI: Proteins (12 Hours)

- Definition, classification, structure, stereochemistry and reactions of amino acids;
- Classification of proteins on the basis of solubility and shape, structure, and biological functions. Primary structure - determination of amino acid sequences of proteins, the peptide bond. Ramachandran plot.

- c) Secondary structure - weak interactions involved - alpha helix and beta sheet and beta turns structure. Pauling and Corey model for fibrous proteins. Collagen triple helix. Super secondary structures - helix-loop-helix.
- d) Tertiary structure - alpha and beta domains. Quaternary structure - structure of hemoglobin. Solid state synthesis of peptides. Protein-Protein interactions, Concept of chaperones

COURSE/LEARNING OUTCOMES

At the end of the course students would be able to:

- CO1:** Relate of the structural and functional aspects of biomolecules (Remembering)
- CO2:** Compare and draw the chemical structures of different biomolecules (Understanding)
- CO3:** Identify the monomers and polymers of biomolecules (Applying)
- CO4:** Analyze the interaction and importance of equilibrium maintenance of different biomolecules for health related issues (Analysing)
- CO5:** Estimate the different concentrations of biomolecules for biological applications (Evaluating)
- CO6:** Elaborate the biological applications of different biomolecules in drug discovery (Creating)

Suggested Readings

1. L. Stryer, Biochemistry, W.H. Freeman and Co.
2. Voet and Voet, Fundamentals of Biochemistry, John Wiley and sons NY
3. David L. Nelson and Michael M. Cox, Lehninger's Principle of Biochemistry, W. H. Freeman and Co.
4. Thomas M. Devlin, John Wiley-Liss, Hobokhen, Text Book of Biochemistry with Clinical Correlation, NJ publishers
5. Zubey GL, Biochemistry, WCB Publishers

LABORATORY COURSES

BCBM6001: BIOMOLECULES LAB

(1 Credit)

1. Preparation of buffers
2. Determination of pKa and pI of acidic, basic, and neutral amino acids
3. Estimation of amino acids by Ninhydrin method
4. Estimation of DNA by DPA method
5. Estimation of RNA by Orcinol method
6. Estimation of proteins by Bradford method
7. Estimation of proteins by Lowry method
8. Isolation and estimation of lipids from seeds
9. TLC of plant pigments
10. TLC of lipids

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Apply the technique based on spectrophotometer for analysis of various biomolecules (Applying)

CO2: Measure various biomolecules at different concentrations for future research experiments (Evaluating)

CO3: Estimate and prepare buffer solutions for different experiments (Creating)

Suggested Readings

1. Walker, J. H. (Ed.) The Protein Protocols Handbook, Humana Press
2. Sadasivam and Manickam Biochemical methods, New Age International

BCAT6002: ANALYTICAL TECHNIQUES LAB

(1 Credit)

1. SDS-PAGE separation of proteins
2. Study of serum proteins by horizontal submerged gel electrophoresis
3. Study of UV absorption spectra of biological macromolecules-proteins, nucleic acids
4. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC
5. Separation of bacterial lipids/amino acids/sugars/organic acids by Paper Chromatography
6. Separation of haemoglobin or blue dextran by gel filtration
7. Quantitative estimation of hydrocarbons/pesticides/organic solvents/methane by gas chromatography
8. Demonstration of PCR, DNA sequencer and fermenter
9. Fricke Dosimetry
10. Optical characterization of liposomes by turbidimetry

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Apply the theoretical concepts learnt in the theory class for Analytical techniques lab (Applying)

Suggested Readings

1. Walker, J. H. (Ed.) The Protein Protocols Handbook, Humana Press
2. Wilson K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press

BCMB6003: MOLECULAR BIOLOGY LAB

(2 Credits)

1. Isolation of plasmid DNA from bacteria.
2. Isolation of chromosomal DNA from bacteria.
3. Competent cell preparation of bacteria.
4. Bacterial transformation of exogenous DNA.
5. Polymerase chain reaction analysis
6. Restriction digestion of DNA

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Experiment with bacteria to perform extraction of genomic and plasmic DNA (Applying)

CO2: Illustrate the various steps of PCR and observe the amplicons in agarose gel electrophoresis (Understanding)

CO3: Test with the various steps involved in transformation and cloning (Creating)

BCIM6004: IMMUNOLOGY AND MEDICAL BIOCHEMISTRY LAB

(2 Credits)

Immunology

1. Single radial immune diffusion
2. Double diffusion method of Ouchterlony
3. Electrophoretic separation of bovine protein
4. Agglutination reaction

Medical Biochemistry

1. Estimation of Lipoproteins.
2. Glucose tolerance test
3. Estimation of bilirubin
4. Estimation of blood urea
5. Estimation of creatine phosphokinase
6. Normal and abnormal constituents of urine

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Understand the principle and mechanism of single radial immune diffusion, double diffusion method of Ouchterlony, Agglutination reaction, electrophoretic separation of bovine protein
- CO2:** Practically estimate lipoprotein, bilirubin, blood urea, creatine phosphokinase from a serum sample
- CO3:** Perform glucose tolerance tests and understand the normal and abnormal constituents of urine

Suggested Readings

1. Turgeon, M. L. Immunology and Serology in Laboratory Medicine Elsevier
2. Detrick, B., Hamilton, R. G., Folds, J. D. Manual of Molecular and Clinical Laboratory Immunology American Society of Microbiology Press
3. Talwar, G. P., Gupta, S. K. Hand Book of Practical and Clinical Immunology CBS Publishers and Distributors

BCPY6005: PHYSIOLOGY LAB

(1 credit)

(A minimum of 10 experiments to be performed)

1. Estimation of urea in serum
2. Estimation of cholesterol in serum.
3. Estimation of calcium in serum.
4. Assay of Serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyruvate transaminase (SGPT)
5. Assay of alkaline phosphatase
6. Assay of amylase in serum
7. Estimation of glucose in serum by glucose oxidase-peroxidase method.
8. Assay of LDH activity in serum

9. Separation of plasma proteins by electrophoresis
10. Estimation of glycosylated hemoglobin
11. Measuring the electrical activity of the heart
12. Measuring Basal Metabolic Rate using a respirometer
13. Counting white blood cells, red blood cells, platelets

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Measure the electrical activity of heart, basal metabolic rate using a respirometer and count the number of red blood cells, white blood cells, platelets (Evaluating)
- CO2:** Test serum for determining SGOT, SGPT, alkaline phosphatase, amylase in it (Creating)
- CO3:** Estimate urea, cholesterol, calcium, glucose, glycosylated haemoglobin in serum (Creating)

BCBM6006: BIOENERGETICS AND METABOLISM LAB

(1 credit)

Bioenergetics

1. Cellular respiration in yeast
2. Photosynthesis and cellular respiration in plants
3. Deciphering how cells make energy (light driven ATP generation in chloroplasts causing pH change, also subjecting chloroplasts to pH changes resulting in ATP production-chemiosmosis theory)

Metabolism

1. Determining the specificity of lactase
2. Effect of pH on trypsin activity
3. Effect of temperature on amylase activity
4. Effect of bile on lipase activity

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Illustrate the mechanism of cellular respiration in yeast, photosynthesis and cellular respiration in plants (Understanding)
- CO2:** Explain the effect of pH on trypsin activity, temperature on amylase activity, bile on lipase activity (Understanding)
- CO3:** Interpret how cells manufacture energy-ATP generation (Evaluating)

Suggested Reading

1. Brown, G. C. and Cooper, C. E. Bioenergetics: A Practical Approach Oxford University Press

BCDI6007: DISSERTATION PHASE I

(2 credits)

Objective: *Dissertation phase I is designed to familiarize the students with the research topics and methodologies by a thorough literature review.*

During dissertation phase I each student chooses a topic in consultation with the assigned supervisor and the student is asked to do thorough literature review under the guidance of the supervisor. At

the end of the semester the student submits literature review report and students presents the matter at a school level seminar.

COURSE/LEARNING OUTCOMES

At the end of Dissertation phase I students will be able to:

- CO1:** Design experiment, prepare work plan and learn how to test hypothesis in research work (Creating)

BCDI6008: DISSERTATION PHASE II

(16 credits)

Objective: *Dissertation phase II involves execution of the research work decided in phase I leading to the preparation, submission and evaluation of the dissertation.*

During the course of the Master's Degree the student is expected to undertake a research work leading to a dissertation. The work will be divided into two phases spread over two semesters. During the research work the student shall study and incorporate recent trends in the area chosen by him/her, and develop a scientific dissertation based on the research and actual bench work. The student shall be required to make presentations and reports at various stages of the research work. The format for the final dissertation shall be as prescribed by the Department. There shall be a viva voce examination on the dissertation by an expert committee comprising external and internal members. The mode and components of the evaluation and the weightages attached to them shall be published by the Department at the beginning of the semester.

BIOTECHNOLOGY

THEORY COURSES

BTRM0003: RESEARCH METHODOLOGY AND BIOSTATISTICS

(4 Credits – 60 hours)

Objectives: *To introduce students to a few aspects of doing research and to provide them with the statistical tools necessary for analysing and interpreting experimentally acquired data*

Module I: Introduction to Scientific Research (15 hours)

- Scientific research- Definition, types: basic and applied research, interdisciplinary research, Steps involved in scientific research
- Scientific literature primary and secondary literature, biological abstract, current content, review, monograph, peer- reviewed journals, e-resources; research and review articles; scientific communication - scientific paper, scientific posters
- Scientific problems: What is scientific problem? methods and techniques, research conditions, data types, techniques, repeatability, reproducibility and reliability, validity, effect measure and choice of statistical test, experimental protocol, experimental routine
- Research design: Meaning, need for research design, features of a good design, Types of research design

Module II: Ethics and Scientific Conduct (5 hours)

Brief introduction to ethics, scientific conduct and misconduct-plagiarism, authorship issues, investigation and punishment of scientific misconduct, ethics of animal and human research

Module III: (15 hours)

- a) Introduction to Biostatistics: definition and applications of biostatistics;
- b) Data-types and presentation: types of biological data, accuracy and significant figures;
- c) Populations and samples: populations, samples from populations, random sampling, variables and attributes, statistical errors
- d) Frequency distributions
- e) Graphical representation of data: line diagram, bar diagram, pie chart, histogram
- f) Measures of central tendency: the arithmetic mean, median and mode
- g) Measures of dispersion: range, mean deviation, variance, standard deviation, standard error of mean, standard score

Module IV: (6 hours)

- a) Permutations and combinations, sets
- b) Probability: introduction, counting possible outcomes, probability of an event, adding and multiplying probabilities
- c) Probability distributions: Binomial, Poisson and Normal distribution

Module V: (19 hours)

- a) Testing of hypothesis and goodness of fit: Null hypothesis, level of significance, errors of influence, Student's t-test, paired t-test, Fischer's test, Chi-square test, linear correlation and linear regression
- b) Analysis of variance: variances of samples and their means, F-distribution, partitioning of the total sum of squares and degrees of freedom, models and types of ANOVA

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Classify the forms of research – basic, applied, interdisciplinary, etc. (Understanding)
CO2: Explain ethical conduct of research and its communication. (Understanding)
CO3: Apply statistical methods of data analysis and interpretation. (Applying)

Suggested Readings

1. Creswell JW. Educational Research-Planning, conducting and evaluating quantitative and qualitative research, Pearson.
2. Laake P, Benestad HB and Olsen BR. Research Methodology in the medical and biological sciences Academic Press, Elsevier.
3. Kothari CR. Research Methodology: Methods and techniques, New Age International [Available online].
4. Gurumani N. Research Methodology for Biological sciences. MJP Publishers (753 pp).
5. Banerjee PK. Introduction to Biostatistics. S. Chand [Available in Guwahati].
6. Sokal RR and Rohlf FJ. Biometry: The principles and practices of statistics in biological research, W. H. Freeman and Company.
7. Zar JH. Biostatistical Analysis, Pearson Prentice Hall.
8. Bailey NTJ. Statistical Methods in Biology, Cambridge University Press.

BTAP0004: ANIMAL AND PLANT BIOTECHNOLOGY**(4 Credits – 60 hours)**

Objective: In this course students will be introduced to the techniques and underlying theories of both plant and animal biotechnology and their application in agriculture, veterinary sciences,

medical sciences and reproductive technology. Ethical issues related to biotechnological research will also be addressed in this course.

Part A: Animal Biotechnology

Module I: Animal cell culture (10 Hours)

General considerations of cell culture: Aseptic condition, Media, Balanced salt solution, Carbon dioxide incubator, feeder layer, serum, growth factors; Types of culture media (defined and undefined media), culture media composition; role of different media. Types of cell culture – organ, Organotypic, single cell, Histotypic/3D, primary cells, cell lines, adherent and suspension cell cultures; Characteristics of cells in culture; measurement of cell viability, apoptosis, senescence; Scaling up of animal cell culture, stem cell culture, embryonic stem cell and their applications.

Module II: Animal improvement (8 Hours)

Embryology: Collection and preservation of embryos; culturing of embryos; micromanipulation technology and fertilization in animals; Equipment used in micromanipulation; Assisted reproductive biotechnology in human and animal; Sperm sorting; Enrichment of semen for x (female) or y (male) sperm; Biotechnology Techniques in Animal Breeding: Artificial Insemination, In Vitro Fertilization and embryo transfer.

Module III: Transgenic animals and application (12 Hours)

Transgenic animal: methods of production and application; transgenic animals as models for human diseases; transgenic animals in livestock improvement; industry, biomedicine, bioreactors; chimera production; Gene knockouts, production of human antibodies in animals; vaccines and their applications; gene therapy for animal diseases; Knockout mice and mice of human (genetic) disease(s); Animal cloning and ethical issues in animal biotechnology.

Part B: Plant Biotechnology

Module IV: Plant tissue culture and Micropropagation (10 Hours)

Definition, brief history, principle and significance of tissue culture; Cellular totipotency:

Cytodifferentiation: Organogenic Differentiation: induction, factors affecting shoot bud differentiation; Cell suspension Culture, Callus Culture, Embryo Culture, Haploid Culture: microspore and macrospore culture. Triploid culture: Endosperm Culture, Protoplast: isolation, Culture and Fusion; Somatic hybridization and cybridization; Somatic Embryogenesis and Synthetic Seed Production; Androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation.

Module V: Methods of gene transfer and Markers (8 Hours)

Introduction to transgenic plants, methods of gene transfer – Agrobacterium tumefaciens mediated, Agrobacterium rhizogenes mediated; Direct gene transfer methods – Chemical, Physical and alternative methods. Selectable markers, reporter gene and promoter in plant vectors.

Module VI: Transgenic plants and Medicinal Plant biotechnology (12 Hours)

Transgenic plants: Herbicide resistance; Drought, Salinity, thermal stress, flooding and submergence tolerance. Seed storage proteins; Protein engineering; Vitamins and other value addition compounds; Metabolic engineering of lipids, flavonoids, vitamin E biosynthesis, flavoring agents (monoterpenes and sesquiterpene), Carotenoid biosynthesis, secondary metabolites; Production of pharmaceutically important compounds; Bioenergy generation; Medicinal plants: different secondary metabolites, application of biotechnology in medicinal plants.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Have a basic understanding on increasing use of modern molecular genetics for genetic mapping and rapid development of new strains of improved crops, livestock, fish, and trees.
- CO2:** Understand the applications of tissue culture and micro-propagation for the rapid multiplication of horticultural crops and trees
- CO3:** Know the importance of Genetic engineering and transformation techniques for production of transgenic plants and animals carrying desirable traits

Suggested Readings

1. Ranga MM. Animal Biotechnology. Agrobios India Limited
2. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers.
3. Freshney IR, R. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.
4. Barnes D, Mather JP, Animal cell culture methods, Academic press.
5. Heldt HW. Plant Biochemistry and Molecular Biology, Oxford University Press.
6. Ignacimuthu S, Applied Plant Biotechnology, Tata McGraw-Hill.
7. Gamburg OL, Philips GC. Plant tissue and Organ culture fundamental methods, Narosa publications.
8. Slater A, Scott N and Flower M, Plant Biotechnology. The genetic manipulation of plants, Oxford University Press.
9. Singh BD. Text book of Biotechnology, Kalyani publishers.

BTGE0005: GENETIC ENGINEERING

(3 Credits – 45 hours)

Objective: *In this course students will learn the basics of genetic engineering and the principles of gene manipulation. Students will be exposed to modern tools and techniques used in various areas of biotechnological/microbiological/biochemistry research.*

Module I: Enzymes in Genetic Engineering (6 Hours)

Restriction nucleases: Exo and Endo nucleases: History, Restriction endonuclease nomenclature, classification of restriction endonuclease – type I, type II, and type III, cleavage patterns – sticky ends, blunt ends, applications; Modifying enzymes – ligases, kinases, RNase, polymerases, phosphatases and methylases, RNA dependent DNA polymerase, Terminal Deoxynucleotidyl transferase.

Module II: Plasmids and Vectors (10 Hours)

Cloning vectors: Plasmids and plasmid vectors, phagemids, cosmids, artificial chromosome vectors (YAC, BAC), E.Coli plasmid vectors – pBR322, pUC18, pET21, Bacterio-phage vectors – λ and M13, Cosmids, phagemids and Phasmids, Shuttle vectors - Yeast vectors, Baculo virus vector. Intein-based vectors; Inclusion bodies; Plant based vectors, Ti and Ri as vectors, Yeast vectors, Insertion and Replacement vectors, Expression vectors; Strategies for production of foreign proteins in E. coli, Yeast, animal cell, pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag.

Module III: Molecular Cloning and Hybridization techniques (12 hours)

Isolation of genomic and plasmid DNA, DNA cloning; Strategies for construction of genomic and cDNA libraries, chromosome walking; screening of libraries; Oligonucleotide, cDNA and antibody probes; The Southern, Northern, Western, North-Western, Zoo blots, South western, Far western blotting and Colony hybridization, yeast-two hybrid system, c-DNA synthesis and cloning: mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis;

Cloning interacting genes two-hybrid systems, cloning differentially expressed genes. Site directed mutagenesis and protein engineering.

Module IV: PCR and its applications (9 Hours)

Primer design, thermostable enzymes, Types of PCR – multiplex, nested, reverse transcription PCR, quantitative real time PCR, touchdown PCR, colony PCR, cloning of PCR products; PCR in gene recombination: Deletion, recombination, addition, and Site-specific mutagenesis, PCR in molecular diagnostics – mutation detection, mismatch amplification mutation assay (MAMA), Oligonucleotide Ligation Assay (OLA), Single-strand conformation polymorphism (SSCP), Allele-specific amplification (ASA).

Module V: DNA Sequencing and applications of genetic engineering (8 Hours)

Maxam and Gilbert method and Sanger's method, Next generation sequencing, Applications of genetic engineering: Transgenic animals and plants, production of recombinant pharmaceuticals, gene therapy, disease diagnosis, Transgenic and gene knockout technologies: Vector engineering, strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Explain the concepts and principles used in modern biotechnological and agricultural applications. (Understanding)
- CO2:** Apply their basic knowledge in plant tissue and modern techniques of micropropagation in their future research works. (Applying)
- CO2:** Apply their concepts for their own experimental design by using the modern gene transfer technique for transgenic plant related research. (Applying)

Suggested Readings

1. S.B. Primrose, R.M. Twyman and R.W. Old; Principles of Gene Manipulation. S.B. University Press.
2. Brown TA, Genomes, Garland Science.
3. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL.
4. Glover DM, Hames BD, Cloning I & II. IRL Press
5. Innis MA, Gelfant MA, Sni skey JJ, PCR Strategies, IRL Press.

BTIM0006: IMMUNOLOGY

(3 Credits – 45 hours)

Objective: This course is designed to provide a foundation in the basic concepts of immunology and immunotechnology. Students will acquire a sound working knowledge of the basic elements of the immune system and the techniques employed in immunodiagnostics, therapeutic techniques and research.

Module I (16 Hours)

- a) History and scope of immunology, hematopoietic stem cells, stromal cells, hematopoiesis, lymphoid tissues and organs (primary and secondary), B-lymphocytes and their activation, Thymus derived lymphocytes and their activation, antigen presenting cells, natural killer cells, dendritic cells, macrophages, structure and functions of Class I and II Major Histocompatibility complex (MHC) molecules;
- b) Types of immunity: innate and acquired, active and passive, humoral and cell mediated, immune globulin: definition, structure and function, clonal selection theory, monoclonal antibody synthesis, generation of antibody diversity, organization and expression of immunoglobulin

genes, antigens: T dependent and T independent antigens, adjuvant (definition, examples, function), antigen antibody reactions, cross reactivity, cytokines-definition: definition, types and functions.

Module II (7 Hours)

The complement systems: definition, function, classical and alternate pathway, transplantation: organ transplantation and HLA tissue typing, autoimmunity, hypersensitivity reactions, immunological tolerance, immune suppression and immunotherapy, vaccine: definition, classification and function.

Module III (10 Hours)

Purification of mononuclear cells from peripheral blood, isolation and characterization of T cells subsets; B cells and macrophages; mitogen and antigen induced lympho-proliferation assay; mixed lymphocyte reaction - assessment of delayed hypersensitivity reactions; macrophage cultures - assay of macrophage activation - isolation of dendritic cells; *In situ* and *In vivo* characterization of cells from tissues; generation of T cell clones.

Module IV (12 Hours)

- a) Disease diagnostics and Immunotechnology: DNA diagnostics, array-based diagnostics and nucleotide polymorphisms; Immuno screening of recombinant library; Tumour immunity, Immunodeficiency disease - SCID, AIDS.
- b) Immunoelectrophoresis, immunofluorescence, Immunohistochemistry; Fluorescent Activated Cell Sorter (FACS); Single and double immunodiffusion, Immunofluorescence, RIA, RID, ELISA, Western blot, Agglutination tests; Vaccine technology including DNA vaccines; identification of T and B epitopes for vaccine development.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the basic concepts about the various components of immune system and how it works based on their previous knowledge from various fields. (Remembering)
- CO2:** Explain how the immune system functions in conjugation with vaccines and its benefits, safety and efficacy. (Understanding)
- CO3:** Outline the function and significance of the Major Histocompatibility complex in immune defense against intracellular pathogens. (Understanding)
- CO4:** Apply the knowledge gained from the immunology in prevention and treatment of infectious diseases. (Applying)
- CO5:** Apply an understanding of the roles of immunology in protection against disease and autoimmune disorders to choices in their daily lives. (Applying)
- CO6:** Analyze new developments in immunological therapies designed for the treatment. (Analyzing)
- CO7:** Distinguish between the innate and adaptive arms of immunity. (Analyzing)

Suggested Readings

1. Kindt TJ, Goldsby RA, Osborne BA, Kuby J. Kuby Immunology. WH Freeman and company, New York.
2. Abbas AK, Lichtman AK and Pober JS (Eds). Cellular and Molecular Immunology. WB Saunders.
3. Delves P, Martin S, Burton D, Roitt I. Roitt's Essential Immunology. Wiley-Blackwell.
4. Weir DM and Steward J. Immunology. Churchill Livingstone, New York
5. Goding. Monoclonal antibodies. Academic Press.
6. Hay FC, Westwood OMR. Practical Immunology. Blackwell Publishing.
7. Price CP, Newman DJ. Principles And Practices of Immunoassay. Nature Publishing Group.

BTBE0007: BIOPROCESS ENGINEERING**(3 Credits – 45 hours)**

Objective: *The course aims to present the students the basic principles of bioengineering in large-scale cultivation of microorganisms for production of industrially important products. Students will be introduced to different aspects in the field of Bioprocess Engineering including bioreactors and fermentors, food biotechnology and environmental biotechnology.*

Module I (8 Hours)

Introduction to bioprocess engineering, bioreactors, bioprocess kinetics, kinetic modeling, cell immobilization, production of biomass and applications; Isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth, media formulation for industrial fermentation, Air and media sterilization; Designing of a fermenter/Bioreactor.

Module II (8 Hours)

Types of fermentation process, analysis of batch: fed batch and continuous bioreactor, biotransformation, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.) Measurement and control of bioprocess parameters

Module III (12 Hours)

Downstream processing: introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment; Industrial production of chemicals using biological aid: alcohols, acids (citric, acetic and gluconic), solvents (glycerols, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid), single cell proteins.

Module IV (10 Hours)

Food Biotechnology: Food spoilage and preservation process, dairy products, wine, beer and other alcoholic Beverages and formulated plant products, petro crops, food from water, fungal protein food from yeast, hybrid seeds, conventional breeding of plant for food production. Transformation of steroids and non-steroid compounds; Mushroom: types, isolation and culture.

Module V (12 Hours)

Bioremediation: Concept (in situ and ex situ bioremediation) and role of bioremediation in controlling various pollution problems (industrial and medical effluents,). Basic concept of phyto-remediation and myco-remediation; Bioremediation of heavy metals, oil spills, plastics, cellulose and paper, xenobiotics; Radioactive waste: Sources, half-life of radioactive elements and mode of decay.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Explain the design and development of fermentation systems for production of biomass and products. (Understanding)
- CO2:** Interpret biochemical and physiological concepts relevant to bioprocesses and their downstream operations. (Understanding)
- CO3:** Discuss bioprocess applications in food, environmental and industrial biotechnology. (Creating)

Suggested Readings

1. Stanbury PF, Whitaker A, Hall SJ. Principles of Fermentation Technology. Butterworth Heinemann. (Available online).
2. Glazer AN. and Nikaldo H. Microbial Biotechnology, WH Freeman and company network.
3. Prescott LM, Harley JP and Klein DA. Microbiology. McGraw Hill.
4. Stainer RY, Ingrtham JL, Wheels ML and Painter PR. General Microbiology. Macmillan.
5. Casida LE. Industrial Microbiology, John Wiley and Sons.
6. Flickinger MC, Drew SW. Encyclopedia of Bioprocess Technology. John Wiley and Sons.
7. Demian AL and Davis. JE. Industrial Microbiology and Biotechnology, ASM Press.

BTAB0008: ADVANCES IN BIOTECHNOLOGY

(4 Credits - 60 hours)

Objective: *This course will review the principles of advanced Biotechnology. The students will be exposed to the frontiers of research and latest techniques in Biotechnology and their applications. This will keep them abreast of the most recent developments in the area. The students will be required to make presentations and submit assignments on the latest developments in the field of Biotechnology with the help of reputed national and international journals.*

Module I: Genomics (10 hours)

Genome organisation, prokaryotic and eukaryotic genomes, chromosomal and extra-chromosomal genomes, model organisms, Next Generation Sequencing (NGS), whole genome sequencing, genome projects, microarrays; epigenetics, pharmacogenomics, comparative genomics, applications of genomics in health, agriculture and industry

Module II: Transcriptomics and proteomics (15 hours)

- a) Transcriptome, analysis of gene expression - ESTs, SAGE, recent developments in RNA sequencing; metatranscriptomics, applications in gene regulation: alternative splicing, non-coding RNA
- b) Proteins and their structure, proteome, 1D and 2D PAGE, X-ray crystallography, Mass spectrometry including MALDI-TOF, protein microarrays, recent developments in secretomics, interactomics; applications of proteomics in drug discovery

Module III: Metabolomics, bioinformatics and systems biology (15 hours)

- a) Metabolome and its significance, recent advancements using high throughput analytical techniques like chromatography coupled with mass spectroscopy (GC-MS, LC-MS), NMR; data analysis (PCA, PLSDA)
- b) Databases, analysis of data using advanced tools of bioinformatics for newer applications; gene ontology
- c) Systems biology – complex biological data, computational and mathematical models, recent developments in network analysis

Module IV: Commercial biotechnology (10 hours)

Commercial production of industrial bio-molecules in bioreactors; bioproducts from both natural and synthetic source and their commercialisation, synthetic biology, nanobiology, recombinant vaccines; commercial plant tissue culture including automation, strategies for environment cleanup Global and Indian biotech sector; entrepreneurship in biosciences.

Module V: Intellectual Property Rights (10 hours)

Introduction to intellectual property: patents, trademarks, copyright and related rights, industrial design, geographical indications, Protection of new varieties of plants and plant breeder's rights World intellectual property organization (WIPO), Indian Patent Act 1970 Rules and amendments. IP in biotechnology; Drafting and filing patent applications; management and practical use of IP rights, including licensing, enforcement and ethics.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Relate with the latest developments in the field of biotechnology particularly in Genomics, Transcriptomics, Proteomics, Metabolomics and other emerging fields of study. (Understanding)
- CO2:** Summarize about the global and Indian scenario of commercial biotechnology including concept of entrepreneurship in biotechnology. (Understanding)
- CO3:** Illustrate IPR and their importance in R&D in biotechnology. (Understanding)

Suggested Readings

1. Primrose, S.B. and Twyman, R., Principles of Gene Manipulation and Genomics, Wiley - Blackwell Publishers.
2. Bernot, A., Genome, Transcriptome and Proteome Analysis. John Wiley & Sons Ltd.
3. Stumpf, M., Balding, D.J. and Girolami, M., Handbook of Statistical Systems Biology, Wiley Publishers.
4. Singh, K.K., Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer, India.

BTPE0009: THERMODYNAMICS AND ENZYMOLOGY**(3 Credits - 45 hours)**

Objective: *The objective of the course is to give the students an in-depth knowledge of the properties and kinetics of enzyme catalyzed reactions in biological systems*

Module I (5 hours)

Laws of thermodynamics, reversible and irreversible processes, entropy, enthalpy, internal energy, free energy and equilibrium constant, Gibbs free energy equation, determination of free energy change of under standard and non-standard conditions, high energy compounds, coupled reactions, determination of feasibility of reactions.

Module II (5 hours)

Isolation and purification of enzymes, Salting out of proteins, Isoelectric point, Electrophoresis of protein. Classification, nomenclature and general properties like effects of pH, substrate and temperature on enzyme catalyzed reactions.

Module III (7 hours)

Kinetics of enzyme catalyzed reaction: Single substrate reactions, bi-substrate reactions, concept of Michaelis-Menten, Briggs Haldane relationship, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics.

Module IV (10 hours)

Activation energy and Arrhenius concept. Binding energy, Enzyme catalysis: enzyme specificity and the concept of active site, determination of active site. Stereospecificity of enzymes. Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis.

Theories on mechanism of catalysis. 'Inhibition of enzyme activity: Competitive-cite: succinate' and Non-competitive-cite: Iodoacetamide' and EDTA as examples: Suicide inactivation'.

Module V (9 hours)

Mechanism of enzymes action: mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase. Multienzymes system, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex. Coenzyme action.

Module VI (9 Hours)

Enzyme regulation: General mechanisms of enzyme regulation, Allosteric enzymes, Feedback Regulation, Sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of Allosteric enzymes. Reversible and irreversible covalent modification of enzymes, cascade systems. Immobilised enzymes and their industrial applications. Ribozyme (catalytic RNA) and Abzyme (use of antibody as enzyme) - definition only.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Outline the properties and kinetics of enzyme catalyzed reactions in biological systems (Understanding)
- CO2:** Explain the chemical reactions and determine the various variables (Understanding)
- CO3:** Analyze the relationship of an enzyme and substrate specificity for product formation (Analyzing)
- CO4:** Analyze the essential role of enzymes in metabolism (Analyzing)

Suggested Readings

1. R. S. Berry, S. A. Rice and J. Ross; Physical Chemistry; Oxford University Press publisher
2. P. C. Rakshit; Physical Chemistry; Sarat Book House publisher
3. Jeremy M. Berg (Editor), John L. Tymoczko (Editor), Lubert Stryer (Editor); Biochemistry; W.H.Freeman & Co Ltd publisher
4. Donald Voet, Judith G. Voet, Charlotte W. Pratt; Fundamentals of Biochemistry; John Wiley & Sons Inc publisher
5. David L. Nelson, Michael M. Cox; Lehninger Principles of Biochemistry; W H Freeman & Co (Sd) publisher
6. Thomas .M. Devlin; Textbook of Biochemistry With Clinical Correlations; John Wiley & Sons publishers publisher

BTCA0010: COMPUTER APPLICATIONS AND BIOINFORMATICS

(3 Credits – 45 hours)

Objective: This course is designed to equip students with a foundation for developing basic programming skills and a sound knowledge of computer applications in biological sciences. Students will learn how to effectively and independently use the available bioinformatics tools and resources. Using bioinformatics tools, students will have the opportunity to apply the concepts of genetics, cell and molecular biology to learn how to retrieve, analyze and process biological data.

Module I (10 Hours)

- a) Basic computer organization, Processor and memory, secondary storage devices, Input-Output devices.
- b) Computer software, Computer language; Basic Ideas in Programming in C: Variables, Constants, Keywords, Input/output, Control Statements, Functions, Structures; Operating system –Basic commands in Linux.

Module II (5 Hours)

- a) Introduction to Spreadsheet, presentation software, document and word processing.
- b) World Wide Web, Client - server organization; Internet Protocols - FTP, HTTP, Telnet; Search engines - search concepts

Module III (12 Hours)

- a) Concept of databases: Biological databases - Primary, secondary, composite databases; Databases for Literature, Sequence and structure; Searching and their retrieval.
- b) DNA and Protein sequence alignments - Pairwise alignment, dot plot, global and local alignment algorithms - Needleman and Wunsch algorithm, Smith-Waterman algorithm; Multiple sequence alignment - progressive alignment and Iterative alignment algorithms; PAM and Blossum scoring matrices; Multiple sequence alignment based database searching – PSI-Blast; Bioinformatics for phylogenetic analysis.

Module IV (9 Hours)

- a) Gene Prediction- Finding genes in prokaryotic and eukaryotic genomes, Regulatory sequence analysis; Genome maps and markers, Genome variation. Oligo design and analysis tool.
- b) Human genome project;
- c) Concept and Software used in Gene expression analysis and Microarray.

Module V (9 Hours)

- a) Structural biology - Protein structure prediction and classification; Homology modeling, Threading and Abinitio methods, Molecular visualization tools-Rasmol, Chime and Swiss pdb viewer. Structure analysis tools - VAST and DALI.
- b) Drug Design and discovery, steps in drug discovery, ADME, Lead identification, QSAR. Proteomic research, metabolic reconstruction.

Suggested Readings

1. Sedgewick R and Wayne K. An Introduction to Computer Science, Princeton University [available online].
2. Blum R and LeBlanc Dee-Ann. Linux for Dummies, WILEY [available online].
3. Kanetkar YP. Let Us C [available online].
4. Rajaraman V. Fundamentals of Computers, Prentice-Hill India.
5. Rajaram R. Computer Concepts and C Programming, SCITECH INDIA.
6. Baxevanis DA, Francis BFO. Bioinformatics: a practical guide to the analysis of genes and proteins, John Wiley and Sons [available online].
7. Krane DE, Raymen, M. L. Fundamental Concepts of Bioinformatics, Benjamin Cummings.
8. Mount DW. Bioinformatics: Sequence and genome Analysis, CHSL Press [available online].
9. Bourne PE and Weissig H. Structural Bioinformatics, WILEY.
10. Ghosh Z and Mallick B. Bioinformatics Principles and Applications, Oxford University Press.
11. Attwood TK and Parry-Smith DJ. Introduction to Bioinformatics, Pearson Education.
12. Elmasr R and Navathe SB. Fundamentals of Database Systems, Pearson Education [available online].
13. Campbell AM and Heyer LJ. Discovering Genomics, Proteomics and Bioinformatics, Benjamin Cummings.

LABORATORY COURSES

BTAP6003: ANIMAL AND PLANT BIOTECHNOLOGY LAB

(2 Credits)

(A) Animal Biotechnology

1. Isolation of genomic DNA from animal cells
2. Preparation of animal cell culture media and Filter sterilization
3. Subculturing / passaging cell lines
4. Preparation of single cell suspension from spleen/liver/thymus
5. Staining of the monolayer cells with Giemsa stain.
6. Quantitation of animals cells using hemocytometer
7. Cell viability test

(B) Plant Biotechnology

1. Isolation of plant genomic DNA, Chloroplast and Mitochondrial DNA
2. Preparation of Plant tissue culture media and Stock solutions
3. Callus induction
4. Shoot/ Root induction - organogenesis
5. Haploid production – Anther and ovule culture
6. Protoplast fusion by PEG
7. Agrobacterium mediated transformation
8. Gus assay/ GFP cloning

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Make use of the techniques for isolation of DNA. (Applying)
- CO2:** Experiment with preparation of culture media for cell cultures. (Applying)

BTGE6004: GENETIC ENGINEERING LAB

(1 Credit)

1. Isolation of genomic DNA from animals/plants
2. DNA amplification using polymerase chain reaction
3. Cloning in plasmid/ Phagemid vectors
4. Gene expression in E. coli and analysis of gene product
5. Agarose gel electrophoresis
6. Ligation of DNA
7. Silver staining of gels
8. Methylene Blue Staining
9. RAPD (Random Amplification of Polymorphic DNA)

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Experiment with isolation of genomic DNA and amplification using polymerase chain reaction (PCR). (Applying)

- CO2:** Make use of RAPD technique. (Applying)
- CO3:** Analyze gene expression. (Analyzing)
- CO4:** Test with ligation of DNA molecule. (Creating)

BTIM6005: IMMUNOLOGY LAB

(1 Credit)

1. Isolation of WBC and RBCs
2. Differential counting of WBC
3. Single radial immune diffusion
4. Double diffusion method of Ouchterlony
5. Immunoelectrophoresis
6. Rocket electrophoresis
7. Agglutination reactions
8. Separation of peripheral blood mononuclear cells by Ficoll-Hypaque
9. Immunodiagnosics (Demonstration using commercial kits)
10. DOT ELISA for the presence of specific antigen.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Illustrate antigen-antibody interaction. (Understanding)
- CO2:** Make use of the immunodiagnosics application. (Applying)
- CO3:** Estimate the concentration of known antigens. (Creating)

BTBE6006: BIOPROCESS ENGINEERING LAB

(1 Credit)

(A minimum of 10 experiments to be conducted)

1. Parts and design of fermenter
2. Solid state fermentation
3. Submerged fermentation
4. Conservation of Bacteria by Lyophilization
5. Production and estimation of protease
6. Production and estimation of amylase
7. Isolation, Preservation and Maintenance of Industrial Microorganisms
8. Growth kinetics for batch culture
9. Media for Industrial Fermentation
10. Immobilization of bacterial cells
11. Scale up fermentation process
12. Production and quantification of alcohol using yeast
13. Lactic acid fermentation process

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Illustrate the parts, design and different fermentation processes. (Understanding)
- CO2:** Experiment with the production and estimation of enzymes. (Applying)
- CO3:** Make use of the scale up fermentation process. (Applying)

BTDI6007: DISSERTATION PHASE I

(2 Credits)

Objective: *Dissertation phase I is designed to familiarize the students with the research topics and methodologies by a thorough literature review.*

During dissertation phase I each student chooses a topic in consultation with the assigned supervisor and the student is asked to do thorough literature review under the guidance of the supervisor. At the end of the semester the student submits literature review report and students presents the matter at a school level seminar.

COURSE/LEARNING OUTCOMES

At the end of Dissertation phase I students will be able to:

- CO1:** Identify recent trends in the chosen area and develop research work. (Applying)

BTDI6008: DISSERTATION PHASE II

(16 Credits)

Objective: *Dissertation phase II involves execution of the research work decided in phase I leading to the preparation, submission and evaluation of the dissertation.*

During the course of the Master's Degree the student is expected to undertake a research work leading to a dissertation. The work will be divided into two phases spread over two semesters. During the research work the student shall study and incorporate recent trends in the area chosen by him/her, and develop a scientific dissertation based on the research and actual bench work. The student shall be required to make presentations and reports at various stages of the research work. The format for the final dissertation shall be as prescribed by the Department. There shall be a viva voce examination on the dissertation by an expert committee comprising external and internal members. The mode and components of the evaluation and the weightages attached to them shall be published by the Department at the beginning of the semester.

BTPE6009: THERMODYNAMICS AND ENZYMOLOGY LAB

(1 Credit)

1. Determination of K_m and optimum pH and temperature of amylase from sweet potatoes
2. Determination of K_m and V_{max} of urease from bean.
3. Determination of K_m of Lipase from moong seeds.
4. Assessment of inhibitor on enzyme activity.
5. Assessment of activator on enzyme activity.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Identify the factors affecting enzyme activity, K_m and V_{max} for different samples. (Applying)

BTCA6010: COMPUTER APPLICATIONS AND BIOINFORMATICS LAB**(2 Credits)**

1. Programs of C language
2. Introduction to basic commands used in LINUX operating systems
3. Introduction to various databases available, information on their usage and tools available in databases
4. Usage/Retrieval of sequence/structure from databases
5. Primer designing and analysis
6. Phylogenetic Analysis based on sequence alignment data and RAPD/ protein profile data
7. Visualization of structures of protein, ligands in databases and their molecular docking
8. Homology modeling

MICROBIOLOGY**THEORY COURSES****MBCG0001: CELL BIOLOGY AND GENETICS****(4 Credits - 60 hours)**

Objective: This course is designed to give a better understanding of cellular biology with complicated biochemical and physiological processes. The course also focuses on genetics as it relates to the function and structures of cells. It will also serve as a foundation for further studies in advanced molecular biology and biochemistry.

Module I (9 Hours)

Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, ribosomes, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure function of cytoskeleton and its role in motility. Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting; Protein synthesis on free and bound polysomes, golgi sorting, post- translational modifications.

Module II (12 Hours)

Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons. Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Uncontrolled cell growth – cell cycle in cancer; oncogenes, tumor suppressor genes; Programmed cell death, aging and senescence

Module III (15 Hours)

Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cell signaling: Hormones and their receptors, cell surface receptor, signal transduction pathways: GCPR, RTK etc., second messengers and their roles in signal transduction, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

Module IV (15 Hours)

- a) Mendelian principles and extension: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance.
- b) Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers mapping by using somatic cell hybrids, development of mapping population in plants. mapping, electron microscope heteroduplex mapping; Fine structure of genes and complex loci in eukaryotes Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.
- c) Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Module VI (9 Hours)

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Transposable Genetic Elements: Transposable elements in bacteria, transposable elements in eukaryotes. Recombination: Homologous and non-homologous recombination, including transposition, site-specific recombination.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Explain cellular biology with complicated biochemical and physiological processes. (Understanding)
- CO2:** Relate the cellular process in genetic level. (Remembering)
- CO3:** Explain genetics as it relates to the function and structures of cells. (Understanding)

Suggested Readings

1. Cooper, G. M., Cell (A Molecular Approach)
2. Karp, G., Cell and Molecular Biology (1996)
3. Sadava D. E., Cell Biology (1993)
4. Kish V. M. and Kleinsmith L. J., Cell and Molecular Biology (1995)
5. deRobertis and deRobertis, Cell and Molecular Biology
6. Gardner, Principles of Genetics
7. Strickberger, Genetics
8. Ram Mahabal, Fundamentals of Cytogenetics and Genetics

MBVB0003: VIROLOGY, BACTERIOLOGY AND MYCOLOGY**(5 Credits - 75 Hours)**

Objective: The contents of this course will help students to understand the evolution, growth, life cycle and applications of virus, bacteria and fungus which will lead the students towards progressive advancement of the subject.

Module I (8 hours)

History and perspective of virology, distinctive properties of virus, variation in morphology of virus, capsid arrangement, envelope composition, viral nomenclature, classification of virus including

Baltimore's classification, assay of plant virus, animal virus and bacteriophage, multiplication of viruses inside the host: infection of host cells, synthesis of viral macromolecules, regulation of the expression of phage genes, viral DNA replication, role of DNA modification, maturation and release of viral particle, isolation and purification of phage.

Module II (17 hours)

Bacterial viruses: classification and nomenclature, lytic and lysogenic phage, regulation in switching between lytic and lysogenic mode, lysogenic conversion, replication of bacterial phage, plant viruses: classification and nomenclature, structure and life cycle of plant viruses, replication of the genetic material of plant viruses, plant diseases caused by virus and their control, animal viruses: classification and nomenclature, structure and lifecycle of animal viruses, replicative strategies employed by DNA and RNA viruses, epidemiology, pathogenesis, diagnosis, prevention and treatment of animal viruses including HIV, viral vaccines, interferon, and antiviral drugs.

Module III (25 hours)

History and development of mycology in the scientific development, general characteristics of fungi, fungal structure and organization, criteria for fungal classification, colony communication and signaling, nutrition requirement of fungi, saprophytic, parasitic, obligatory and facultative, biotrophic, semi-biotrophic and necrotrophic mode of growth, fungal cell differentiation, reproduction in fungi - vegetative, asexual and sexual with special reference to their significance, homothallism and heterothallism, sex hormones in fungi, ecto-mycorrhizae, endo mycorrhizae and vesicular arbuscular mycorrhizae, fungal-plant interactions: symbiotic and antagonistic interactions, use of endophytic fungi as biocontrol agents against plant diseases caused by fungi, fungi and animal diseases - Dermatophytes and agents of superficial mycoses, significance of fungi in biotechnology and industrial application, fungal metabolites and their economic significance - mycotoxins, medicinal uses of fungi (antibiotics), fungi as food - mushrooms, mushroom poisoning.

Module IV (10 hours)

History and development of bacteriology in the scientific development, general features of eubacteria and archaeobacteria, morphology of bacteria, bacterial cell wall composition and synthesis, plasma membrane, cytoplasmic matrix, nucleoid, inclusion bodies, ribosomes, flagella, Pilli, endospore and exospores, plasmids and episomes, staining techniques: basic and acidic dyes, simple and differential staining, Grams staining, acid fast staining, flagella and spore staining.

Module V (15 hours)

Bacterial growth curve, effect of physical and chemical factors on bacterial growth, measuring bacterial growth-spectrophotometric method, microscopic counting, serial dilution and viable cell count, most probable number, and filtration technique, bacterial reproduction, bacterial culture media: chemically defined, complex, differential and special selective media, nutritional types: photoautotroph, photoorganotroph, chemolithotroph (ammonia, nitrite, sulfur, hydrogen, iron oxidizing bacteria), chemoorganotroph, effect of oxygen on growth, classification on the basis of oxygen requirement and tolerance, bacterial two component signaling system, application of bacteria in agriculture (nitrogen fixing organisms; bioremediation of hydrocarbons and biopesticides), antibiotics and chemotherapeutic drugs, antibiotic sensitivity assays, sterilization, physical and chemical control of bacteria.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Understand the growth and life cycles of virus, bacteria and fungus
- CO2:** Explain evolution in the study and development of microbial life forms

- CO3:** Apply the information toward development of strategies in using microbes for biochemical reactions, bioremediation, agriculture and in the study of disease progression
- CO4:** Explain role of micro-molecules with regard to cellular communication, sexual development of microbes, and plant-microbe interaction.
- CO5:** Understand the role and patterns in epidemiology, pathogenicity, diagnosis, prevention and treatment

Suggested Readings

1. S. E. Luria, J. E. Darnell; General Virology; John Wiley and Sons publisher
2. A.J. Rhodes, C.E. Van Rooyen; Text book of Virology; 5th revised edition
3. Kerry F. Harris, Oney P. Smith, James E. Duffus; Virus-insect-plant Interactions; Academic Press Inc
4. S. J. Flint, Lynn W. Enquist, Robert M. Krug, Vincent R. Racaniello; Principles of Virology: Molecular Biology, Pathogenesis, and Control; American Society for Microbiology
5. Constantine J. Alexopoulos, Charles W. Mims, Meredith M. Blackwell; Introductory Mycology; 4th Edition edition
6. A. H. S. Onions, D. Allsopp, H. O. W. Egging; Smith's Introduction to Industrial Mycology; 1st edition
7. Jr, Michael Pelczar; Microbiology; 5th edition
8. Joanne Willey, Linda Sherwood, Chris Woolverton; Microbiology; 8th edition
9. R Y, J L Ingraham et. al. Stanier; General Microbiology; 5th edition
10. Schlegel; General microbiology; Cambridge University Press

MBDE0004: MICROBIAL DIVERSITY AND ECOLOGY

(2 Credits - 30 Hours)

Objective: To provide students with an introduction and in depth knowledge to microbial diversity and microbial ecology with emphasis on recent molecular, biological and genomics developments in these fields.

Module I (8 hours)

Prokaryotic taxonomy: classical and modern (polyphasic approach), prokaryote and eukaryote species concept, biodiversity: definition and classification, molecular chronometers, molecular phylogeny, chemotaxonomy, estimation of diversity of microbial community by different methods including both metabolic and molecular, culture dependent and culture independent microbial community, metagenomics studies and its applications.

Module II (6 hours)

Microbial biodiversity analysis and documentation, major drivers of biodiversity change, biodiversity management approaches, extremophiles-definition, classification and survival strategies in hostile environment, importance and applications of extremophiles.

Module III (7 hours)

Microbial ecology vs. macroecology, concept of habitat and niche, fundamental and realized niche, resource partitioning, character displacement, microbial community structure, microbial interactions within community, characteristics of microbial population growth curves, microbial population regulation, r and K selected strategies, microbial community succession, microbial biofilm: definition, development and importance.

Module IV (9 hours)

Structure and function of ecosystems-terrestrial (forest, grassland) and aquatic (freshwater, marine, estuarine), microbial role in biogeochemical cycles (C,N,P), primary production and decomposition,

environmental pollution and greenhouse gases, several sustainable approaches for remediation of xenobiotic compounds, wastewater remediation, genetically modified organism: definition and applications.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Understand phylogenetic relationship, construction of trees, chemotaxonomic relationship among various microbial taxon, its metagenomic profiling and both classical and modern approaches in prokaryotic taxonomy.
- CO2:** Understand biochemical and molecular mechanisms extremophiles evolved to adapt to the surrounding and different environmental conditions and its applications in industry
- CO3:** Perform quorum sensing and biofilm production and detection; microbial population growth profiles and community succession
- CO4:** Have basic information in the structure, anatomy, function of an ecosystem, the role of microbes in the sustenance of the ecosystem
- CO5:** Develop interest to know the role of microbes in bioremediation and apply their knowledge in environment pollution to apply microbes in bioremediation process (using the information gathered in the theory of the previous course: Virology, Bacteriology, Mycology)

Suggested Readings

1. Prescott, Harley and Klein; Microbiology; McGraw Hill Education publisher
2. S.C. Tiwari, G.D. Sharma; Microbial Diversity: Status and Potential Applications; Scientific Book Centre publisher
3. D.J. Bagyaraj, K. V. B. R. Tilak, H.K. Kehri; Microbial Diversity and Functions; New India Publishing Agency
4. James T. Staley, Anna-Louise Reysenbach; Biodiversity of Microbial Life: Foundation of Earth's Biosphere; Wiley-Blackwell publisher
5. Michael T. Madigan, John M. Martinko, Paul V. Dunlap; Brock biology of the microorganisms; Pearson publisher
6. Ronald M. Atlas; Microbial ecology-Fundamentals and applications; Pearson Education publisher
7. Heinz Stolp; Microbial Ecology: Organisms, Habitats, Activities; Cambridge University Press
8. Morris A. Levin; Microbial Ecology: Principles, methods and applications (Environmental Biotechnology); McGraw Hill Higher education publisher.
8. Frank R. Spellman; Handbook of Environmental Engineering; CRC Press
9. J. McArthur; Microbial Ecology: An Evolutionary Approach; Academic Press Inc publisher

MBIM0005: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

(3 Credits - 45 Hours)

Objective: *This course is designed to provide students with an in depth knowledge in two complementary disciplines; the immune system and how they interact with the challenges posed by pathogens.*

Module I (16 hours)

History and scope of immunology, hematopoietic stem cells, stromal cells, hematopoiesis, lymphoid tissues and organs (primary and secondary), B-lymphocytes and their activation, Thymus derived lymphocytes and their activation, antigen presenting cells, natural killer cells, dendritic cells, macrophages, structure and functions of Class I and II Major Histocompatibility complex (MHC)

molecules, types of immunity: innate and acquired, active and passive, humoral and cell mediated, immunoglobulin: definition, structure and function, clonal selection theory, monoclonal antibody synthesis, generation of antibody diversity, organization and expression of immunoglobulin genes, antigens: T dependent and T independent antigens, adjuvant (definition, examples, function), antigen-antibody reactions, cross reactivity, cytokines: definition, types and functions.

Module II (7 hours)

The complement systems: definition, function, classical and alternate pathway, transplantation: organ transplantation and HLA tissue typing, autoimmunity, hypersensitivity reactions, immunological tolerance, immune suppression and immunotherapy, vaccine: definition, classification and function.

Module III (12 hours)

History of medical microbiology, normal microflora of human body, role of resident microbial flora, host parasite interactions, microbial infection steps: colonization, association, adhesion and invasion of host tissue and toxigenesis with details account of several virulence factors, pathogenesis islands, endo-toxins and exo-toxin, water and food born pathogenic microorganisms, laboratory diagnosis, epidemiology, prevention and treatment.

Module IV (10 hours)

Principles of chemotherapy, antimicrobial agents (synthetic compounds and antibiotics): mechanism of work, drug discovery: historical perspective and current approaches, phases of drug discovery, toxicity evaluation of drug (LD50, acute, sub-acute and chronic toxicity), drug trial, drug metabolism, microbial drug resistance.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Understand the working of the immune system in humans; explain the role of every defense barrier in avoiding infection and the genetic role in diversity in antibody development
- CO2:** Understand the processes involved in immunotherapy, vaccine development, monoclonal antibody production
- CO3:** Understand the mechanism of host-parasite interaction, the stages in disease progression, the differences in pathogenicity, virulence and toxicity owing to microbes
- CO4:** Design diagnostic strategies to study disease prognosis
- CO5:** Understand mechanism of antibiotic resistance – both molecular and physiological, the economic design in discovery of novel antibiotic candidates, the phases in drug discovery and clinical trials

Suggested Readings

1. Stewart Sell, Ira Berkower; Immunology and immunopathology and immunity; 5th Edition
2. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai; Cellular and molecular immunology; 8th Edition
3. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt; Essential Immunology; 12th Edition
4. Thomas J Kindt, Barbara A. Osborne, Richard Goldsby; Immunology; 6th Edition
5. Jawitz, Melnick and Adelberg; Review of Medical Microbiology; 27th Edition; Mc Graw Hill education LANGE
6. Mark Gladwin, Trattler William, C. Scott, M.D. Mahan; Clinical Microbiology Made Ridiculously Simple; 6th Edition
7. Bailey, Scott; Diagnostic Microbiology; 13th Edition
8. Dennis L. Kasper, Anthony S. Fauci; Harrison's Infectious Diseases; 2nd Edition

9. Ananthanarayan, Paniker; Textbook of Microbiology; 8th Edition
10. WWC Topley, Sir Graham S; Topley and Wilson's Principles of Bacteriology, Virology and Immunity: Bacterial Diseases; Volume 3

MBAM0006: ADVANCES IN MICROBIOLOGY

(4 Credits - 60 Hours)

Objective: *This course deals with the principles, procedures and applications of advanced techniques in Microbiology. This course will introduce students to the current tools and processes in Microbiology which will make them competent to pursue research in cutting-edge areas in Microbiology. Students will be required to make presentations and submit an assignment on the most recent developments in the field of Microbiology from reputed peer-reviewed national and international journals and books.*

Module I: Industrial microbiology (20 hours)

- a) Fermentation technology: growth and product formation, batch and continuous fermentation process, large scale production of recombinant microorganisms, bioreactors, scale-up techniques, and downstream processing strategies.
- b) Strain improvement: producer strains and microbial strain improvement, production of industrially important enzymes and its application (food and dairy industry), production of recombinant molecules and therapeutic compounds through bioreactors.
- c) Biosensors: types of biosensors, microbial biosensors and its application in industry, diagnostics and in food.
- d) Biological weapons - definition and applications.

Module II: Food and Dairy Microbiology (15 hours)

- a) Microorganisms: important microorganisms in food microbiology, food contamination and spoilage, preservation using temperature, drying, additives and radiation.
- b) Food: Cultures for food fermentation, fermented foods – comparison between globally and locally available varieties, probiotics, prebiotics and synbiotics.
- c) Sanitation: food sanitation and control, quality assurances in foods, Government regulatory practices and policies - FDA, EPA, HACCP, ISI and BIS.

Module III: Advanced molecular studies (15 hours)

Molecular studies: Microbial biodiversity analysis using different advanced sequencing strategies including pyrosequencing and next gen sequencing, metatranscriptomics, metaproteomics and metabolomics.

Module IV: Intellectual Property Rights (IPR) (10 hours)

- a) Introduction: Intellectual property rights - patents, types, trademarks, copyright and related rights, industrial design and rights, traditional knowledge, geographical indications.
- b) Patents: patentable and non patentability issues, patenting life, legal protection of biotechnological inventions, world intellectual property rights organization (WIPO), Indian Patent Act 1970 and recent amendments.
- c) Entrepreneurship in biosciences.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Recall the principles, procedures and applications in recent techniques in microbiology in different levels such as industry, food and dairy. (Remembering)
- CO2:** Interpret the techniques and the underlying principles in downstream processing. (Understanding)
- CO3:** Identify techniques applicable for Improvement of microorganisms based on known biochemical pathways and regulatory mechanisms. (Applying)
- CO4:** Organize how to source for microorganisms of industrial importance from the environment. (Applying)
- CO5:** List the recent developments in microbiology research. (Analyzing)
- CO6:** Elaborate on ethical research, filing of patents, trademarks and copyrights, and what is novelty in microbiology research. (Creating)

Suggested Readings

1. Adams MR. Food Microbiology. New Age International Private Limited
2. Joshi VK. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. (Volume 2) Educational Publishers & Distributors.
3. Patel AH. Industrial Microbiology. Macmillan India Limited.
4. Casida LE. Industrial Microbiology. Wiley Eastern
5. Davis JE, Demain AL. Manual of industrial Microbiology and Biotechnology. 2ndedition. ASM publications.
6. Fraser CM, Read TD, Nelson KE. Microbial Genomes, Humana Press.2.
7. Miller RV, Day MJ. Microbial Evolution-Gene establishment, survival and exchange, ASM Press.
8. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
9. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
10. Goel D, Prashar S. IPR, Biosafety and Bioethics. (2013).Pearson
11. Collee JG, Fraser, AG, Marmion, BP, Simmons A. Practical Medical Microbiology. (2007) 14th edition, Elsevier.
12. Bailey's and Scott's Diagnostic Microbiology. Tille P (2013), 13th edition, Mosby
13. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
14. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
15. Goel D, Prashar S. IPR, Biosafety and Bioethics. (2013).Pearson
16. Collee JG, Fraser, AG, Marmion, BP, Simmons A. Practical Medical Microbiology. (2007) 14th edition, Elsevier.
17. Bailey's and Scott's Diagnostic Microbiology. Tille P (2013), 13th edition, Mosby

MBBM0007: BASIC MICROBIOLOGY

(3 Credits – 45 hours)

Objective: *The course is designed to impart a general knowledge on the different aspects of microbiology on the basis of various microorganisms like virus, bacteria etc. with modern microbial techniques.*

Module I: Introduction to Microbiology (10 Hours)

Historical perspective: Discovery of microbial world, Landmark discoveries relevant to the field of microbiology, controversy over spontaneous generation.

- Microbial taxonomy and diversity: Basis of microbial classification, Haeckel's 3 Kingdom concept, Whittaker's 5 Kingdom concept, three Domain of Carl Woese, Archaeal taxonomy.
- Staining techniques: Basic and acidic dyes, simple and differential staining, negative and positive staining, Grams' staining, acid fast staining, flagella and spore staining.
- Sterilization: physical and chemical control of bacteria.

Module II: Microbial Growth and Nutrition (10 Hours)

- Microbial growth: Definition of growth and bacterial reproduction, microbial growth curve, mathematical expression of exponential growth phase, measurement of growth and growth yields - spectrophotometric method, microscopic counting, serial dilution and viable cell count, most probable number, synchronous growth and filtration technique, continuous culture, effect of environmental factors on growth.
- Principles of microbial nutrition: nutritional groups of bacteria - photoautotroph, photoorganotroph, chemolithotroph (ammonia, nitrite, sulfur, hydrogen, iron oxidizing bacteria), chemoorganotroph, effect of oxygen on growth, classification on the basis of oxygen requirement and tolerance.
- Culture media: chemically defined, complex, differential and special selective media.
- Microbial cultures: Concept of pure culture, methods of pure culture isolation, enrichment culturing techniques, single cell isolation, and pure culture development.

Module III: Microbial Physiology (15 Hours)

- Microbial pigments: chlorophyll, bacteriochlorophyll, rhodopsin, carotenoids, pyocyanin, prodigiosin, pyoverdine.
- Photosynthesis: classification of photosynthetic bacteria, photosynthetic electron transport systems.
- Metabolism: An overview of metabolism; Glycolysis; Pentose-phosphate pathway; Entner-Doudoroff pathway; Glyoxalate pathway; The citric acid cycle; Fermentation of carbohydrates and Pasteur effect, Aerobic and anaerobic respiration.

Module IV: Bacterial cell morphology and Chemotherapy (10 Hours)

- Morphology of bacteria: bacterial cell wall composition and synthesis, plasma membrane, flagella, pilli, endospore and exospores, capsules – types, composition and function.
- Intracellular components: Reserve food materials and inclusion bodies; cytoplasmic matrix, nucleoid.
- Antibiotics: General characteristics of antimicrobial drugs, classification and mode of action,
- Antifungal and antiviral drugs: mode of action.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Define microbial diversity and taxonomy. (Remembering)
- CO2:** List Microbial culture, metabolism and host pathogen interactions. (Remembering)
- CO3:** Explain about Microbial ecology- survival strategies like antibiotics, extremophiles. (Understanding)

CO4: Explain evolution in the study and development of microbial life forms. (Understanding)

CO5: Identify the role and patterns in epidemiology, pathogenicity, diagnosis, prevention and treatment. (Applying)

Suggested Readings

1. Pelczar MJ, Ried RD and Chan, ECS, Microbiology
2. Prescott and Dunn, Industrial Microbiology
3. Ananthanarayanan and JayaramPaniker, Text Book of Microbiology
4. Gerard J Tortora, Berdell R Funke, Microbiology: An Introduction Christine L Case Benjamin-Cummings Publishing Company.
5. The Prokaryotes. A handbook on the biology of bacteria: ecophysiology, isolation, identification, applications. Volumes I-IV by Balows, A., Truper, H. G., Dworkin, M., Harder, W., Schleifer, K. H. Springer-Verlag, New York.
6. Albert G. Moat and John W. Foster. Microbial Physiology, John Wiley and Sons. Gopal Reddy et al., Laboratory Experiments in Microbiology

LABORATORY COURSES

MBCG6001: CELL BIOLOGY AND GENETICS LAB

(1 Credit)

1. Subcellular fractionation: mitochondria and chloroplast and their characteristics
2. Study of mitosis and meiosis in plants/cultured cells
3. Isolation of DNA from animal and plant sources
4. Agarose gel electrophoresis of isolated genomic DNA
5. Determination of T_m of DNA
6. Isolation of auxotrophic mutants by replica plating

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Identify different stages of cell division. (Applying)

CO2: Make use of the technique of extraction of DNA from both plant and animal tissues. (Applying)

CO3: Measure the T_m of the melt curve of DNA. (Evaluating)

MBBM6002: BASIC MICROBIOLOGY LAB

(1 Credit)

1. Growth curve: Effect of temperature, pH and carbon and nitrogen source on growth
2. Microscopic examination and study of bacteria, yeast and molds by Gram stain, acid fast stain and staining of spores
3. Assay of antibiotics
4. Isolation and maintenance of organisms by plating, streaking and serial dilution methods
5. Observation of specimen and permanent slides

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Explain microbial growth and nutrition and factors affecting growth (temperature, pH, etc.). (Understanding)

- CO2:** Infer from the colony and cell morphology. (Understanding)
CO3: Experiment with the bacteria to Isolate and maintain them as pure culture. (Applying)
CO4: Measure the Minimum Inhibition Concentration against a bacterial isolate using different antibiotic discs. (Evaluating)
CO5: Discuss the motility of bacterial cells. (Creating)
CO6: Test the working chemistry of staining different bacterial cells. (Creating)

MBMT6003: MICROBIOLOGY TECHNIQUES LAB

(2 Credits - 60 hours)

1. Isolation of bacteriophage from natural sources
2. Cultivation and quantification of phages
3. phage induction
4. Isolation of fungi from soil
5. Staining of fungus
6. Pure culture preparation and preservation of microorganism
7. Microbial growth measurement by direct cell count method, serial dilution method, turbidity method
8. Staining technique-simple, Gram's staining, negative staining, spore staining, acid fast staining of bacteria
9. Determination of bacterial motility
10. Microbial biofilm detection

COURSE/LEARNING OUTCOMES

At the end of the lab experiments students will be able to:

- CO1:** Isolate and identify coliphages, bacteria, fungi and algae from various natural environment sources, its enumeration by serial dilution and turbidity analysis, infer from the colony and cell morphology, and motility
CO2: Prepare single colonies and preserve the cultures
CO3: Produce and detect bacterial biofilms

Suggested Readings

1. S. E. Luria, J. E. Darnell; General Virology; John Wiley & Sons publisher
2. A.J. Rhodes, C.E. Van Rooyen; Textbook of Virology;
3. Kerry F. Harris, Oney P. Smith, James E. Duffus; Virus-insect-plant Interactions; Academic Press Inc
4. S. J. Flint, Lynn W. Enquist, Robert M. Krug, Vincent R. Racaniello; Principles of Virology: Molecular Biology, Pathogenesis, and Control; American Society for Microbiology
5. Constantine J. Alexopoulos, Charles W. Mims, Meredith M. Blackwell; Introductory Mycology
6. A. H. S. Onions, D. Allsopp, H. O. W. Eggins; Smith's Introduction to Industrial Mycology
7. Jr, Michael Pelczar; Microbiology
8. Joanne Willey, Linda Sherwood, Chris Woolverton; Microbiology
9. R Y, J L Ingraham et al. Stanier; General Microbiology
10. Schlegel; General microbiology; Cambridge University Press

MBDE6004: MICROBIAL DIVERSITY AND ECOLOGY LAB**(1 Credit)**

1. Isolation of thermophilic microorganisms
2. Isolation of Cyanobacteria from natural sample
3. Isolation of halophiles
4. Isolation of anaerobic microorganisms
5. Isolation of nitrogen fixing bacteria from soil
6. Isolation of protease secreting bacteria from soil
7. Effect of stress (temperature/pH/salt concentration) on microbial community
8. Determination of DO, COD and BOD of water sample

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Evaluate different strategies in isolation and identification of extremophiles and nitrogen fixers and normal skin microbiota
- CO2:** Determine level of pollution in water by both chemical and microbial processes
- CO3:** Identify industrially important protease secreting bacteria growing in varied environmental conditions

MBIM6005: IMMUNOLOGY AND MEDICAL MICROBIOLOGY LAB**(1 Credit)**

1. Single radial immunodiffusion
2. Double diffusion method of Ouchterlony
3. Electrophoretic separation of bovine protein
4. Agglutination reaction
5. Minimum inhibitory concentration (MIC) determination of antimicrobial compound against microorganism
6. Antibiotic assay using standard curve
7. Study of natural microflora of skin
8. Isolation of hemolytic bacteria using blood agar media

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Understand antigen-antibody interaction (based on zone of equivalence)
- CO2:** Study and understand bacterial growth patterns in normal and antibiotic stressed conditions and hence design epidemiological study of antibiotic resistance pattern
- CO3:** Evaluate different strategies in isolation and identification of normal skin microbiota and understand their response to antibiotics
- CO3:** Differentiate between haemolytic and non-haemolytic bacteria

MBDI6006: DISSERTATION PHASE I**(2 credits)**

Objective: *Dissertation phase I is designed to familiarize the students with the research topics and methodologies by a thorough literature review.*

During dissertation phase I each student chooses a topic in consultation with the assigned supervisor and the student is asked to do thorough literature review under the guidance of the supervisor. At the end of the semester the student submits literature review report and students presents the matter at a school level seminar.

COURSE/LEARNING OUTCOMES

At the end of Dissertation phase I students will be able to:

- CO1:** Illustrate scientific information in a succinct manner and learn the process of scientific writing. (Understanding)
- CO2:** Organize literature survey and carry out the initial study required before designing their dissertation project. (Applying)
- CO3:** Design experiment, prepare work plan and learn how to test hypothesis in research work. (Creating)

MBDI6007: DISSERTATION PHASE II**(16 credits)**

Objective: *Dissertation phase II involves execution of the research work decided in phase I leading to the preparation, submission and evaluation of the dissertation.*

During the course of the Master's Degree the student is expected to undertake a research work leading to a dissertation. The work will be divided into two phases spread over two semesters. During the research work the student shall study and incorporate recent trends in the area chosen by him/her, and develop a scientific dissertation based on the research and actual bench work. The student shall be required to make presentations and reports at various stages of the research work. The format for the final dissertation shall be as prescribed by the Department. There shall be a viva voce examination on the dissertation by an expert committee comprising external and internal members. The mode and components of the evaluation and the weightages attached to them shall be published by the Department at the beginning of the semester.

DEPARTMENT OF ZOOLOGY

Mission:

- To provide better understanding of Zoological Science by interacting with the natural environment and sensitizing the students about social responsibilities.
- To expose the learners to recent advances in various branches of Zoology and to provide high quality Zoology education keeping emphasis on learning and research.

Vision:

- To develop the department as an interdisciplinary center of learning, research and innovation.
- To make it a hub of Biodiversity research and making the surrounding a nature laboratory.

Programme Outcome:

- The students will acquire analytical and innovative thinking with high skill in biological techniques and also acquire latest knowledge and develop deeper understanding of Zoology.

DETAILED SYLLABUS

THEORY COURSES

ZGDB0005: DEVELOPMENTAL BIOLOGY

(4 Credits–60 hours)

Objective: *The objective of this course on Developmental Biology is to enable the students understand the process of development in animals and the phenomena associated with it. It will enable the students understand the environmental influences on development and factors responsible for age in animal so to imbibe the current knowledge pertaining to the development of animal embryos of diverse taxonomic groups through experimental analyses based on modern biological tools.*

Module I (14 hours)

- Fertilization-pre and post fertilization events, activation of eggs, gamete fusion and prevention of phylogeny
- General concept of Induction: mesoderm development, Determination: Imaginal disc of insects, Differentiation: Formation of fruiting bodies in Dictyostellium
- Neo cytoplasmic interaction in development of unicellular organism and in early development and differentiations of multicellular organisms, importance and role of cytoplasm, hybridization experiments, nature of changes in nuclei, cell hybridization, nuclear transplantation experiments.

Module II (10 hours)

- Principles of experimental embryology: the developmental dynamics of cell specifications stem cells and developmental commitment, totipotency and pluripotency.
- Morphogenesis and cell adhesion-the thermo dynamic model of cell interactions, concept of morphogen gradient and morphogenetic field, cell adhesion molecules.

Module III (10 hours)

Role of maternal contribution in early embryonic development in *Drosophila*: maternal effect genes, Gap genes, pair rule genes and hoxgenes in development.

Module IV (10 hours)

Organogenesis: vulva formation in *Caenorhaptitis elegans*; Regeneration of Salamander limbs: Polar Co-ordinate model; Lens regeneration in amphibia; Bone and neural regeneration-Medical Advances in regeneration.

Module V (16 hours)

- Medical implications of Developmental Biology - Genetic error of human development; Environmental assault on human development, Terato genic agents (Retinoicacid, pathogens, alcohol, drugs and chemicals, heavy metals); Environmental oestrogens.
- Infertility-Invitro fertilization and embryo transfer. Cloning experiments–Amphibians and Mammals. Embryonic stem cells and their applications; ethical issues
- Sex determination-Timing and gene expression in mammalian sex determination, Brain sex determination pathways invertebrates and flies, Hormone disruptors and sex determination problems, Temperature-dependents exdetermination in turtles, Evolution of sex from invertebrate to vertebrate; ethical issues.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the process of development in animals and the phenomena associated with it. (Remembering)
- CO2:** Outline the principles of experimental embryology. (Understanding)
- CO3:** Apply the concepts of stem cells in relation to health sciences. (Applying)
- CO4:** Analyze the various teratogenic agents and environmental estrogens. (Analyzing)
- CO5:** Evaluate the interactions of maternal effect of gene, gap gene, pair-rule gene, and hox-gene in development with respect to *Drosophila*. (Evaluating)
- CO6:** Discuss the various methods of assisted reproductive technology. (Creating)

Suggested Readings

1. Balinsky, B.I. An Introduction to Embryology. W.B Saunders Co., Philadelphia.
2. Gilbert, S.F. Developmental Biology. Sinamer Associates Inc. Saunderland, Massachusetts, U.S.A.
3. John E. Hall: Text Book of Medical Physiology. Guyton & Hall
4. Kalthoff: Analysis of biological development. McGraw-Hill, 1996.
5. Karp, G. and Berrill, N.J. Development. McGraw Hill, New York.
6. Nagabhusanam, R. and Sarojini, R. Invertebrate Embryology. Oxford and IBA Publishing Co.
7. Oppenheimer, S.B. Introduction to Embryonic Development. Allyn and Bacon, Inc.
8. Saunders, J.W. Developmental Biology. MacMillan Co., London.
9. Tyagi and Shukla, Development of Fishes. Jaya Publishing House, New Delhi.
10. Wolpert: Principles of development. Oxford.
11. N. Arumugan, A textbook on Embryology, Saras Publication.
12. Gurbachan S. Miglani, Developmental Genetics, I.K. International Publishing House Pvt. Ltd.
13. Verma P.S. and Agarwal V.K, Chordate Embryology, S. Chand Publishing.
14. Chordate Embryology by Verma P.S. and Agarwal V.K., S. Chand Publishing.
15. Saidapur.S.K. Reproductive cycles of Indian vertebrates. (Allied Publishers Ltd. New Delhi)
16. Sarkar. H.B.D Principles of Vertebrate reproductive Biology
17. Chester-Jones I: Fundamentals of Comparative vertebrate Endocrinology (Pleum Press: NY)

ZGAZ0007: APPLIED ZOOLOGY I**(4 Credits - 60 Hours)**

Objective: This course aims to provide a basic understanding of sericulture, apiculture, aquaculture and immunology

Module I (20 hours)

- a) Sericulture: Types of Silk Worm (Tasar, Muga and Eri), their host plants, silkworm rearing and management practices. Diseases and Pest of Silk Worm and their management, Biodiversity conservation project through sericulture (Case study- 7 Weaves Model)
- b) Apiculture: Different species of honey bees, bee plants, pollen calendar, bee keeping and management practices, bee products, Bee enemies and diseases.

Module II (20 hours)

Aquaculture: Aquarium fish keeping: Ornamental Fishes of India special reference to North East India, common aquarium fishes; Aquarium Maintenance, Fisheries management: Composite fish culture, induced breeding and hybridization; Prawn and Pearl Culture, Exotic and Indigenous food Fishes of NE India, Fish and shell fish diseases and their control measures. Fish genetic resource conservation; Aquaponics—prospect and future.

Module III (20 hours)

Immunology: Immune system-innate and adaptive immunity; components and characteristic features, humoral and cell-mediated immunity; Cells and organs of immune system; T cells and B cells - maturation, activation and differentiation; Antigens- immunological properties of antigens, factors influencing antigenicity; Immunoglobulin- structure and function, classes of Ig molecules, Antigen- antibody interactions; Complement system- classical, alternative and lectin pathways, regulation of complement system, biological consequences of complement activation; Major Histocompatibility Complex (MHC)- general organization and inheritance of the MHC, MHC molecules and genes; Hypersensitivity reactions- types, mechanisms of type I to IV hypersensitivity reactions; Autoimmunity- Organ specific autoimmune disease and treatment.

Suggested Readings

1. Venkitaraman: Economic Zoology, Sudarsana Publishers
2. Srivastava : A Text Book of Applied Entomology, Vol. II & II.I Kalyani Publishers
3. Shukla & Upadhyaya : Economic Zoology. Rastogi Publishers.
4. Anantha krishnan, T. N. and K.G. Shivarama krishnan. Ecological entomology: Insect life in odd environment. Scientific Pub.: India
5. David, B. V and T.N. Anantha krishnan. General and Applied Entomology. 2nd Edition. Tata McGraw-Hill Publ. Co. Ltd.: New Delhi
6. Fenemore P G and Prakash Applied Entomology (New Age Publishers: New Delhi)
7. Packer, B. Aquaponics System: A Practical Guide to Building and Maintaining Your Own Backyard Aquaponics
8. Jayashree, K.V, C.S. Tharadevi & N. Aurumugam. Apiculture. Saras Publication
9. Chandra Girish. Apiculture & the Honey Bee (Know about the species of honey bees, beekeeping, pollination, beehives, entomology, beekeepers, honey making
10. Arumugam, N., T. Murugan , R. Ram Prabhu, J. Johnson Rajeshwar. Applied Zoology.Saras publication
11. Ganga & Chetty. Comprehensive Sericulture 2nd Edition Paperback. Oxford & IBH publication
12. Narasaiah, M.L. Problems and Prospects of Sericulture.Discovery Publishing Pvt.Ltd
13. Sharma, A.K., K. Jaiswal & R.N. Pandey. Research and Development in Indian Sericulture.Alfa Publications
14. Singh, R.N. & C.M. Bajpeyi. Muga Culture.APH Publishing Corporation
15. Marepally, L.Tasar Culture. Educreation Publishing
16. Bernstein , S. Aquaponic Gardening: A Step-By-Step Guide to Raising Vegetables and Fish Together New Society Publishers

SPECIALISATION I: ENTOMOLOGY AND ENVIRONMENTAL BIOLOGY**ZGIF0008: INSECTS- STRUCTURE AND FUNCTION****(4 Credits-60 hours)**

Objective: To help students learn about Insect systematics and insect biology.

Module I (20 hours)

Origin and evolution of insects; Segmentation of insect: head, thorax and abdomen; Type of mouthparts, antennae, legs, their modifications and functional significance; Wings: wing structure, venation and wing coupling; Insect flight taking *Drosophila* as a model

Module II (20 hours)

Classification of insect up to family with example : a) Coleoptera, Diptera, Hymenoptera; b) Lepidoptera, Odonata; c) Orthoptera, Hemiptera and Isoptera; Insect molecular taxonomy-DNA as a new tool for insect identification

Module III (10 hours)

Insect integument: Structure, chemical compositions, bio-composition of chitin, function of integument

Module IV (10 hours)

Receptor organ in insects (Chemoreceptors, mechano receptors and photoreceptors); Sound and Light producing organs in insects; Locomotion in insects

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the basics of insect classification of different insect orders up to family level. (Remembering)
- CO2:** Identify details of insects' morphology, origin and locomotion and the different receptor organs. (Applying)
- CO3:** Discuss the basic concepts of insect-plant interactions. (Creating)

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
2. Modern Entomology, D.B. Tembhare Himalaya Publishing House
3. Text Book of Applied Entomology Vol- I & Vol- II, K.P. Srivastava, Kalyani Publishers
4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil kumar Saxena, Astral International (P) Ltd.
5. Indian Insect Pests, H. Maxwell-Lefroy & F.M. Howlett, Astral International (P) Ltd.
6. A Handbook on Economic Entomology, Abhishek Shukla, Astral International (P) Ltd.
7. Insect Pest Management: Ecological Concepts, T.V. Sathe & Jyoti M. Oulkar, Astral International (P) Ltd.

ZGIP0009: INSECT PHYSIOLOGY**(4 Credits-60 Hours)**

Objective: To provide in-depth knowledge of insect physiology.

Module I (20 hours)

Digestive System: Different types of alimentary canal, salivary glands, physiology of digestion and absorption; **Respiratory System:** General organization of respiratory system, classification of respiratory system, respiration in terrestrial insects-different types of spiracles and their structure, opening and closing mechanism of spiracle, trachea and tracheoles, air sac, ventilation of tracheal system, mechanism of gaseous exchange, respiration in aquatic insects, physiology of gill and plastron respiration, respiration in parasitic insects; **Circulatory system:** Diaphragms and sinuses, dorsal vessels, accessory pulsatory organs, blood circulation, chemical composition of haemolymph, different types of haemocytes and their functions.

Module II (15 hours)

Nervous system: Structure and types of neurons, central nervous system basic plan, gross anatomy and microanatomy of brain and ganglion, sympathetic nervous system, nerve impulse transmission; **Excretory System:** Basic and cryptonephrial system, malpighian tubules-anatomy and histology, Accessory organs of excretion, metabolic pathways of formation of uric acid and ammonia, elimination of Uric acid by malpighian tubules; **Diapause:** Hormonal control of embryonic, larva, pupal and reproductive diapause

Module III (15 hours)

Reproductive System: male and female reproductive system, spermatogenesis, oogenesis; Hormonal control of reproduction in male and female insects; Neuroendocrine system: Neuroendocrine organs, hormones produced by neurosecretory cells, corpus allatum, corpus cardiacum and prothoracic gland, their chemical nature and functions, insect immunity; Growth and metamorphosis of insects; Insect Pheromones.

Module IV (10 hours)

Intermediary metabolism: the energy demand for insect flight, mechanism stores carbohydrate resources, proline as a fuel for flight, mobilization and use of lipid for flight energy. Insect muscle: Structure and function, attachment to exoskeleton, physiology of contraction Insect eye: Structure and function, physiology of vision.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain about the development and physiology of different systems; hormones and pheromones. (Understanding)
- CO2:** Compare the morphology of insect organ systems. (Analyzing)
- CO3:** Examine how the morphology of an organ is related to its function and how these systems help the insects to adapt to the environment. (Analyzing)

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
2. Modern Entomology, D.B. Tembhare Himalaya Publishing House
3. Text Book of Applied Entomology Vol- I & Vol- II, K.P. Srivastava, Kalyani Publishers
4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil kumar Saxena, Astral International (P) Ltd.
5. Indian Insect Pests, H. Maxwell-Lefroy & F.M. Howlett, Astral International (P) Ltd.
6. A Handbook on Economic Entomology, Abhishek Shukla, Astral International (P) Ltd.
7. Insect Pest Management: Ecological Concepts, T.V. Sathe & Jyoti M. Oulkar, Astral International (P) Ltd.

SPECIALIZATION II: CELL AND MOLECULAR BIOLOGY**ZGCB0010: CELL AND MOLECULAR BIOLOGY-I****(4 Credits-60 Hours)**

Objective: *Through course aims to provide an understanding of the structure and working of various components of the cell such as biomembranes and its role in the transport of various macromolecules, cell cytoskeleton and their role in maintaining proper cell shape and cell movement, chromosomal structure and organization, genes and gene regulation and protein hierarchical structure.*

Module I (10 hours)

Transport across cell membrane: Biomembrane, Mechanism of diffusion, Facilitated diffusion; Osmosis and water channels, movement, Flick's law, Donnan equilibrium; Uniporter-catalyzed transport, difference between uniport-catalyzed transport and passive diffusion, GLUT- 1 transport & its kinetics; Intracellular ion environment and membrane electric potential; Active transport - P-class ion pumps, F-class and V-class ion pumps and ABC superfamily, Plasma Membrane Ca⁺⁺ ATPase pump, Muscle Ca⁺⁺ ATPase pump and Na⁺/K⁺ ATPase pump; Cotransport by symporters and antiporters; Transport across epithelia, Receptor mediated endocytosis.

Module II (15 hours)

Cytoskeleton: Microfilaments: Actin cytoskeleton, G-actin and F-actin; structural and functional polarity. Cortical actin network, erythrocyte and platelet cytoskeleton; Actin bundle support projecting fingers of membrane; Dynamics of actin assembly, actin polymerization; Toxins effect on actin monomer - polymer equilibrium, stabilization of actin filaments by actin capping proteins; Movement with actin polymerization (a) Intracellular bacterial and viral movements (b) Actin polymerization at the leading edge of moving cells; Myosin: (a) Structure and mechanism of movement with actin (b) Conformational changes in myosin during movement.

Microtubules: Microtubules structure and microtubule assembly from organizing centers, Microtubule dynamics, Microtubule associated proteins (MAP's) and crosslinking of microtubules.

Microtubules and mitosis (a) Centrosome duplication (b) Kinetochore and force for poleward chromosome movement (c) Organization of spindle pole and orientation of assembly (d) Formation of poles and capture of chromosomes (e) Kinetochore and force of poleward chromosome movement (f) Astral microtubule and cytokinesis (g) Microtubules and plant cell formation.

Module III (20 hours)

Molecular structure of genes and chromosomes: Definition of gene; Chromosomal organization of genes- coding and non-coding DNA; Functional re-arrangements in chromosomal DNA; Organizing cellular DNA into chromosomes; Morphological and functional elements of eukaryotic chromosomes.

Regulation of Gene expression: Operon concept; Positive and Negative regulation; Inducers and corepressors; Regulation by attenuation-his and trp operons.

Module IV (15 hours)

Protein structure and function: Structure and chemistry of amino acids; Hierarchical structure of proteins-Secondary structure: α -helix, β -pleated sheets and bends; Prediction of secondary structure, Ramachandran plot; Tertiary structure, forces stabilizing tertiary structure; Domains and Motifs; Quarternary structure of proteins

DNA binding proteins and gene regulation: DNA binding domain; Homeodomain proteins; Zinc finger proteins; Winged-helix (Forked head) proteins; Leucine-Zipper proteins; Helix Loop helix proteins.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the structure and working of various components of the cell such as biomembrane structure and organization; genes and gene regulation and protein hierarchical structure. (Remembering)
- CO2:** Illustrate various suitable method for the functioning of cell. (Remembering)
- CO3:** Explain about the various types of protein in the cell organization. (Understanding)
- CO4:** Make use of various types of diffusion method and the Flick's law, Donnan equilibrium for explaining osmosis. (Applying)
- CO5:** Examine the positive and negative control of gene expression. (Analysing)
- CO6:** Recommend the use of Ramachandran plot for the prediction of secondary structure of protein. (Evaluating)

Suggested Readings

1. Cooper, G. M., Cell (A Molecular Approach)
2. DeRobertis & DeRobertis: Cell and Molecular Biology
3. Lodish et al: Molecular Cell Biology

4. Karp: Cell and Molecular Biology
5. Becker et al: World of Cell
6. T.A. Brown: Genome
7. Griffith et al: Modern Genetic Analysis
8. Hartl & Jones: Essential Genetics: A Genome Perspective
9. Ram Mahabal, Fundamental of Cytogenetics and Genetics
10. Lewin, Genes VIII

ZGIY0011: IMMUNOLOGY-I

(4 Credits-60 Hours)

Objective: *Through this theory paper, the course aims to provide a basic introduction to the immune system, its components, cells and organs associated with providing cellular and humoral immunity, antigen and antibody structure, monoclonal antibodies, Major histocompatibility complex, hypersensitivity and autoimmunity.*

Module I (15 hours)

Cells and organs of immune system: Hematopoiesis- B-Lymphocytes, T-lymphocytes and Null cells; Mononuclear cells (antimicrobial and cytotoxic activities, secretion of factors); Granulocytic cells (Neutrophils, Eosinophils and Basophils); Mast cells; Dendritic cells and Langerhans cells; Organs of immune system: Primary lymphoid organs (Thymus and bone marrow), Secondary lymphoid organs (Lymph nodes, spleen, mucosal associated lymphoid tissue and cutaneous associated lymphoid tissue, tonsils and Peyer's patches; Lymphatic system.

Molecular Immunology: Components of immunity; Innate (nonspecific) immunity- Anatomic barriers, Chemical barriers, Phagocytic barriers, Inflammatory barriers; Adaptive (specific) immunity- Humoral and cell-mediated immunity (CMI): (a) Recognition of antigen by B-and T-lymphocytes and antigen presenting cell (APC) (b) Clonal selection of lymphocytes; Cellular interactions required for generation of immune responses (a) Activation and proliferation of B and T cells (b) Generation of humoral immune responses (c) Generation of Cell mediated immune responses.

Module II (15 hours)

Antigens: Immunogenicity versus antigenicity; Factors that influence immunogenicity, Contribution of the immunogens (foreignness, molecular size, chemical composition and heterogeneity, susceptibility to antigen processing and presentation); Haptens and epitopes; Immunogen dosage and route of administration and adjuvants.

Immunoglobulins structure and function: Molecular structure of Ig; Immunoglobulin classes (IgG, IgM, IgE and IgD and their biological activities; Immunoglobulin - mediated effector functions (Opsonization, activation of complement, antibody dependent cell- mediated cytotoxicity , neutralization); Antigenic determinants on immunoglobulin (isotype, allotype and idiotype); Monoclonal antibodies: Formation and selection of hybrid cells, Production of monoclonal antibodies, Clinical uses of monoclonal antibodies, Catalytic monoclonal antibodies (abzymes).

Antigen - Antibody Interaction: Antibody affinity and activity; Cross reactivity; Agglutination reactions; Precipitation reaction.

Module III (20 hours)

Major Histocompatibility complex: General organization and inheritance of MHC; Location and function of MHC; MHC haplotypes; MHC molecules and gene: Structure of class I molecules; Structure of class II molecules; Organization of class I and II genes; Peptide binding by MHC molecules; Class III molecules; Regulation of MHC expression; MHC and immune responsiveness; MHC and disease susceptibility.

Antigen processing and presentation: Role of antigen presenting cell, Early evidence for the necessity of antigen processing; Cells that function in antigen presentation; Evidence for two processing and presentation pathways; Endogenous antigens (The cytosolic pathway): (a) Peptide generation by proteosomes (b) Peptide transport from the cytosol to rER (c) Assembly of peptide with class I MHC molecules; Exogenous antigens (The endocytic pathway) (a) Peptide generation in endocytic vesicles (b) Transport of class II MHC molecules to endocytic vesicles. (c) Assembly of peptide with class II MHC molecules.

Module IV (10 hours)

Hypersensitivity: Type I, II, III and IV; In vivo and in vitro

Autoimmunity: Organ specific autoimmune disease; Systemic autoimmune disease.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of immune system and its components. (Remembering)
- CO2:** Explain about the cells and organs associated with cellular and humoral immunity. (Understanding)
- CO3:** Make use of monoclonal antibody for various diseases. (Applying)
- CO4:** Analyze the antigen-antibody reactions. (Analyzing)
- CO5:** Recommend the list of various agents responsible for hypersensitivity reaction. (Evaluating)
- CO6:** Develop a network of various components and complexes of immune system and make a checklist of organ specific and systemic autoimmune diseases. (Creating)

Suggested Readings

1. Kuby et al.: Kuby Immunology
2. Abbas A.K., Lichtman A.K. and Pober J.S. Cellular and Molecular Immunology
3. Roitt et al.; Essential Immunology
4. Price C.P., Newman D.J., Principles and Practices of Immunology
5. Kindt T.J., Osborne B.A., Goldsby R., Immunology

SPECIALIZATION III: FISHERY SCIENCE

ZGTF0012: TAXONOMY AND FUNCTIONAL ANATOMY

(4 Credits- 60 Hours)

Objective: To provide knowledge on Fish taxonomy and functional biology.

Module I (10 hours)

Fin fish taxonomy: General characters and classification, major fish groups (extant & extinct), phylogeny of fishes; Gross external anatomy of fishes: skin and its derivatives, scales and their significance; Significance of fish osteology in taxonomy, Fish barcoding

Module II (30 hours)

Fin fish functional biology: Food and feeding habits: Food– Kinds and varieties, abundance of food and its availability, structural adaptation, search for food, classification based on food and feeding habits; respiratory organs in fishes– Modification of gills and Tracheae in relation to habit – Structural adaptations of air breathing fishes; Age and growth: Growth, length weight relationships, condition factors, morphometric indices and bioenergetics index, variation in growth rate, age determination; Modes of reproduction, reproductive cycle, gonad maturity stages, Hormonal regulation of gonadal development, activity of Gonadotropin-releasing hormone, modes of spawning; Environmental factors controlling reproduction and factors affecting development.

Module III (20 hours)

Shell fish taxonomy and functional anatomy: General characters of crustaceans and mollusks; Food, feeding habits and adaptations of cultured prawn and shrimps; Food, feeding habits and adaptations of cultured Mollusks; Reproductive patterns in prawn and shrimp, reproductive organs, gonad maturity, spawning and fertilization; Endocrine organs in crustaceans and their role in reproduction; Reproductive patterns in Molluscs, reproductive organs, gonad maturity, spawning and fertilization

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Demonstrate the knowledge of non-piscine fishery resources and their importance in fisheries. (Understanding)
- CO2:** Apply the knowledge of fish biology and its importance in fishery practices for the development of future entrepreneurship. (Applying)
- CO3:** Develop fundamental skill to identify and classify various groups of fishes, their relationship with morpho-anatomical and molecular techniques. (Applying)

Suggested Readings

1. Barrington, F.J.W. Invertebrates: Structure and Functions. EIBS.
2. Carl, B.E. Biology of Fishes. Saunders,
3. Fretter, V. & A. Graham. The functional anatomy of vertebrates. Academic Press Inc. (Lon.) Ltd.
4. Kaestner, A. Invertebrate Zoology. Vol. I – III, John Wiley & Sons
5. Kurian, C.V. & V.O. Sabastian. Prawns and Prawn Fisheries of India.
6. Lagler, K.E. et. Al. Ichthyology. John Wiley,
7. Low, M.S. & G.M. Calliet (eds.). Readings in Ichthyology. Prentice Hall,
8. Moyle Peterb, Fishes : An Introduction to Ichthyology. Prentice Hall.
9. Nikolsky, G.V. Ecology of Fishes. Academic Press, NY Howar, W.S. & D.J. Randal. Fish Physiology, Vols. 1–4, Academic Press, NY
10. Norman, J.R. & P.H. Greenwood. A History of Fishes, Ernest Benn Ltd.
11. Jayaram K. C. The fresh water fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka.
12. Jhingran V. G. Fish and Fisheries of India.
13. Lagler, K.F. Ichthyology. John Wiley Publication
14. Norman, J.R. & P.H. Green Wood. A history of fishes.
15. Bond, E. Carl. Biology of fishes.
16. Kumar S and Thembre M Anatomy and Physiology of Fishes (Vikas Publishing House)
17. Love, M.S. & Cailiet, G.M. Readings in Ichthyology. Prentice Hall Publications.
18. Srivastava, C.B.L. Textbook of Fishery Science and Indian Fisheries. KutubMahal
19. Khanna S. S. and H. R. Singh. A textbook of Fish Biology and Fisheries, Narendra Publishing House
20. Beaven C R. Handbook of the freshwater fishes of India (Narendra Publishing House)
21. Biswas K P A Text Book of Fish, Fisheries and Technology, (Narendra Publishing House)
22. Brown E and Margret 1957 Physiology of Fishes Vol I & II (Academic Press, Inc. Publishers)
23. Daniels R J R Freshwater fishes of Peninsular India (Universities press)
24. Kumar S and Thembre M Anatomy and Physiology of Fishes (Vikas Publishing House)
25. Bond, E. Carl. Biology of fishes.
26. Brown E and Margret Physiology of Fishes Vol I & II (Academic Press, Inc. Publishers)
27. Lagler, K.F. Ichthyology. John Wiley Publication
28. Love, M.S. & Cailiet, G.M. Readings in Ichthyology. Prentice Hall Publications, 1979.
29. Norman, J.R. & P.H. Green Wood. A history of fishes.
30. Pandey. Fish and Fisheries. Rastogi Publications

ZGAF0013: AQUACULTURE AND FISH GENETICS**(4 Credits-60 Hours)**

Objective: This course is designed to provide in depth knowledge of Aquaculture management and to develop theoretical knowledge on Fishery Genetics and Fish Biotechnology

Module I (15 hours)

Fishery Management: Construction of fish farm and reclamation of swamps; Selection of species for culture – Biological principles, Preparation and management of nursery ponds, rearing ponds and stocking ponds along with control of weeds, pests and predators, Construction of hatcheries and their management.

Aquaculture Management: Feed, health and water quality management.

Module II (15 hours)

Freshwater fish culture : Indian Major carps and exotic carps - Composite Fish Culture; Air breathing fishes; Integrated Fish Farming – Paddy cum Fish Culture and Fish cum Livestock Culture, Monoculture, Monosex culture; Sewage fed fisheries, Catfish culture, Trout culture.

Freshwater prawn culture; shrimps and Crab culture; cage culture and pen culture, Lobster culture, Mussel culture; Pearl oyster culture; Edible oyster culture

Module III (15 hours)

Fish nutrition: Nutritional requirements, formulation and preparation of fish feeds Food & Feeding habits of commercially important fishes. Larval nutrition — Importance of live feed and artificial feed, Different types of feed available for larvae.

Fish seed resources: Procurement and transportation of seed from natural resources.

Module IV (15 hours)

Fishery Genetics and Biotechnology: Inheritance in fishes, sex determination, hybridization

Cytogenetics and molecular techniques in fisheries: Comet Assay, Micronuclei Test, Fish Cell Culture, Application of biotechnological tools: Recombinant DNA, Trans genesis and Andro genesis Cell lines and cell culture; production of monoclonal antibodies. Jellyfish Green Fluorescent Proteins and their applications, Cryopreservation

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Compare various freshwater fish culture methodologies and their significance. (Understanding)
- CO2:** Utilize the knowledge on the process of fishery and aquaculture management for development of future entrepreneurship. (Applying)
- CO3:** Utilize the knowledge of nutritional requirement in fishery and development of skill on fish feed formulation for a profitable fish farming system. (Applying)
- CO4:** Apply the knowledge of the application of modern biotechnological tools and their role in the development of fishery. (Applying)

Suggested Readings

1. Arumugam, N. Aquaculture & Fisheries, Saras Publication
2. Bardach, J.E., Ryther, J.H. and McLarney, W.O. Aquaculture. John Wiley & Sons Inc., USA.
3. Beaven C R Handbook of the freshwater fishes of India (Narendra Publishing House)
4. Boris, Gomelsky. Fish Genetics.VDMVerlag
5. C.I.F.R.I., Prawn Fisheries Bulletin

6. Chakroff, M., Freshwater Fish Pond Culture and Management, Scientific Publishers
7. Christenson, K. Aquaculture: Introduction to Aquaculture for Small Farmers. Createspace Independent Publishing Platform
8. Daniels R J R Freshwater fishes of Peninsular India (Universities press)
9. Dholakia, A.D. Identification of Prawns/Shrimps of India and Their Culture. Daya Publishing House
10. Elizabeth Gosling. Bivalve Molluscs: Biology, Ecology and Culture Wiley-Blackwell
11. Ghosh, S., Palanisamy, K. and Pathak, S.C. Shrimp and Freshwater Hatchery Public Relations Division, National Bank for Agriculture and Rural Development, Bombay.
12. Gray, Camillo W. Guide to Shrimp and Prawn Culture in Bangladesh. University of Stirling Institute of Aquaculture
13. Gupta S.K., Gupta P.C. General & Applied Ichthyology. S Chand & Company
14. Hall, C. B., Ponds and Fish Culture, Agro Botanical Publishers
15. Harvey, B. J. and Hoar, W. S.. Theory and practice of induced breeding in fishes.
16. Hora, S. L. and Pillay, T.V. R. Handbook on Fish Culture in the Indo-Pacific Region, Fisheries Division, Biology Branch, FAO,
17. Huet, M., Textbook of Fish Culture, Breeding and Cultivation of Fish, Fishing News (Books) Ltd..
18. CAR. Handbook of Fisheries and Aquaculture Reddy,
19. M.S. A Text Book of Aquaculture, Discovery Publishing Pvt. Ltd
20. Jhingran V. G. Fish and Fisheries of India.
21. Kolappan Nisha. Identification of Genetic Relation Between Fish Species Using Sds-Page. ambert Academic Publishing
22. Kurian, C.V. and Sebastian, V.O. Prawns and prawn Fishery of India. Hindustan Publishing Corporation (India), New Delhi.
23. Lakra W. S., Abidi SAH, Mukherjee SC and Ayyappan S. 2004. Fisheries Biotechnology.
24. Lucas, J.S. Aquaculture: Farming aquatic animals and plants (Fishing News Books)
25. MackLenzie, Simon A. Genomics in Aquaculture Academic Press
26. Michael Bernard New(Editor), Wagner Cotron iValenti(Editor), James H. Tidwell(Editor). Freshwater Prawns: Biology and Farming Wiley-Blackwell
27. Mikhalev, Viktor. Genetics and Fish Breeding. Arcler
28. Nigel Preston(Editor), Dean R. Jerry(Editor) Biology and Culture of Farmed Marine Shrimps. CRC Press
29. Pandian, T.J. (Editor), C.A. Strüssmann (Editor), M.P. Marian (Editor). Fish Genetics and Aquaculture Biotechnology. CRC Press
30. Pandian, T.J. Genetic Sex Differentiation in Fish. CRC Press
31. Pillay, T. V. R.. 1993. Aquaculture – Principles and Practices. Fishing News Book.
32. Pillay, T.V.R. and M.N. Kutty, Aquaculture: Principles and Practices. Wiley India Pvt Ltd; Second edition
33. Rao, K. L. 1975. India's water wealth.
34. Rath, R.K. Freshwater Aquaculture Scientific Publishers Journals Dept
35. Ravishankar Piska, 1999. Fisheries and Aquaculture. Lahari Publications, Hyderabad.
36. Santhanam R. Fisheries Science, Daya Publishing House, 1990.
37. Selvamani B.R & Mahadevan R.K 2008 Freshwater fish farming (Campus Books International)
38. Singh, B. & A. Dey. Fish and Fisheries. Invincible Publishers
39. Singh, N.P. & B. Santosh. Handbook of freshwater aquaculture. New India Publishing Agency
40. Turner, Bruce. Evolutionary Genetics of Fishes (Monographs in Evolutionary Biology). Springer

SPECIALIZATION IV: ANIMAL ECOLOGY AND WILDLIFE BIOLOGY**ZGEB0014: ANIMAL ECOLOGY AND BIOGEOGRAPHY****(4 Credits-60 Hours)****Objective:** *To develop an understanding of the theoretical perspectives of Ecology and Biogeography***Module I: Basic Ecological concept (15 hours)**

- Habitat & Niche, Ecological Versatility & Niche dimension,
- Competitive displacement: Gause's principle of Competitive Exclusion, Predator-Prey relation: Lotka Volterra Model of Interspecific Competition, Ecological equivalents,
- Species diversity, Species richness, Global patterns in species richness, Theories of species richness, Invasive species and its effect on species richness.
- Ecosystem model

Module II Habitat and landscape ecology (25 hours)

- Introduction to Habitat Ecology:** Ecology of major habitats- Grasslands, Wetlands, Forests. Physical and anthropogenic factors influencing habitats.
- Introduction to Landscape Ecology:** Edge, ecotones, Edge effect interspersed and juxtaposition. Habitat fragmentation and its effect on resident community.
- Meta population concept and its application in designing Nature reserve; Theory of Island Biogeography.
- Measuring Wildlife habitat:** Inventory, evaluation and monitoring of wildlife habitat - availability, quality, palatability of graze and browse. Inventory of unique habitats, their distribution and need for conservation, Animals signs as indicators of habitat use.

Module III: Principles of Biogeography (10 hours)

History of biogeography. Ecology of dispersal and faunal exchange, barriers, mode of dispersal, origins and radiation; island biogeography: endemism, refugia. Continental drift; dispersal and vicariance biogeography; dispersal mechanisms and dispersal barriers.

Module IV: Indian biogeography (10 hours)

India's biogeographic classification. Case studies of Indian fauna explaining Biogeographic Theories. Biogeographic affinities of the fauna and flora of the Indian sub-continent.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define basic ecological concepts and have a deep understanding of the theories of ecology. (Remembering)
- CO2:** Explain the concepts of landscape ecology, its importance in designing protected areas, reasons of difference in species diversity across different habitats, role of human in fragmenting habitats of wildlife. (Understanding)
- CO3:** Examine the quality of Wildlife habitat, document and monitor different biodiversity around themselves. (Analysing)
- CO4:** Identify different types of animal signs through animal mark and sign analysis. (Applying)
- CO5:** Outline the different theories and processes of Biogeography, dispersal of species and barriers to their dispersal and Case studies which would provide them a deep insight to Indian biogeography. (Understanding)

Suggested Readings

1. Smith TM and Smith RL (2012). Element of Ecology (9th edition). Pearson Publication
2. Begon M, Townsend CR and Harper JL (2006). Ecology From individuals to Ecosystems (4th edition). Blackwell Publishing
3. Ricklefs RE and Miller GL (1999). Ecology (4th edition). WH Freeman Publication
4. Mani MS (1974). Ecology and Biogeography in India. Springer Netherlands
5. Cox CB, Moore PD and Ladle R (2010). Biogeography: An Ecological and Evolutionary Approach (9th Edition). Wiley-Blackwell.
6. Huggett RJ (2004). Fundamentals of Biogeography (2nd edition). Routledge London and New York
7. Ladle R and Whittaker RJ (2011). Conservation Biogeography. Wiley Blackwell
8. MacArthur RH (1984). Geographical Ecology: Patterns in the Distribution of Species. Princeton University Press.
9. MacArthur RH and Wilson EO (2001). The Theory of Island Biogeography. Princeton University Press.
10. Mayr E (1969). Principles of Systematic Zoology. Tata McGraw Hill Publ. Co.
11. Mayr E and Ashlock PD (1991). Principles of Systematic Zoology. McGraw Hill International Edition.
12. Simpson GG (1961). Principles of Animal Taxonomy. Columbia University Press.

ZGWM0015: WILDLIFE CONSERVATION AND MANAGEMENT**(4 Credits-60 Hours)**

Objective: *The basic objective of the course is to give the students a sound understanding of the wildlife conservation and management.*

Module I: Conservation Biology (20 hours)

- a) **Introduction to conservation biology:** values of biodiversity and conservation ethics, Patterns and process of biodiversity, losses and threats to biodiversity. Geological and present extinctions, changes in species composition and problem of climate change.
- b) **Strategies for conservation –**
 - **In situ conservation:** International efforts and Indian initiatives; protected areas in India – sanctuaries, national parks, biosphere reserves, sacred groove and Community Reserve. Ecological restoration and its significance
 - **Ex situ conservation :** Principles and practices; botanical gardens, fields gene banks, seed banks, cryobanks; non-formal conservation efforts.

Module II: Wildlife Management (25 hours)

- a) Principles and practices of wildlife management; Management of special habitats: riparian zones, Grasslands, wetlands.
- b) Species conservation projects: Tiger, Lion, Rhino, Crocodile, Turtle, Adjutant stork.
- c) Management plan for Protected Areas: Principles of planning, objectives, resource surveys, analysis of surrounding region, management zones, theme plans, communications, staff and visitor amenities, monitoring. Financing protected areas; Need for wildlife management planning

Module III: Plant diversity and Phyto resources (15 hours)

- a) Plant Biodiversity: Concept, status in India, utilization and concerns.
- b) Forest products: Important timber yielding planting. Timber types,
- c) Non Timber forest products

- d) Plants used as avenue trees for shade, pollution control and aesthetics.
- e) Threatened plants of India with special reference to NE India

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Relate different principles and practices of wildlife management. (Understanding)
- CO2:** Explain about different plant diversity, phytoresource utilization and their importance, threatened plants of India with respect to Northeast India. (Understanding)
- CO3:** Make use the concepts of conservation biology, different types of practices and approaches in wildlife and its habitat conservation in conservation work. (Applying)
- CO4:** Apply role of biology in wildlife management. (Applying)
- CO5:** Analyze the importance of Species Conservation project with reference to the present scenario of conservation in India. (Analyzing)
- CO6:** Recommend better plans for habitat management in context to wildlife conservation. (Evaluating)

Suggested Readings

1. Hillis DM (1996) (ed). Molecular Systematics. Sinauer Publ Inc. Dash, M. Fundamentals of Ecology. Tata McGraw Hill
2. Gopal, R. Wildlife Management, Allied International
3. Saharia, V. Wildlife conservation
4. Primack- Essentials of Conservation Biology
5. Dyke- Conservation Biology- Foundation, Concepts , Applications
6. Primack- A primer of Conservation Biology
7. Singh- Textbook of Wildlife Management
8. Bailey- Principles of Wildlife Mangement
9. Krausman and Cain- Wildlife Management and Conservation
10. B.B. Dutta- A handbook of Plant Resource Utilization and Conservation
11. Kibue- Wildlife Conservation and Utilization
12. Trivedi and Sharma- Plant Resource Utilization and Conservation

ZGAZ0016: APPLIED ZOOLOGY II

(4 Credits- 60 hours)

Objective: The course is designed to provide knowledge on parasitology with special reference to emerging viral diseases, Pest management, Poultry rearing and Biodiversity

Module I: Parasitology (20 hours)

Parasitism and types of parasites, primary and secondary hosts, transmission of parasitic infection. Host- parasitic interactions – parasitic effects benefiting the parasites, parasitic effects benefiting the host. *Vibrio cholera* and *Clostridium titani*- Life cycle, mode of transmission, infection and treatment. Influenza, Dengue, Bird flu - Life cycle, mode of transmission, infection and treatment. Toxins and antitoxins, Identification characters, life cycle, pathogenecity and control of *Taenia solium* and *Ancylostoma duodenale*

Module II: Insect pest management, Public Health and Forensic Entomology (10 hours)

Concept of Pest, concept of integrated pest management (IPM) Mosquito (*Aedes*, *Culex*, *Anopheles*), Housefly- Taxonomy, Biology, Behavior and their control.

Life cycle of Calliphora and Scrophaga, determination of death and causes of death.

Module III: Poultry management (8 hours)

Poultry Rearing / Farming: Housing and equipment; Nutritional Requirements; Poultry diseases
Poultry products: Broilers, meat processing and meat products; Egg structure and quality, factors affecting size and egg processing; Poultry by products

Module IV: Biodiversity (12 hours)

Components of Biodiversity (Genetic, Organismal and Ecological), Value of Biodiversity, threats to biodiversity, biodiversity conservation, Mega biodiversity countries, hot spots and heritage sites, Threats to biodiversity. IUCN Red list categories. Habitat diversity of Indian wildlife, endemic and threatened species of northeast India Ethnozoology with special reference to Northeast India Vermiculture: species of worms, condition for efficient vermiculture (domestic and commercial level), Economics of Vermiculture

Suggested Readings

1. Venkitaraman: Economic Zoology, Sudarsana Publishers
2. Srivastava : A Text Book of Applied Entomology, Vol. II & II.I Kalyani Publishers
3. Shukla & Upadhyaya : Economic Zoology. Rastogi Publishers.
4. Ananthkrishnan, T. N.and K.G. Shivaramkrishnan. Ecological entomology: Insect life in odd environment. Scientific Pub.: India
5. David, B.VandT.N. Ananthkrishnan. General and Applied Entomology. Tata McGraw-Hill Publ. Co. Ltd.: New Delhi
6. Dent, D. R.Insect pest management. Westville Publishing House: Delhi
7. Eldridge B Medical entomology (Springer)
8. Fenemore P G and Prakash Applied Entomology (New Age Publishers: New Delhi)
9. Madigan, M. T., J. M. Martinko and J. Parker Brock Biology of Microorganisms (Ed. IX).Prentice Hall International Publication.
10. Kreier, J.P and J.R. Baker.Parasitic Protozoa. Allen and Unwin Press.
11. Kathering ,M.G. A. James paul and V. Zaman. Churchill Livingstone. Medical and Veterinary Protozoology
12. Asa C. Chandler, (7th ed.), Introduction to Parasitology, With Special Reference to the Parasites of Man, New York: Wiley
13. Despommier, Gwadz, Hotez, Knirsch: Parasitic Diseases (5th Ed). Apple Trees Productions, LLC.
14. Stephen A. Berger, John Marr, Human Parasitic Diseases Sourcebook, Jones & Bartlett Learning
15. D Molyneux, Advances in Parasitology- Control of Human Parasitic Diseases, (1st Ed).Academic Press.
16. Jeremy Farrar & Peter Hotez& Thomas Junghanss &Gagandeep Kang & David Laloo & Nicholas J. White. Manson's Tropical Diseases, (23rd Ed).Elsevier publication.
17. Howes, H. Modern Poultry Management. read Books
18. Jadhav & Siddiqui .Handbook of Poultry Production and Management. Jaypee Publications
19. Maiti, P.K. & P. Maiti. Biodiversity: Perception, Peril and Preservation. PHI Learning Private Limited
20. Bharucha, E.The Bio-Diversity of IndiaHardcover. Grantha Corporation
21. Krishnamurthy. An Advanced Textbook On Biodiversity : Principles and Practice. Oxford & IBH Publishing
22. Johns, J. Worm Farming - Creating Compost at Home With Vermiculture. Createspace Independent Pub
23. NPCS Board of Consultants & Engineers. The Complete Technology Book on Vermiculture and Vermicompost
24. ICAR. Handbook of Integrated Pest Management (IPM) Pub: ICAR, Govt. of India
25. Metcalf, R W.H.Luckmann. Introduction To Insect Pest Management. Wiley India Pvt Ltd

SPECIALISATION I: ENTOMOLOGY AND ENVIRONMENTAL BIOLOGY**ZGIG0017: INSECT ECOLOGY****(4 Credits-60 Hours)**

Objective: At the end of the course student will develop understanding of Insect diversity and behavior.

Module I (16 hours)

Dynamics of insect life system-determinants of insect abundance, population change, birth rate, Death rate, movements; Effect of environment on insect development-effect of flight, temperature & humidity, Regulation of insect populations, resistance of insect population to pest management; Basic concept of surveillance and sampling of insect

Module II (10 hours)

Dominance of insect-cause of success; Adaptation of insect- aquatic, terrestrial, soil, boring wood

Module III (12 hours)

Insect biodiversity, threats to insect biodiversity, impact of climate change on insect communities; Natural history of dragonfly, leaf insect, hawkmoth, milkweed butterfly, sal stem borer, golden beetle.

Insect plant interaction, Plant resistance to insects/Parallel evolution of Insect and angiosperm, Pollination Biology with special reference to Bees

Module IV (22 hours)

Insect behavior: chemotropism, thigmotropism, hydrotropism, rheotropism, anemotropism, phototropism, thermotropism, geotropism, instinct. Protective behavior: mimicry crypsis, warning coloration. Behavioural defence, chemical defence; Breeding behavior; Insect association: Passive insect association, active association, aestivating aggregation, protective aggregation, swarming aggregation, sleeping aggregation, dissociation, social aggregations.

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
2. Modern Entomology, D.B. Tembhare Himalaya Publishing House
3. Text Book of Applied Entomology Vol- I & Vol- II, K.P. Srivastava, Kalyani Publishers
4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushilkumar Saxena, Astral International (P) Ltd.
5. Indian Insect Pests, H. Maxwell-Lefroy & F.M. Howlett, Astral International (P) Ltd.
6. A Handbook on Economic Entomology, Abhishek Shukla, Astral International (P) Ltd.
7. Insect Pest Management: Ecological Concepts, T.V. Sathe & Jyoti M. Oulkar, Astral International (P) Ltd.

ZGPM0018: PRINCIPLES OF PEST MANAGEMENT**(4 Credits-60 Hours)**

Objective: To develop understanding of theoretical perspective of insect pest control and management

Module I (23 hours)

Concept of pest and pest status, kinds of pest; House hold pest: Cockroach, Lepisma, bedbug, their life history and control; Stored grain pest: Sitophilus oryzae, Tribolium castaneum, Trogodermagranarium, Sitotrogace rellela, Callobruchus chinensis, life history and control; Major pest of rice vegetables, tea, jute and pulses- classification upto family, life history, nature and damage control (two each);

Forest insects: defoliators, borers and suckers of teak, sal and gamari classification upto family, life history and control (two each), Insect damage and sign categories of forest insects.

Module II (12 hours)

Pest management: Economic decision level for pest population- Concept of economic injury level, economic threshold, crop susceptibility to injury, Pre insecticide era, insecticide era, concept of pest management.

Module III (25 hours)

Primary control measure: Physical, mechanical, traditional and legislative measure. Chemical control: concept of LD 50 and LC 50, Classification and mode of action of important insecticides, Insecticide toxicity to humans, drawbacks of chemical control, Insect resistance to pesticides, Fumigants application and operation precautions, insecticide law and regulations. Pheromonal control.

Biological and genetic control: Use of parasites, parasitoids, predators and pathogenic organisms, sterile insect techniques, lethal mutations, inherited sterility, cytoplasmic incompatibility; Integrated Pest Management and a case study

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Illustrate the classification and life histories of the important household and agricultural and forest pest. (Understanding)
- CO2:** Apply the latest knowledge of pesticides application equipment. (Applying)
- CO3:** Determine latest concepts of the principles of biological control, rearing, screening, and conservation of natural enemies and their problems in biological control. (Evaluating)

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
2. Modern Entomology, D.B. Tembhare Himalaya Publishing House
3. Text Book of Applied Entomology Vol- I & Vol- II, K.P. Srivastava, Kalyani Publishers
4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil Kumar Saxena, Astral International (P) Ltd.
5. Indian Insect Pests, H. Maxwell-Lefroy & F.M. Howlett, Astral International (P) Ltd.
6. A Handbook on Economic Entomology, Abhishek Shukla, Astral International (P) Ltd.
7. Insect Pest Management: Ecological Concepts, T.V. Sathe & Jyoti M. Oulkar, Astral International (P) Ltd.
8. Indian Pest Aphids, T.V. Sathe & B.V. Jadhav, Astral International (P) Ltd.
9. Insect Pest Predators, T.V. Sathe & Y.A. Bhosale, Astral International (P) Ltd.
10. Insect Predators and Pest Management, Vaishali J. Patil & T.V. Sathe, Astral International (P) Ltd.
11. Insect in Vegetables, Dharmo K. Butani & M.G. Jotwani, Astral International (P) Ltd.

SPECIALIZATION II: CELL AND MOLECULAR BIOLOGY

ZGMB0019: CELL AND MOLECULAR BIOLOGY-II

(4 Credits-60 Hours)

Objective: *This course aims to provide understanding of cell adhesion molecules and their role in cell junctions, various cell signaling methods, intracellular protein traffic, cell cycle, cell death, aging and cancer, and cytogenetic analysis.*

Module I (15 hours)

Cell-Cell Signaling: Endocrine, paracrine and autocrine signaling; Receptor Proteins- Cell Surface receptors and intracellular receptors; Cell Surface receptors-G-protein coupled receptors, ion channel receptors, tyrosine kinase-linked receptors and receptors with intrinsic enzymatic Activity; Second messenger System - cAMP and IP₃, DAG; MAP kinase cascade, JAK/STAT and TGF- β / Smad signaling, NF- κ B signaling; Signaling from plasma membrane to nucleus (a) CREB links cAMP signals to transcription (b) MAP kinase. Wnt pathway, Hedgehog pathway and Notch pathway

Module II (10 hours)

Protein sorting and targeting to organelles: Protein traffic through the endomembrane system; Targeting of proteins to the Rough Endoplasmic Reticulum and Golgi complex; Anterograde and retrograde transport; Signal-mediated protein transport to organelles (a) Nucleus (b) Mitochondria (c) Peroxisome

Module III (10 hours)

Genetic analysis in Cell Biology: Mutation: type and causes; Isolation and analysis of mutants; Physical and Genetic mapping of mutations; Molecular cloning of genes defined by mutations.

Module IV (15 hours)

Cell Cycle: Bacterial cell cycle (Helmstetier - Cooper or I+C+D model); Partition and cytokinesis; Eukaryotic cell cycle – G₁, S, G₂ and M phases; Cell cycle check points; Molecular basis of cell cycle regulation(a) Cyclins and cyclin - dependent kinases(b) Regulation of CDK cyclin activity.

Cell Death: Apoptosis and necrosis; Apoptosis-its characteristics; Genes involved in apoptosis.

Module V (10 hours)

Aging, the biology of senescence: Maximum life span and life expectancy; Causes of aging: (a) General wear and tear and genetic instability (b) Free radicals, oxidative damage and antioxidants (c) Telomerases and aging.

Cancer: Tumor cells and onset of cancer; Proto-oncogenesis and tumor suppressor genes; Mutation causing loss of cell cycle; Mutations affecting genuine stability.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the cell adhesion molecules and their role in cell junctions. (Remembering)
- CO2:** Explain various methods of cell death. (Remembering)
- CO3:** Classify the various cell signaling methods. (Understanding)
- CO4:** Make use of various theory of aging for understanding its process. (Applying)
- CO5:** Analyze the genetics and physical mapping of mutation. (Analyzing)
- CO6:** Estimate the effect of Cyclins and cyclin - dependent kinases in cell cycle regulation. (Evaluating)
- CO7:** Testing the characteristics of various types of tumor in the development of cancer. (Creating)

Suggested Readings

1. Cooper, G.M., Cell (A Molecular Approach)
2. Sadava, D.E., Cell Biology
3. Karp, G., Cell and Molecular Approach
4. Kish, V.M. and Kleinsmith L.J., Cell and Molecular Biology
5. Gardener, Principles of Genetics
6. Strickberger, Genetics
7. Ram mahabal, Fundamental of Cytogenetics and Genetics

ZGIM0020: IMMUNOLOGY II**(4 Credits-60 Hours)**

Objective: *This course aims to provide a detailed understanding of the organization and expression of the immunoglobulin genes, functional significance of cytokines, immune responses to various infectious diseases, immunodeficiencies and immunization techniques, transplantation and tumour immunology.*

Module I (20 hours)

Organization and expression of Ig genes: Multigene organization of Ig genes; Light-chain multigene family; Heavy chain multigene family; Variable region gene rearrangement, V-J rearrangements in light chain DNA, V-D-J rearrangements in heavy chain DNA, Mechanism of gene rearrangement, Allelic exclusion; Generation of antibody diversity, Multiple germ line V, D and J gene segments; Combinatorial V-J and V-D-J joining; Junctional diversity; Association of heavy and light chain; Expression of Ig genes, Differential RNA processing of heavy chain primary transcripts, Expression of membrane secreted Ig, Simultaneous assembly and secretion of IgM and IgD, Synthesis, assembly and secretion of Ig; Class switching of constant regions

Module II (15 hours)

Cytokines: Properties of cytokines, General structure of cytokines, Function of cytokines, Cytokines related diseases, Bacterial septic shock, Bacterial toxic shock and similar diseases, Lymphoid and myeloid cancers, Chagas disease

Immune system in health and disease: Immune response to infectious disease; Viral infections (a) Viral neutralization by humoral antibody (b) Cell - mediated antiviral mechanism (c) Viral evasion of host defense mechanisms; Bacterial infections (a) Immune responses to extra cellular and intracellular bacteria (b) Bacterial evasion of host defense mechanism; Protozoan diseases; Diseases caused by helminthes.

Module III (15 hours)

Vaccines: Active and passive immunization; Designing vaccines for active immunization; Whole organism vaccine (a) Attenuated viral or bacterial vaccines (b) Inactivated viral or bacterial vaccines; Polysaccharide vaccines; Recombinant vector vaccines; DNA vaccines; Synthetic peptide vaccines; Multivalent peptide vaccines

Immunodeficiencies: Primary and Secondary Immunodeficiencies, lymphoid and myeloid lineage; AIDS: Structure and types, genome organization, replication, opportunistic agents and therapeutic agents

Module IV (10 hours)

Tumor immunology: Tumor antigen; Tumor evasion; Immune system against tumors; Therapies.

Transplantation immunology: Acute, hyperacute and chronic rejection; Tissue matching (HLA typing); Graft Vs host (GVH) reaction; Xenotransplantation; Immunosuppressive drugs; role of monoclonal antibodies in transplantation.

Suggested Readings

1. Kindt, T.J., Osborne, B.A., Kuby, J., Kuby Immunology
2. Kasper, D.I., Fauci, A.S., Harrison's Infectious Diseases
3. Abbas, A.K., Lichtman, A.H.H., Pillai, S., Cellular and Molecular Immunology
4. Sell, S., Berkower, I., Immunology and Immunopathology and Immunity

SPECIALIZATION III: FISHERY SCIENCE**ZGCP0021: CAPTURE FISHERY AND POST-HARVEST TECHNOLOGY****(4 Credits-60 Hours)**

Objective: *The students will learn about River systems and their fishery, Marine fishery, Fish yield and preservation, processing and marketing of fishes and their by products*

Module I (20 hours)

Capture fishery: Fish catch statistics of the world special reference to India; Riverine Fisheries River Systems in India, their ecology and fisheries (Ganga & Brahmaputra); Reservoir Fisheries: Development, Exploitation and management of Reservoirs with special reference to India—Dams and their effect On fish migration; Beel fisheries of Assam: Fish resources, problems and management; Marine fisheries of commercial importance; Coastal fisheries of India (Sardine & Mackerel fisheries)

Module II (10 hours)

Cold water fisheries: Hill stream fisheries of North East India; Mahseer fisheries: prospects and problems with special reference to NE India; Major Estuaries of India and their fisheries; Brackish water Fisheries: Chilka lake. Hilsa fishery—causes of decline and efforts for revival;

Module III (10 hours)

Craft and Gear used in Fisheries: Traditional and mechanized boats and nets used in catching fish; Population Dynamics: Fish populations and factors affecting the population structures; Estimation of fish yield and control of overfishing, Yield and optimum catch; Fishing crafts and gears used in Inland capture fisheries; Destructive fishing— its impact on fish diversity.

Fish oils, Fish Proteins, Fish manure, Fish glue, Fish flour, Isinglass, Fishmeal, Fish Silage, Fish guano, Bone meal; Production of fish sauce by lactic acid fermentation.

Module IV (20 hours)

Post-harvest technology and fish by-products: Preservation and processing: Methods of preservation Of both fin fish and shell fish preservation (Refrigeration and freezing, Drying, Salting, Smoking, Canning, Pickling, pasting and spicing) and associated problems; Rigor mortis and post-mortem changes. handling and packaging of fish for marketing; product stability and shelf-life. Fish By-products:

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Explain about the capture fishery resources of the country and the managerial practices for sustainable utilization of these aquatic resources. (Understanding)
- CO2:** Develop the knowledge of cold water fishery resources of the country and their applicability in the development of future entrepreneurs in fishery sector of the region. (Applying)
- CO3:** Explain about the various fishing gears and crafts used in various water bodies of the country. (Evaluating)
- CO4:** Develop new idea on the development of efficient fishing tools and the skill to predict the possible fish stock in the water bodies and management for sustainable utilization of the resources. (Creating)
- CO4:** Develop the skill of fish preservation and processing for long term utilization. (Creating)

Suggested Readings

1. Bal, D.V. and Veerabhadra Rao, K. Marine Fisheries. IBH Publications
2. Balakrishnan, N. N. and Thampy, D. M.A textbook of marine ecology.

3. Beaven C R Handbook of the freshwater fishes of India (Narendra Publishing House)
4. Biswas K P A Text Book of Fish, Fisheries and Technology, (Narendra Publishing House)
5. Brody , Fishery by-products technology,, AVI, Westport
6. Chandy, M. Fishes, National Book Trust, India;
7. EIRI Board.Hand Book Of Fish Farming & Fishery Products
8. Gopakumar, K., Singh, B.N. and Chitranshi, V.R. Fifty Years of Fisheries Research in India, Fisheries Division Indian Council of Agricultural Research, New Delhi.
9. Gupta S.K., Gupta P.C .General & Applied Ichthyology.S Chand & Company
10. Jayaram K. C. The fresh water fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka.
11. Jhingran V. G. Fish and Fisheries of India.
12. Jobling M Environmental Biology of Fishes (Chapmen and Hall)
13. Khanna S. S. and H. R. Singh. A textbook of Fish Biology and Fisheries, Narendra Publishing House,
14. Kreuzer, R., Fishery products., FAO, Fishing News Books Ltd., England
15. Krishnaveni, G., N.VeerabhadraRao and K.Veeranjaneyulu Recent Technologies in Fish and Fisheries. Rigi Publication
16. Lagler, K.F. Ichthyology. John Wiley Publication.
17. Nikolsky, G.V. Ecology of fishes. Academic Press.
18. Pandey.Fish and Fisheries.Rastogi Publications
19. Rao, K. L. India's water wealth.
20. Ravishankar Piska. Fisheries and Aquaculture. Lahari Publications, Hyderabad.
21. Ricker, W.E. 1984.Methods for assessment of fish production in freshwaters.Blackwell Publications.
22. Rounsfell, G.A. and Everhart, W.H. Fishery Science: it's Methods and Applications John Wiley & Sons,
23. Sachindra, N.M. & N.S. Mahendrakar. Fish Processing Byproducts: Quality Assessment And Application Studium press
24. Santhanam,R. Fisheries Science, Daya Publishing House, 1990.
25. Singh, B. A. Dey. Fish and Fisheries. Invincible Publishers
26. Srivastava, C.B.L. A Textbook of Fishery Science and Indian Fisheries, Kitab Mahal.
27. The Wealth of India, Raw Materials Vol. IV, Fish and Fisheries, CSIR, 1962

ZGLF0022: LIMNOLOGY, FISHERY ECONOMICS, ORNAMENTAL FISHERY AND FISH PATHOLOGY (4 Credits-60 Hours)

Objective: *The course will help the students to understand the principles of limnology and economics of fishery. The students will also develop knowledge on fish diseases and control*

Module I (15 hours)

Limnology: Physico-chemical factors of fresh water habitat; Nutrients – Availability, Seasonal distribution and availability of phosphorous, Nitrogen and Silicon; Ecological classification of freshwater organisms; Plankton –Distribution, seasonal variation in space and time, planktonic migration, cyclomorphosis

Module II (15 hours)

Fishery economics and law: Larvivorous fishes in relation to public health; Exclusive Economic Zone(EFZ) and its strategy; Fisheries co-operatives and their role in fish production and marketing; Aquaculture and rural development in India; Fishery education, training and extension; Fishery research Institutes in India; Fishery legislation and their role in fishery development.

Module III (15 hours)

Ornamental fishery: Ornamental fish culture: Ornamental aquarium fishes, Breeding and care of Freshwater aquarium fishes; Aquarium keeping—Design and construction of tanks; species-wise tank size requirement; heating, lighting, aeration and filtration arrangements; decorations; common aquarium plants and their propagation; Maintenance of Natural Colour of fishes in Aquarium.

Module IV (15 hours)

Fish pathology: Fish and Prawn/Shrimp Diseases: Types of Diseases-viral, bacterial, fungal, protozoan and other parasitic diseases; symptoms & control measures; Diagnosis-Histopathological methods; Immunoassay; Biochemical assay; Serological techniques; Role of biopesticides; Application of Monoclonal antibodies; Vaccines and immune stimulants; Drug resistance.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Explain the needs of physico-chemical factors in maintaining a proper productive aquatic ecosystem, an essential element in aquaculture and fishery management. (Understanding)
- CO2:** Utilize the understanding of fishery economics and laws of the country, various fishery training institutions and their roles and extension programs in fishery development. (Applying)
- CO3:** Develop the skill on ornamental fish culture and aquarium preparation and maintenance. (Applying)
- CO4:** Apply the knowledge acquired on fish pathology and their prophylactic control measures. (Applying)

Suggested Readings

1. Agarwal, S.C. Limnology
2. Bond, E. Carl. Biology of fishes.
3. Datta, J. J. Datta Munshi. Fundamentals of Limnology
4. Dholakia, A.D. Ornamental Fish Culture and Aquarium Management. Daya Publishing House
5. Edward, J. Noga. Fish Disease: Diagnosis & Treatment
6. Gerald, A. Textbook of Limnology. The C.V. Morby Co.
7. Hutchinson, G.E.A. Treatise on Limnology. Vol.1. John Wiley & Sons.
8. Kumar, Arvind. Fundamentals of Limnology. APH Publishing Corporation
9. Nikolsky, G.V. Ecology of fishes. Academic Press.
10. Ricker, W.E. Methods for assessment of fish production in freshwaters. Blackwell Publications.
11. Ruttner, F. Fundamentals of Limnology. University of Toronto Press, 1968.
12. Sharma Shailendra & Pawan Kumar Bharti. Limnology and Aquatic Science. Discovery publishing house
13. Smith David J. Aquarium Keeping: Aquarium Keeping Essentials
14. Thornton Kent W., Bruce L. Kimmel, Forrest E. Payne. Reservoir Limnology: Ecological Perspectives
15. Untergasser, D. Handbook of Fish Diseases. TFH Publications
16. Welch, P.S. Limnological Methods. McGraw Hill Book Company, New York.
17. Wetzel, Robert G. Limnology: Lake and River Ecosystems. Elsevier Academic Press

SPECIALIZATION IV: ANIMAL ECOLOGY AND WILDLIFE BIOLOGY**ZGRE0025: WILDLIFE RESOURCE MANAGEMENT, LAWS AND TECHNIQUES IN POPULATION STUDY****(4 Credits-60 Hours)**

Objectives: *The course is designed to equip students with a foundation of Natural resource management and Conservation and to make them aware of wildlife laws and different techniques used for population study.*

Module I Species conservation (20 hours)

IUCN categories, criteria for allocation into different categories. Threatened animal species of India with special reference to NE India. Role of Iconic species designation in conservation. Concept and significance of conservation of Flagship (Target) species; overview of conservation problems and issues of fauna of Indian sub-continent.

Module II Natural resource management and conservation (15 hours)

- Introduction to forestry, principles of forest management, Importance and performance of joint forest management (JFM) – Role of Non-Government Organizations (NGO).
- Conservation movement in India. Concept of stakeholders. International conservation bodies; IUCN, UNDP, Durrell Wildlife Conservation trust.
- Project Grants for Wildlife Conservation

Module III Forest and Wildlife laws of India (5 hours)

Wildlife Protection Act, 1972; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of forest Rights) Act, 2006.

Module IV Population ecology and Sampling Techniques (20 hours)

- Demographic and life history parameters, evolution of life history parameters: r & K selection, allometry, aging and sexing, life tables, age and stage structures models, methods of estimation of life history and demographic parameters.
- Sampling designs for population estimation, population estimation methods: Mark-Recapture for Closed Population, Collection Techniques used in wildlife study.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain about conservation history in India. (Remembering)
- CO2:** Illustrate the role of different species. (Understanding)
- CO3:** Apply different techniques for management of wildlife and its habitat. (Applying)
- CO4:** Analyse the threats on different species. (Analyzing) Identify the structure and demography of wildlife population. (Applying)
- CO5:** Analyze the role of Non-Governmental Organisations in wildlife conservation. (Analyzing)
- CO6:** Explain about different laws of wildlife against illegal poaching, hunting etc. (Evaluating)
- CO7:** Estimate the population size of wildlife. (Evaluating)

Suggested Readings

- Caughley G (1978). Analysis Of Vertebrate Populations. John Wiley, Chichester.
- Hastings A (1997). Population Biology: Concepts And Models. Springer Verlag, New York.
- Neal D (2004). Introduction to population biology. Cambridge University Press. UK

4. Ricklefs R (2010). The Economy of Nature (6 edition). W. H. Freeman
5. Tokeshi M (1998). Species Coexistence: Ecological and Evolutionary Perspectives.
6. W. J. Ecological Census Techniques Cambridge University Press
7. Patro, L. Biodiversity Conservation and Management
8. Misra, H.N. – Managing Natural Resources- Focus on Land and Water
9. Anderson, Sweeney and Williams- Wildlife and Natural Resource Management
10. Deal, K.H. Environmental Economics and Natural Resource Management
11. Kumar, R. Environmental Laws
12. Muthukrishna- Natural Resource Economics
13. Field, B.C. Economics of Environment
14. Began, M. & Mortimer, M.- Population Ecology
15. Rockwood- Introduction to population Ecology

ZGWC0026: TECHNIQUES IN WILDLIFE STUDY WILDLIFE HEALTH, FORENSICS AND CONFLICT (4 Credits-60 Hours)

Objective: To develop skills in understanding the wildlife health management, to understand the concept of wildlife forensics, to develop an understanding of the theoretical perspectives in the area of Human Animal Conflicts.

Module I Wildlife Health (20 hours)

- a) Introduction to disease and epizootiology, Determinants of disease and disease transmission, Disease and population dynamics.
- b) Review of major parasitic diseases of Indian wild mammals, birds, amphibians and reptiles. Assessment of condition, health and nutritional status in free-ranging populations. Disease control operations, Planning and management of wildlife health programmes.

Module II Techniques for wildlife study, Capture and handling of wild animals (15 hours)

- a) Techniques for wildlife study: Radio telemetry and acoustic analysis.
- b) Capture and handling of animals - purpose, restraint techniques, different capture methods and animal barriers. Drug immobilization - drug delivery equipment and accessories. Handling and transport of wild animals, designing sledge, crate and holding enclosures.

Module III Conservation Genetics and Wildlife Forensics and Trade (15 hours)

- a) Application of genetics for wildlife conservation; Application of Molecular markers, PCR, DNA Sequencing in wildlife forensics and conservation. Loss of genetic diversity
- b) Wildlife Forensics- Overview, various forensic protocols for species identification;
- c) Wildlife trade: The Convention on International trade in Endangered Species of Wild Fauna and Flora (CITES),

Module IV Human-wildlife conflict (10 hours)

- a) Causes and management; Impact on ecosystem, lives and livelihood of human;
- b) Ecotourism: problems and prospects with special reference to northeast India.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define wildlife disease, determinants of diseases and causes of disease outbreaks. (Remembering)
- CO2:** Illustrate the concepts of genetics in wildlife. (Understanding)
- CO3:** Apply different molecular markers for sequencing in wildlife forensic. (Applying)

- CO4:** Apply different techniques of wildlife study. (Applying)
CO5: Apply the basic concepts of capturing and handling animals. (Applying)
CO6: Recommend mitigation plans to reduce human animal conflict. (Evaluating)
CO7: Estimate population dynamics due to disease outbreaks. (Evaluating)
CO8: Develop the prospects of ecotourism in Northeast India, its importance and consequences. (Creating).
CO9: Discuss about wildlife forensic, various protocols for species identification and trade of wildlife products. (Creating)
CO10: Design and implement disease control operations, planning and management of wildlife health programmes. (Creating)
CO11: Design equipment for wildlife transportation. (Creating)

Suggested Readings

1. Fowler- Restraint and Handling of wild and Domestic Animals
2. Briscoe, Ballou and Frankhan- Introduction to Conservation Genetics
3. Leeschcke, Temivk and Jain – Conservation Genetics
4. Frankhan, Ballou and Briscoe- Primer of Conservation Genetics
5. Cooper and Cooper- Wildlife Forensic Investigations
6. Huffman and Wallacw- Wildlife Forensics – Methods & Applications
7. Sahaipal, Thakar & Goyal – Forensic Examination of Hair of Protected Indian Wildlife Species
8. Linacre and Tobe- Wildlife DNA analysis
9. Rao, G. Textbook on pathology of Wildlife Diseases
10. Jani, R. Basic of Wildlife Health Care Management
11. Ayadi, D.P. Human Wildlife Conflict
12. Wang, J. Human Wildlife Conflict management: Understanding the Fundamentals of Human Wildlife Conflicts in Human Dominated Landscape

ZGBE0027: BIOSYSTEMATICS AND EVOLUTION

(4 Credits -60 hours)

Objective: *The objective of this course is*

- *to acquaint the student with different procedures of taxonomy and different methods of analysis of variations and theories of classification.*
- *to enable the students to identify, classify and name the organisms according to international code of zoological nomenclature.*
- *to comprehend the scientific concepts of animal evolution through an understanding of its evidences, its mechanics, process and products.*
- *to learn about the theoretical background of the use of bioinformatics in evolutionary studies*

Module I: Biosystematics (10 hours)

Trends in Biosystematics: Chemotaxonomy, Cytotaxonomy, Numerical and Molecular Taxonomy; Dimensions of Speciation; Species Concepts: Subspecies and other intraspecific Categories; Cladistics

Module II: Taxonomy and Nomenclature (10 hours)

Taxonomic Categories. Different Kinds, Hierarchy of Categories; Taxonomic Procedures: Taxonomic collections, Preservations, Process of identification(General Idea); Taxonomic Keys: types, merits and demerits; International Code of Zoological Nomenclature (ICZN):Operative principles, interpretation and application of important rules; Formation of names of various Taxa.

Module III: Evolution (15 hours)

- a) Micro and Macro evolution;
- b) Natural Selection-Concept of stabilizing selection, Frequency dependent selection, Balancing selection, Disruption selection;
- c) Destabilizing factors-Mutation, Genetic drift, Migration, Meiotic drive;
- d) Emergence of Non Darwinian theory of evolution, Neutral theory of evolution(Kimura).

Module IV: Speciation and Molecular basis of evolution (15 hours)

- a) Isolation Mechanisms-Isolation Mechanisms and their role in speciation, Models of speciation (Allopatric, sympatric, parapatric);
- b) Molecular basis of evolution-Constructing evolutionary trees, measures of genetic relationship among organisms, Molecular clock of evolution, Molecular phylogeny; Origin and
- c) Evolution of Primates.

Module V: Evolutionary Bioinformatics (10 hours)

- a) Concept of databases: Biological databases - Primary, secondary, composite databases; Databases for Literature, Sequence and structure; Searching and their retrieval.
- b) Bioinformatics for phylogenetic analysis. DNA and Protein sequence alignments-airwise alignment, dot plot, global and local alignment algorithms; Multiple sequence alignment;Multiple sequence alignment based data base searching-PSI-Blast;
- c) Homology modeling.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Explain the concept of biosystematics and its different branches. (Understanding)
- CO2:** Explain the causes of evolution and natural selection. (Understanding)
- CO3:** Apply taxonomy to solve the species problem. (Applying)
- CO4:** Identify species on the basis of taxonomic keys. (Applying)
- CO5:** Apply bioinformatics tools used for evolutionary studies. (Applying)
- CO6:** Interpret the International Code of Zoological Nomenclature (Evaluating).
- CO7:** Justify the role of isolating mechanisms in speciation, estimate, construction of evolutionary trees, and measurement of genetic relationship among organisms. (Evaluating)
- CO8:** Create evolutionary trees to understand the evolution of primates. (Creating)
- CO5:** Construct taxonomic key to classify different species. (Creating)

Suggested Readings

1. G. G. Simpson. Principle of animal taxonomy; Oxford IBH Publishing Company.
2. V.C Kapoor-Theory and practice of animal taxonomy
3. J.C. Avice. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
4. E.O. Wilson, Biodiversity, Academic Press, Washington.
5. E. Mayer & P. Ashlock. Principles of systemic Taxonomy
6. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Norton & Co.
7. Dalela and Sharma. Animal taxonomy and Museology, Jai Prashnath & company.
8. Bugs, Butterflies, Spider, snakes (1998). Kern Preston-Mafham, Nigel Marven & Robturvey.
9. Dbzhansky, Th., F.J. Ayala, G.L. Stebbins and J.M. Valentine. Evolution. Surject Publication, Delhi.
10. Futuyama, D.J. Evolutionary Biology, Sinauer Associates, INC Publishers, Dunderland. 11. Jha,

11. A.P- Genes and Evolution. John Publication, New Delhi.
12. Ashok Verma, Principles of Animal Taxonomy, Alpha Science International Ltd, Delhi.
13. Ramesh Chandra Tripathi, Biosystematics and Taxonomy, University Book House, Jaipur.
14. Avers, C.J. Evolution Process and Pattern in Evolution Oxford University, Press, New York, Oxford.
15. Ayala, F. J. and Valentine J. W. Evolving the theory and Process of Organic Evolution,
16. Brookfield, A. P. Modern aspects of Evolution. Hutchinson London, Melbourne.
17. Gallow, P. Evolutionary principles.
18. Chapman and Hall. Freeman, S. and Herron, Jon C. Evolutionary analysis Pearson Prentice Hall, New Jersey.
19. Futuyma, D. J. Evolutionary Biology, Sinauer Assoc. Inc. Pub. USA.
20. Meglitsch, P. A. Invertebrate Zoology (3rd edition), Oxford University Press.
21. Minkoff, E. C. Evolutionary Biology, Addison Wesley Pub. Co., London.
22. Wen-Hsiung Li, Molecular Evolution, Sinauer associates Inc. Pub. USA.
23. Burton S. Guttman: Evolutiona beginner's guide, One world Publications.

ZGCI0028: CELL BIOLOGY AND IMMUNOLOGY- THEORY AND APPLICATIONS

(4 Credits-60 hours)

Objective: This course is designed to give a better understanding of cellular biology with complicated biochemical and physiological processes. The course also focuses on basic concepts of immunology.

Module I: Cell Organisation (10 hours)

- a) Biomembranes-Molecular composition and functional feature of membrane lipid, protein and carbohydrate.
- b) Cytoskeletons -Structure and Organisation of Microfilament, Microtubule and Intermediate filament.
- c) Cell Motility-intercellular transport, kinesin-dynin, cilia and flagella.

Module II: Cell adhesion molecule, Cell signaling, Cell cycle (15 hours)

- a) Extracellular Matrix and Cell Interaction-Cell walls, Adhesion junctions, Tight junctions, Gap junctions, Plasmodesmata; Cell-Cell Adhesion - Ca^{++} dependent and Ca^{++} independent Homophillic Cell-Cell Adhesion.
- b) Cell division and cell cycle regulation and control of cell cycle; Cyclins and Cyclin Dependent Kinases(CDK), Regulation of CDK-Cyclin activity, Molecular basis of Cellular Check Points;
- c) Cell-Cell Signalling-Cell Signalling, Cell surface receptors, G-Protein coupled receptors and Second messenger

Module III: Immunology (15 hours)

Immune system-innate and adaptive immunity; components and characteristic features, humoral and cell-mediated immunity; Cells and organs of immune system; T cells and B cells-maturation, activation and differentiation; Antigens-immunological properties of antigens, factors influencing antigenicity; Immunoglobulin-structure and function, classes of Ig molecules, Antigen-antibody interactions; Introduction to Complement system and major histo-compatibility complex

Module IV: Analytical techniques (20 hours)

- a) Review of principles of light microscopy; principles and applications of phase contrast and fluorescence microscopy
- b) Principles and applications of Transmission and Scanning Electron microscopy
- c) Spectroscopy: basic principles and types

- d) Theories of Tissue fixation and staining techniques
- e) Basic principles of colorimetry
- f) Principles and applications of centrifugation techniques: types of centrifugation; Introduction to hydrodynamics
- g) Molecular modeling
- h) ELISA, RIA, Immunodiffusion

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define cell division and signaling pathways. (Remembering)
- CO2:** Explain about the different cellular biology with complicated biochemical and physiological processes. (Understanding)
- CO5:** Apply various immunological techniques (Applying)
- CO4:** Analyze the results obtained after application of the techniques. (Analyzing)
- CO5:** Evaluate the regulation of cell cycle and its control. (Evaluating)

Suggested Readings

1. Cooper, G. M., Cell (A Molecular Approach)
2. Sadava D. E., Cell Biology
3. Kish V. M. and Kleinsmith L. J., Cell and Molecular Biology
4. DeRobertis & DeRobertis: Cell and Molecular Biology (Lee & Febiger, 1987)
5. Karp: Cell and Molecular Biology
6. Lodish et al: Molecular Cell Biology
7. Pollard & Earnshaw: Cell Biology
8. Verma P. S. and Agarwal V.K, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.
9. Verma P.S. and Agarwal V.K, Cell Biology (Cytology, biomolecules and Molecular Biology), S. Chand & Company Ltd.
10. Kubiyet al. : Kub Immunology
11. H.H. Willard, L.L. Merritt Jr. and others, Instrumental Methods of Analysis. 6th Edition, 1986, CBS Publishers and Distributors.
12. Chatwal G and Anand, S., Instrumental Methods of Chemical Analysis, 1989, Himalaya Publishing House, Mumbai.
13. Williams, B.L. and Wilson, K., A Biologist's Guide to Principles and Techniques of Practical Biochemistry, 1975
14. B.B. Straughan and S. Walker Eds., Spectroscopy, Volume 1, Chapman and Hall Ltd.

ZBGG0029: MOLECULAR BIOLOGY AND GENETICS

(4 Credits-60 hours)

Objective: The objective of this course is to provide a comprehensive knowledge of molecular aspects of biological function at the molecular level, with particular emphasis on the structure and regulation of genes, as well as the structure and synthesis of proteins and its applications.

Module I: Nucleic Acids (16 hours)

- a) Nucleic acids - Molecular Structures of DNA and RNA.
- b) DNA Replication-Replication in Prokaryotes and Eukaryotes, Semi conservative nature of DNA replication, Messelsons-Stahl experiment, Enzymes and proteins associated with replication, DNA polymerases, Regulation of eukaryotic genome replication.

- c) DNA Damage and Repair Mechanism-Different types of DNA Damage, Direct repair system, Excision repair system, Mismatch repair system, DNA break repair.

Module II: Transcription and Translation (12 hours)

- a) Transcription-Basic concept of Prokaryotic and Eukaryotic transcription, Promoters (Pribnowbox, TATAbox, CpGisland), Transcription factors, Initiation, elongation and termination of transcriptions in Eukaryotes.
- b) Post Transcriptional Modification
- c) Translation- Genetic Code, Mechanism of Initiation, Elongation and Termination.

Module III: (10 hours)

- a) Organisation of genetic material-Nucleosome, Molecular anatomy of eukaryotic chromosome; Genome size and Complexity-C value paradox, Unique and repetitive DNA, Euchromatin and Heterochromatin
- b) Sex Chromosomes - Sex determination, Role of Y chromosome, Dosage Compensation in Drosophila and Human Being, X-Chromosome inactivation, Sex chromosome anomalies
- c) Human Genetics-Normal Human Karyo typing, Autosomal chromosome abnormalities, Principle and Methods of Pedigree Analysis
- d) Genetic Imprinting-Imprinting of genes, Epigenetic, Epigenetic regulation by DNA methylation; Somatic Cell Genetics-Cell fusion technology, Chromosome mapping, Application of Somatic Cell Genetics.

Module IV: Genetic Inheritance (8 hours)

- a) Concept of gene: Allele, multiplealleles, pseudoallele, complementation tests; Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters
- b) Extra Chromosomal Inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Module V: Protein structure (2 hours)

- a) Primary structure
- b) Secondary structure
- c) Tertiry structure

Module VI: Bioinformatics (5 hours)

- a) Gene Prediction-Finding genes in prokaryotic and eukaryotic genomes, Regulatory sequence analysis; Genome maps and markers, Genome variation.
- b) Human genome project; Concept and Software used in Gene expression analysis and Microarray.
- c) Structural biology-Protein structure prediction and classification.

Module VII: Electrophoretic Techniques (7 hours)

- a) Basic principles of Electrophoresis, Agarose gel, native and SDS-PAGE
- b) Isoelectric focusing, 2D-PAGE and their uses in protein research
- c) Blotting Techniques

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the structure of nucleic acids. (Remembering)
- CO2:** Make use of the methods of sex determination and pedigree analysis. (Applying)
- CO3:** Analyze the various patterns of genetic inheritance. (Analyzing)
- CO4:** Test the complexity in the organization of genetic material. (Creating)
- CO5:** Analyze the results obtained after using various advanced molecular biology techniques. (Analyzing)

Suggested Readings

1. Gardner, Principles of Genetics
2. Strickberger, Genetics
3. Ram Mahabal, Fundamentals of Cytogenetics and Genetics
4. Brooker: Genetics: Analysis and Principles
5. Griffith et al: Modern Genetic Analysis
6. Hartl & Jones: Essential Genetics: A Genomic Perspective
7. Boyer: Modern Experimental Biochemistry and Molecular Biology
8. DeRobertis & DeRobertis: Cell and Molecular Biology
9. Hanes, Gel Electrophoresis of Proteins - A Practical Approach
10. SedgewickRandWayneK.AnIntroductiontoComputerScience,PrincetonUniversity[available online].
11. Blum R and LeBlanc Dee-Ann. Linux for Dummies, WILEY [available online].
12. Kanetkar YP. Let Us C [available online].

ZGAP0030: ANIMAL PHYSIOLOGY**(4 Credits-60 hours)**

Objective: This course aims to help students to understand the internal physical and chemical functions of animals and their parts which include digestion, excretion, circulation, respiration, nervous system, sense organs and reproduction.

Module I Physiology of digestion (10 hours)

- a) Glands and secretion of digestive enzymes,
- b) Mechanism of digestion, Gastrointestinal hormones,
- c) Absorption of Carbohydrates, lipids and proteins.

Module II Physiology of Respiration (10 hours)

- a) Alveolar ventilation, alveolar-capillary gas exchange, Transport of O₂ and CO₂
- b) Oxygen dissociation curve and the factors influencing it,
- c) Regulation of respiration.

Module III Mammalian blood chemistry (10 hours)

- a) Mammalian blood chemistry, blood groups,
- b) Blood clotting mechanism,
- c) Cardiac cycle and its regulation in mammals.

Module IV Musculature in vertebrates (10 hours)

- a) Musculature in vertebrates: Types of muscles, Ultrastructure and chemical composition of skeletal muscles,
- b) Molecular mechanism and regulation of muscle contraction, muscle fatigue and rigor mortis.

Module V Physiology of Excretion (10 hours)

- a) Ultrastructure of nephron, mechanism of urine formation, excretion of dilute solutes and mechanism of excretion of excess solutes, counter current mechanism
- b) Osmoregulation in different animal groups (aquatic and terrestrial)

Module VI Nerve physiology (10 hours)

- a) Neuron: Ultrastructure, types and function,
- b) Membrane potential: Resting membrane, membrane potential, action potential, Nernst Equation, Chronaxi, Rheobase, utilization time.
- c) Neural impulse induction through an axon, neurotransmitters and synaptic transmission-mode of information transfer across electrical and chemical synapses

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the physiology of digestion, different glands involved in the process, their secretions. (Remember)
- CO2:** Explain about the physiology of Respiration, interpret the Oxygen dissociation curve and to understand the regulation of respiration. (Understanding)
- CO3:** Develop a clear concept of mammalian blood chemistry, the blood clotting mechanism, musculature in vertebrates, molecular mechanism and regulation of muscle contraction, nerve physiology, and physiology of excretion. (Applying)
- CO4:** Analyze the mechanism of digestion, absorption of various biomolecules and the role of gastrointestinal hormones in digestion. (Analyzing)

Suggested Readings

1. Brooks and Marshall: Essentials of Endocrinology, Blackwell Science.
2. Ganong: Review of Medical Physiology, Lang Medical Publications
3. Guyton and Hall: Text Book of Medical Physiology ,W.B. Saunders
4. Hadley: Endocrinology, Prentice hall. International Edition.
5. Keel et al: Samson Wright's Applied Physiology, Oxford Press,
6. Larson:WilliamsTextBookofEndocrinology,10thedition.W.B.SaundersCompany,Philadelphia.
7. Murray et al: Harper's Illustrated Biochemistry, Appleton & Lange
8. Norris: Vertebrate Endocrinology. Lea & Febriger.
9. Turner and Bagnara: General Endocrinology, W. B. Saunders Company Philadelphia.
10. West: Best and Taylor's Physiological Basis of Medical Practice, Williams and Wilkins,
11. N Arumugam and A Mariakuttikan, Animal Physiology, Saras Publication.
12. N Arumugam, Animal Physiology & Biochemistry, Saras Publication.
13. Dharmalingam, Textbook Of Endocrinology, Jaypee Brothers Medical Publisher
14. VermaPS, Agarwal V.K and Tyagi B. S, Animal Physiology, S. Chand Publishing.

ZGEE0031: ECOLOGY AND ENVIRONMENTAL BIOLOGY**(4 Credits - 60 Hours)**

Objective: *The purpose of this course is to familiarize students with essential aspects of environmental conservation and management through a comprehensive understanding of the components of the ecosystem, biological cycles, habitat ecology, resource ecology, pollution and its management*

Module I (12 hours)

- a) Types of ecosystems—Salient features of aquatic and terrestrial ecosystems and their biotic communities.
- b) Ecological energetic and energy flow; Measuring ecosystem productivity
- c) Population Ecology—Population density, Growth rate, Natality, mortality, survivorship curves and lifetables, Biotic potential

Module II (12 hours)

- a) Community Ecology—Types of biotic communities, organization, carrying capacity, r and k-selection.
- b) Community Development—Types of community changes, ecological succession—its causes and examples, climax community.
- c) Species interactions, Competition theory, Niche, Habitat,
- d) Ecological Equivalents, Character displacement; Liebig law of minimum, Shelford's law of tolerance, Significance of limiting factors, Ecotone and Edge effect.
- e) Thermoregulation: Heat balance in animals, Adaptations to temperature extremes, Aestivation, hibernation and Diapause, acclimatization, avoidance and tolerance

Module III (12 hours)

- a) Eutrophication in aquatic ecosystem, Remediation of eutrophication.
- b) Acidification in aquatic and terrestrial environment, Consequences and control strategies.
- c) Environmental monitoring, Environmental impact assessment and environmental management plan.
- d) Biogeochemical cycles—carbon, nitrogen, sulphur cycles, impact of human activity on nutrient cycles.

Module IV (12 hours)

- a) Biodegradation and Bioremediation: concept, environmental limitation for bioremediation, bioremediation of ecosystem (Air/water/soil)
- b) Wastes in Ecosystem and management: Agricultural wastes and Management, Biomedical wastes and Management, Domestic waste, effects and management for purification and recirculation.
- c) Environmental toxicology: Diversity and classification of environmental toxins, Air, Water and soil pollutants, Food additives and contaminants, Pesticides, Metals and Solvents, Radioactive pollution.

Module V Biodiversity (12 hours)

- a) Components of Biodiversity (Genetic, Organismal and Ecological), Value of Biodiversity, threats to biodiversity, biodiversity conservation, Mega biodiversity countries, hotspots and heritage sites,
- b) IUCN Red list categories. Habitat diversity of Indian wildlife, endemic and Threatened species of northeast India
- c) Ethnozoology with special reference to Northeast India

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Outline the foundations of Ecology. (Understanding)

- CO2:** Explain the effects of abiotic environment on plants and animals to understand the distribution and abundance of life on earth (Understanding)
- CO3:** Develop solutions to pressing environmental problems that threaten ecological systems at every level (Creating)

Suggested Readings

1. Asthana, D.K. and Asthana, M. Environmental Problems and Solutions S. Chand and Co., New Delhi.
2. Odum : Basic Ecology (Saunders)
3. Odum : Fundamentals of Ecology (Saunders)
4. Odum. E.P. Fundamentals of Ecology. Nataraj Publishers, Dehra Dun.
5. Raven, Berg, Johnson : Environment (Saunders College Publishing)
6. Sharma :Ecology and Environment (Rastogi Publication)
7. Smith, R.L. Elements of Ecology. Harpet and Row Publishers, New York.
8. Trivedi, P.R. and Gurdeepraj, K. Environmental Biology. Akashdeep Publishing House New Delhi
9. Turk and Turk : Environmental Science
10. VermaP.S. and Agarwal V.K, Environmental Biology(Principles of Ecology)by,S.Chand Publishing.
11. GuptaS.R.andSinghS.P.,EcologyEnvironmentalScienceandConservation,S.ChandPublishing
12. Manju Yadav, Ecology, Discovery Publishing House
13. Rana S.V.S. ,Essentials of Ecology and Environmental Science, S.V.S. Rana. Publisher, Prentice-Hall of India
14. Anderwartha, H.G.and Birch,L.C.,The distribution and abundance of animals, University of Chicago Press, Chicago London.
15. Beeby, A., Applying Ecology Chapman and Hall Madras.
16. Begon, M.,HarperJ.L.andTownsend,C.R.,Ecology–Individuals, populationsandcommunities, Blackwell Science, Cambridge UK.
17. Brewer, R., The science of Ecology, Saunders College of Publishing, New York.
18. Chapman,J.L.andResis,M.J.,Ecology-Principlesandapplications,CambridgeUniversityPress, Cambridge UK.
19. Kaeighs, S. C., Ecology with special references to animal and Man, PrenticeHall Inc.
20. Putmann, R. J. and Wratten, S. D., Principles of Ecology,
21. Crown Helm, London. Salanki,J.,Jeffery E. and Hughes G.M., Biological Monitoring of the Environment (A manual of Methods) CAB International, Wallingford UK. Singh M C: Environment Protection and the Law (Ashish Publishing House)

ZGEB0032: ENDOCRINOLOGY AND BIOCHEMISTRY

(4 Credits-60 hours)

Objective: The objective of this course is to provide a comprehensive knowledge of various biochemical pathways and bioenergetics through electron transport chain. Hormones and their influence on body metabolisms are also studied with special reference to reproduction.

Module I: Basic concepts: Hormone, action and Feedback Mechanism (5 hours)

Hormone: Classification and Chemical nature of hormones Homeostasis: Concept and Feedback system Hormone receptor and target organ concept, Mechanism of hormone action. Hypothalamo-hypophysial axis

Module II: Endocrine glands-Structure, Hormones, Functions, Axis, Abnormalities (15 hours)

- a) Structure of the pituitary gland; pituitary hormones and their functions
- b) Structure of thyroid glands, thyroid hormones–biosynthesis and metabolic functions. Role of thyroid hormone in amphibian metamorphosis

- c) Structure of adrenal gland; Synthesis of adreno-cortical and medullary hormones and their functions.
- d) Structure of endocrine pancreas and Hormones of Islets of Langerhans.

Module III: Reproductive Endocrinology (10 hours)

- a) Testis and ovary –endocrine structure and their functions
- b) Reproductive cycle- Oestrous cycle and Menstrual cycle, Role of Hormones in Implantation, Parturition and Lactation
- c) Neuroendocrine regulators in insects and mammals,

Module IV: Metabolism (13 hours)

- a) Carbohydrate metabolism-Glycolysis, Glycogenolysis, Gluconeogenesis, TCA cycle, Cori cycle, Phosphogluconate pathway.
- b) Lipidmetabolism-Oxidation of fatty acid, Cholesterol biosynthesis and metabolism, Prostaglandins.
- c) Protein metabolism- Amino acid Classification, Amino acid degradation, Decarboxylation, Deamination, Ornithine Cycle.

Module V: Bioenergetics and Enzymes (10 hours)

- a) Bioenergetics-Energy producing and utilizing system, Electron transfer system and Oxidative Phosphorylation.
- b) Enzymes-Classification of enzymes, General properties of enzymes, Mechanism of enzyme action, Enzyme kinetics, Michaelis-Menten and Lineweaver-Burke Equations; Enzyme inhibition.

Module VI: Basic concepts of biochemistry (10 Hours)

- a) Review of concepts of acids and bases, Principle and working of pH meter, Buffer preparation,
- b) Principle of Laminar-air flow chamber.
- c) Principles, types and applications of Chromatography
- d) Gas Chromatography, GC-MS, LC – MS / MS, MALDI TOF mass spectrometer
- e) Ion Exchange Chromatography, gel permeation, Affinity and reverse phase chromatography
- f) HPLC and FPLC

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the various metabolic pathways and the role of hormone. (Remembering)
- CO2:** Explain the basic principles of modern analytical techniques. (Understanding)
- CO3:** Analyze the energy production and utilization. (Analyzing)
- CO4:** Explain the enzyme kinetics. (Evaluating)

Suggested Readings

1. Brooks and Marshall: Essentials of Endocrinology, Blackwell Science.
2. Ganong: Review of Medical Physiology, Lang Medical Publications
3. Guyton and Hall: Text Book of Medical Physiology ,W.B. Saunders
4. Hadley: Endocrinology, Prentice hall. International Edition.
5. Keel et al: Samson Wright's Applied Physiology, Oxford Press,
6. IliamsTextBookofEndocrinology,10thedition.W.B.SaundersCompany,Philadelphia.
7. Murray et al: Harper's Illustrated Biochemistry, Appleton & Lange

8. Norris: Vertebrate Endocrinology. Lea & Febriger.
9. Turner and Bagnara: General Endocrinology, W. B. Saunders Company Philadelphia.
10. Berg et al.: Biochemistry, Freeman
11. Boyer: Modern Experimental Biochemistry and Molecular biology
12. DeRobertis & DeRobertis: Cell and Molecular Biology
13. Freifelder: Physical Biochemistry
14. Holme and Peck: Analytical Biochemistry, Tata McGraw Hill
15. Switzer and Garrity: Experimental Biochemistry
16. Biochemistry, Tata-McGraw Hill

ZGAZ0033: APPLIED ZOOLOGY

(4 Credits-60 hours)

Objective: The course is designed to provide knowledge on Sericulture, apiculture, vermiculture, aquaculture, poultry rearing, parasitology with special reference to emerging viral diseases, Pest management.

Module I (15 hours)

Sericulture: Types of Silk Worm (Muga and Eri), their host plants, silkworm rearing and management practices. Diseases and Pest of Silk Worm and their management, Biodiversity conservation project through sericulture (Case study- 7Weaves Model)

Apiculture: Different species of honey bees, bee plants, pollen calendar, bee keeping and management practices, bee products, Bee enemies and diseases.

Vermiculture: species of worms, condition for efficient vermiculture (domestic and commercial level), Economics of Vermiculture

Module II (10 hours)

Aquaculture: Aquarium fish keeping: Ornamental Fishes of India special reference to North East India, common aquarium fishes; Aquarium Maintenance, Fisheries management: Composite fish culture, induced breeding and hybridization; Prawn and Pearl Culture, Exotic and Indigenous food Fishes of NE India, Fish and shell fish diseases and their control measures. Fish genetic resource conservation; Aquaponics—prospect and future.

Module III: Poultry management (8 hours)

Poultry Rearing / Farming: Housing and equipment; Nutritional Requirements; Poultry diseases Poultry products: Broilers, meat processing and meat products, Poultry by products

Module IV : Parasitology (15 hours)

Parasitism and types of parasites, primary and secondary hosts, transmission of parasitic infection. Host-parasitic interactions—parasitic effects benefiting the parasites, parasitic effects benefiting the host. *Vibrio cholera* and *Clostridium titani*-Lifecycle, mode of transmission, infection and treatment. Dengue, Bird flu - Life cycle, mode of transmission, infection and treatment.

Module V: Insect pest management, Public Health and Forensic Entomology (12 hours)

Concept of Pest, concept of integrated pest management (IPM)

Mosquito (*Aedes*, *Culex*, *Anopheles*)-Taxonomy, Biology, Behavior and their control.

Life cycle of *Calliphora* and *Scrophaga*, determination of death and causes of death.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- C01:** Outline the knowledge acquired about the cultivation of silkworm, maintenance of the farm, seed technology, silkworm rearing and silk reeling. (Understanding)
- C02:** Identify the various skills that are necessary for self-employment in the mulberry and seed production. (Applying)
- C03:** Apply the latest knowledge of pesticides application equipment. (Applying)
- C04:** Make use of beehives for honey production and pollination. (Applying)
- C05:** Develop an overall idea of fish farming, the scientific management of different species in aquaculture, aquarium keeping and fish diseases. (Applying)
- C06:** Identify the different types of parasites, their life cycles and the diseases caused by them. (Applying)
- C07:** Assess the basic life cycle of the honeybee and about beekeeping tools and equipment. (Evaluating)
- C08:** Explain about the virus carrying vectors, like Aedes, Culex and Anopheles. (Evaluating)

Suggested Readings

1. Venkitaraman: Economic Zoology, Sudarsana Publishers
2. Srivastava : A Text Book of Applied Entomology, Vol. II & II.I Kalyani Publishers
3. Shukla & Upadhyaya : Economic Zoology. Rastogi Publishers.
4. Ananthkrishnan, T.N. and K.G. Shivaramkrishnan. Ecological entomology: Insect life in our environment. Scientific Pub.: India
5. David, B. V and T.N. Ananthkrishnan. General and Applied Entomology. 2nd Edition. Tata McGraw-Hill Publ. Co. Ltd.: New Delhi
6. Fenemore P G and Prakash Applied Entomology (New Age Publishers: New Delhi)
7. Packer, B. Aquaponics System: A Practical Guide to Building and Maintaining Your Own Backyard Aquaponics
8. Jayashree, K.V., C.S. Tharadevi & N. Aurumugam. Apiculture. Saras Publication
9. Chandra Girish. Apiculture & the Honey Bee (Know about the species of honey bees, beekeeping, pollination, beehives, entomology, beekeepers, honey making)
10. Arumugam, N., T. Murugan, R. Ram Prabh, J. Johnson Rajeshwar. Applied Zoology. Saras publication
11. Ganga & Chetty. Comprehensive Sericulture 2nd Edition Paperback. Oxford & IBH publication
12. Narasaiah, M.L. Problems and Prospects of Sericulture. Discovery Publishing Pvt. Ltd
13. Sharma, A.K., K. Jaiswal & R.N. Pandey. Research and Development in Indian Sericulture. Alfa Publications
14. Singh, R.N. & C.M. Bajpeyi. Muga Culture. APH Publishing Corporation
15. Bernstein, S. Aquaponic Gardening: A Step-By-Step Guide to Raising Vegetables and Fish Together New Society Publishers
16. Jadhav & Siddiqui. Handbook of Poultry Production and Management. Jaypee Publications
17. Krishnamurthy. An Advanced Textbook on Biodiversity: Principles and Practice. Oxford & IBH Publishing
18. Johns, J. Worm Farming - Creating Compost at Home With Vermiculture. Createspace Independent Pub
19. NPCS Board of Consultants & Engineers. The Complete Technology Book on Vermiculture and Vermicompost
20. ICAR. Handbook of Integrated Pest Management (IPM) Pub: ICAR, Govt. of India
21. Metcalf, R.W.H. Luckmann. Introduction to Insect Pest Management. Wiley India Pvt Ltd

22. <https://bloncampus.thehindubusinessline.com/case-studies/figure-out-how-7weaves-can-scale-up-and-go-global/article25933346.ece>
23. <https://bloncampus.thehindubusinessline.com/case-studies/7weaves-a-promising-model-for-ethical-slow-fashion/article26388043.ece>
24. <https://bloncampus.thehindubusinessline.com/case-studies/strong-business-model-can-creat-value-for-all/article26388095.ece>
25. <https://bloncampus.thehindubusinessline.com/case-studies/focussing-on-organic-growth-and-sustainability/article26389036.ece>

ZGEP0034: ETHOLOGY AND POPULATION GENETICS

Objective: *The purpose of this course is to familiarize students with essential aspects of animal behaviour, sociobiology and population genetics*

Module I: Basic Concepts of Ethology (10 hours)

- a) Concepts of Ethology,
- b) Genes and behaviour: Selfish gene concept, Fisher's Runaway theory
- c) Evolution and development of behaviour
- d) Deception, Mimicry, and Camouflage: Deimatic behaviour, Aposematic behaviour

Module II: Sociobiology (20 hours)

- a) Socialbehaviour: Properties and advantages of social grouping, social group of monkeys;
- b) Fitness: Darwinian fitness, individual fitness, kin selection, group, cooperation, reciprocity, altruism, reciprocal altruism, Proximate and Ultimate causations;
- c) Parental care in animals (amphibians)

Module III: Learning and Communication (10 hours)

- a) Communication in animals-vocal, tactile, visual and chemical
- b) Territoriality and aggression
- c) Learning: Introduction and definition, Types-Habituation, trial and error, conditioning, cognition and imprinting; Short and long term memory, neural mechanism of learning

Module IV: Population Genetics (20 hours)

- a) Gene frequencies in population - The Hardy-Weinberg principle and analysis of gene frequencies in natural population.
- b) Major factors influencing gene frequencies (migration, inbreeding),
- c) Effects of selection and mutation on gene frequencies.
- d) Gene flow between subpopulations

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define states and events of behaviour. (Remembering)
- CO2:** Illustrate the concept of ethology and its significance. (Understanding)
- CO3:** Explain fitness in terms of evolution (Understanding)
- CO4:** Apply Hardy Weinberg law for studying population genetics (Applying)
- CO5:** Identify sociobiology, social hierarchy, dominance in group living animals. (Applying)
- CO6:** Construct behavioral catalog for studying animal behavior. (Creating)

Suggested Readings

1. Drickamer & Vessey: Animal Behaviour –Concepts, Processes and Methods, Wadsworth
2. Goodenough et al :Perspectives on Animal Behaviour, Wiley,
3. Grier : Biology of Animal Behaviour, Mosby,
4. John Alcock: Animal Behaviour, Sinauer associates
5. John Krebs, Baron Krebs: An introduction to behavioural ecology, Blackwell scientifics
6. Aubrey Manning: An introduction to animal Behaviour, Cambridge University press

ZGPP0101: NON-CHORDATES I: PROTISTA TO PSEUDOCOELOMATES**(4 Credits-60 Hours)(L-T-P:4-0-0)**

Objective: To know the general characters and classification of Non-chordates and understand the increasing complexity of body forms.

Module I: Protista, Parazoa and Metazoa (19 Hours)

General characteristics and Classification up to classes Study of Euglena, Amoeba and Paramecium Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoebahistoltytica* Locomotion and Reproduction in Protista Evolution of symmetry and segmentation of Metazoa

Module II: Porifera (7 Hours)

General characteristics and Classification up to classes Canal system and spicules in sponges

Module III: Cnidaria (12 Hours)

General characteristics and Classification up to classes Metagenesis in Obelia Polymorphism in Cnidaria, Corals and coral reefs.

Module IV: Ctenophora (4 Hours)

General characteristics and Evolutionary significance

Module V: Platyhelminthes (10 Hours)

General characteristics and Classification up to classes Life cycle and pathogenicity of *Fasciola hepatica* and *Taeniasolium*

Module VI: Nematelminthes (8 Hours)

General characteristics and Classification up to classes Life cycle, and pathogenicity of *Ascarislumbricoides* and *Wuchereriabancrofti* Parasitic adaptations in helminthes

Note: Classification to be followed from “Barnes, R.D. (1982). Invertebrate Zoology, V Edition”

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Interpret the evolution and history of the phylum. (Understanding)
- CO2:** Illustrate the life cycles of important representative organisms belonging to these phyla. (Understanding)
- CO3:** Identify the distinguishing characters of the protists and pseudoceolomates. (Applying)
- CO4:** Analyze the pathogenicity of selected non-chordate/ pseudoceolomate organisms. (Analyzing)

Suggested Readings

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science Barrington
3. E.J.W. (1979) Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

ZGPE0102: PERSPECTIVES IN ECOLOGY**(4 Credits-60 Hours)(L-T-P:4-0-0)****Objective:** *To understand Principles and the concepts in ecology and wildlife management***Module I: Introduction to Ecology (6 Hours)**

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors

Module II: Population (24 Hours)

Unitary and Modular populations Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion Exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors Population interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses

Module III: Community (12 Hours)

Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example Theories pertaining to climax community

Module IV: Ecosystem (14 Hours)

Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with one example of Nitrogen cycle Human modified ecosystem

Module V: Applied Ecology (4 Hours)

Ecology in Wildlife Conservation and Management

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Compare the mechanism of various biological interactions. (Understanding)
- CO2:** Analyze different population dynamics and interactions. (Analyzing)
- CO3:** Identify the relationship between biotic and abiotic factors. (Applying)
- CO4:** Apply conservation and management strategies for local endangered species. (Applying)
- CO5:** Construct ecosystem energetics with reference to food chain. (Creating)

Suggested Readings

1. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pres

ZGCL0103: NON-CHORDATES II: COELOMATES**(4 Credits-60 Hours)(L-T-P:4-0-0)****Objective:** *To know the general characters and classification of Coelomates and understand the increasing complexity of organization of life from lower to higher Coelomates*

Module I: Introduction to Coelomates (2 Hours)

Evolution of coelom and metamerism

Module II: Annelida (10 Hours)

General characteristics and Classification up to classes Excretion in Annelida

Module III: Arthropoda (17 Hours)

General characteristics and Classification up to classes Vision and Respiration in Arthropoda
Metamorphosis in Insects Social life in bees and termites

Module IV: Onychophora (4 Hours)

General characteristics and Evolutionary significance

Module V: Mollusca (15 Hours)

General characteristics and Classification up to classes, Respiration in Mollusca Torsion and detorsion in Gastropoda, Pearl formation in bivalves, Evolutionary significance of trochophore larva.

Module VI: Echinodermata (12 Hours)

General characteristics and Classification up to classes, Water-vascular system in Asterozoa, Larval forms in Echinodermata, Affinities with Chordates

Note: Classification to be followed from "Ruppert and Barnes (2006) Invertebrate Zoology, 8th edition, Holt Saunders International Edition" CBCS Undergraduate Program in Zoology 2015

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Interpret the evolution of body cavity in coelomates. (Understanding)
- CO2:** Illustrate the morphological structure different larval forms of important representative organisms belonging to these phyla. (Understanding)
- CO3:** Identify the distinguishing characters of the coelomates. (Applying)
- CO4:** Distinguish the unique physiology of selected representative non-chordate/ coelomate organisms. (Analyzing)

Suggested Readings

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
2. Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

ZGCB0104: CELL BIOLOGY

(4 Credits-60 Hours)(L-T-P:4-0-0)

Objective: To understand structure and functions of Cell organelles

Module I: Overview of Cells (3 Hours)

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions

Module II: Plasma Membrane (7 Hours)

Various models of plasma membrane structure Transport across membranes: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Desmosomes, Gap junctions

Module I: Endomembrane System (10 Hours)

Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Module IV: Mitochondria and Peroxisomes (8 Hours)

Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes

Module V: Cytoskeleton (8 Hours)

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Module VI: Nucleus (12 Hours)

Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Module VII: Cell Division (8 Hours)

Mitosis, Meiosis, Cell cycle and its regulation

Module VIII: Cell Signaling (4 Hours)

GPCR and Role of second messenger (cAMP)

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

- CO1:** Define the composition and function of membrane structure. (Remembering)
- CO2:** Interpret the different cell types, viz., prokaryotes, eukaryotes and viroids. (Understanding)
- CO3:** Demonstrate the presence and location of DNA, RNA and polysaccharides in tissue sections. (Understanding)
- CO4:** Distinguish the three primary components of the cytoskeleton and their role in affecting cell shape, function and movement. (Analyzing)
- CO5:** Compare the complexity and interaction of the varied organelles, including Endoplasmic Reticulum, Golgi apparatus, Mitochondria, nucleus and peroxisomes. (Evaluating)

Suggested Readings

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

ZGAD0105: ANIMAL DIVERSITY

(4 Credits-60 Hours)(L-T-P:4-0-0)

Objective: To know the general characters and classification of Non-chordates and Chordates and to understand the increasing complexity of body forms.

Module I: Protista (4 Hours)

General characters of Protozoa; Life cycle of Plasmodium

Module II: Porifera (3 Hours)

General characters and canal system in Porifera

Module III: Radiata (3 Hours)

General characters of Cnidarians and polymorphism

Module IV: Aceolomates (3 Hours)

General characters of Helminthes; Life cycle of Taeniasolium

Module V: Pseudocoelomates (3 Hours)

General characters of Nemethehelminthes; Parasitic adaptations

Module VI: Coelomate Protostomes (3 Hours)

General characters of Annelida ;Metamerism.

Module VII: Arthropoda (4 Hours)

General characters. Social life in insects.

Module VIII: Mollusca (3 Hours)

General characters of mollusca; Pearl Formation

Module IX: Coelomate Deuterostomes (3 Hours)

General characters of Echinodermata, Water Vascular system in Starfish.

Module X: Protochordata (2 Hours)

Salient features

Module XI: Pisces (4 Hours)

Osmoregulation, Migration of Fishes

Module XII: Amphibia (4 Hours)

General characters, Adaptations for terrestrial life, Parental care in Amphibia.

Module XIII: Amniotes (5 Hours)

Origin of reptiles. Terrestrial adaptations in reptiles.

Module XIV: Aves (5 Hours)

The origin of birds; Flight adaptations

Module XV: Mammalia (6 Hours)

Early evolution of mammals; Primates; Dentition in mammals.

COURSE/LEARNING OUTCOMES

At the end of the course, students will be able to:

- CO1:** Explain the diversity and evolution of different non-chordate and chordate phyla, including birds and reptiles. (Understanding)
- CO2:** Illustrate the life cycle, pathogenicity, parasitic adaptations and social adaptations of selected non-chordates. (Understanding)
- CO3:** Summarize the increasing morphological complexity of different body forms pertaining to both non-chordates and chordates. (Understanding)
- CO4:** Identify the different animal phyla based on their general and unique characteristics. (Applying)
- CO5:** Compare the patterns of migration, parental care, terrestrial and flight adaptations and dentition in different vertebrate groups. (Analyzing)

Suggested Readings

1. Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
2. Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
3. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
4. Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.
5. Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi.

ZGEP0106: ENVIRONMENT AND PUBLIC HEALTH**(4 Credits-60 Hours)(L-T-P:4-0-0)****Objective:** *To study about the environment and human interaction to public health.***Module I: Introduction (10 Hours)**

Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

Module II: Climate Change (10 Hours)

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

Module III: Pollution (10 Hours)

Air, water, noise pollution sources and effects, Pollution control

Module IV: Waste Management Technologies (20 Hours)

Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

Module V: Diseases (10 Hours)

Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid

COURSE/LEARNING OUTCOMES

At the end of the course, students will be able to:

- CO1:** Illustrate the effects of air, water and noise pollution with regards to human health. (Understanding)
- CO2:** Identify different types and sources of environmental hazards, their persistence, dose and exposure. (Applying)
- CO3:** Distinguish the different factors contributing to climate change and their effect in human health. (Analyzing)
- CO4:** Compile the various types of waste generated, their disposal and management. (Creating)

Suggested Readings

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.

4. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
5. Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.

LABORATORY COURSES

ZGPR6004: PROJECT MANAGEMENT, REPORTING AND DOCUMENTATION

(2 Credits)

Objective: This course, which will be conducted as a short-term workshop, is designed to help the students to prepare a project proposal, learn the techniques of handling a project and prepare reports.

Objective	Help the student to understand Entrepreneurship, identification of qualities of a successful entrepreneur & how to develop it
Module	Entrepreneurship : Concept and Functions
Content	<ul style="list-style-type: none"> • Who is an entrepreneur? • Entrepreneurial competencies(Initiative, Creativity and Innovation, Risk Taking and Risk Management, Problem Solving, Leadership, Persistence, Quality Performance, • Information Seeking, Systematic Planning, Persuasion and Influencing Others, • Enterprise Launching Competencies, Enterprise Management Competencies) • Functions of an entrepreneur (Promotional functions: Innovation, Risk-taking, • Organisation Building, Discovery of an idea, Detailed Investigation, Assembling the Requirements, Financing the Proposition. Managerial functions: Planning, Organizing, • Staffing, Leadership, Supervision, Communication, Motivation, Controlling. • Commercial Functions : Production, Finance, Marketing, Accounting) • Types of entrepreneur (Innovative Entrepreneur, Imitative Entrepreneur, Fabian • Entrepreneurs, Drone Entrepreneurs) • Entrepreneurship: meaning and definition; types of entrepreneurship; entrepreneur and entrepreneurship • Difference between entrepreneur and employee
Objective	Help the students to generate various business ideas and link the best one with them
Module	Generation of business ideas and linking
Contents	<ul style="list-style-type: none"> • EDP: Meaning, Need, Importance of EDP • Necessity of generating ideas • Ways to generate ideas, Area Assessment Survey – Modes (Desk Research, Field Work, Market Need Based Opportunities, Ideas from Existing Entrepreneurs) • Linking business ideas with the entrepreneur

	<ul style="list-style-type: none"> Methodology of Opportunity Identification & Profiling Business Ideas (Preparation of Personal Profile, Development of OS (decision making) Framework, Snap Investigation of ideas generated, Evaluation in terms of OS (decision making) Framework and Short-listing of Ideas, Pre-feasibility Studies, Errors in Selection, Final Opportunity Selection) Preparation of business project plan and business project plan execution (Summary of the Project/Project at a Glance, General Information, Details of the Proposed Project, Market Potential, Manufacturing Process, Production Programme/Sales Revenue, Cost of Manufacturing and Profitability Projections)
Objective	To impart knowledge on social entrepreneurship
Module	Social entrepreneurship
Contents	<ul style="list-style-type: none"> Who is a social entrepreneur (definition and case study) Difference between entrepreneurship and social entrepreneurship Characteristics of social entrepreneur (Social Catalysts, Socially aware, Opportunity- seeking, Innovative, Resourceful, Accountable) Examples and case study
Objective	To impart knowledge on preparation of DPR
Module	Preparation of Detailed Project Report (DPR) and financials of a DPR
	<ul style="list-style-type: none"> Business plan : key questions Technical arrangement & Production process (Manufacturing process, Sources of technical know how, plant & machinery, Supplier identification & supplier selection, Raw materials, packaging, land requirement, utilities and manpower, financial viability) and Location selection (Layout, built up area etc)
Content	<ul style="list-style-type: none"> Product and Market (Product description, Capacity, Market study and market demand, Product mix, Branding, Channels of distribution, Advertising and Promotion etc.) Project cost and means of finance (Land, site development, building and civil works, plant and machinery cost, other fixed assets, technical knowhow fees, preliminary and preoperative expanses, working capital margin, contingency and escalation) Income analysis (Capital utilisation and income estimate, Expenditure estimate, Profit estimate, income tax estimate, profitability ratios : TC ratio, cash flow estimate, risk analysis, sensitivity analysis etc.)
Objective	Impart knowledge on implementing, managing and monitoring the progress of the selected project
Module	Project implementation and management
Contents	<ul style="list-style-type: none"> Understanding Total Quality Management (Acceptable Quality Level, Benchmarking, Deming Wheel, ISO 9000,Pareto Analysis, Quality Circles, Measures of Central Tendency and Dispersion, Geometric Moving Average, Statistical Process Control etc.) Goal Oriented Project Planning (Project Planning Matrix and Product Matrix)

	<ul style="list-style-type: none"> Project Activity Planning and Implementation (Gantt Charts, the Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM) of project scheduling) Soft skills for launching and managing a project (Creativity and Problem Solving, Interpersonal Communication, Persuasion and Use of Influence Strategy, Negotiation and Networking, Delegation of Authority and Work Effort, Efficiency Orientation As a Trait, Leadership, Concept of risk and risk taking, Legal Requirements, Types of business organisation) Managing Business Crisis – Starting and Liquidity Crisis
Objective	To impart the Knowledge of different component of Market
Module	Concept of market
Content	<ul style="list-style-type: none"> Traditional market Emerging market : E commerce Analysing the market environment 4 Researching the market and market survey Marketing mix Product mix Promotion mix Price mix, method of pricing
Objective	To impart knowledge on Book Keeping
Module	Book keeping and Accountancy
	<ul style="list-style-type: none"> Basic concept of Accounting (Management and financial accounting) Basic books of accounts (Journal, Purchase book, Purchase return book, Sales book, Sales return book, ledger book, Cash book etc.) Financial statement: Meaning, Importance <ul style="list-style-type: none"> Profit and loss account Balance sheet Depreciation and adjustment etc. Interpretation of financial Statement (Liquidity, Current ratio, Profitability ratio, Inventory turnover ratio, Debtors turnover ratio, ROI etc) Fund flow Analysis
Objective	To impart knowledge on Documentation and Reporting
Module	Documentation and Reporting
Content	Why to Document
	What is a Documentation Report
	When and How to prepare the Documentation Report
	Typical format of a Documentation report
	Layout of the Report
	Writing a Report

ZGJP6007: INTRODUCTION TO JOURNALISM AND PHOTOGRAPHY**2 Credits**

Objective: *This course, which will be conducted as a short-term workshop, is designed to help the students with hands on experiences in journalism and photography.*

Total 30 Hour Learning Objective

Through theory and practical assignments, this class provides the students with hands on experiences in photography. Lectures, field studies, guest instructors, student presentation and group work will help you develop the analytical basis and insight to reflect upon and assess the impact of photographs on our ideas of the world.

By the end of this course, Students will: Be able to start their career in photography. Will be able to create picture story / Photo Essays and understand the conventions and challenges of telling stories through images

Gain personal leadership through challenging, intercultural assignments

Objective: *This module will help to understand the students about photography basics*

Module I: Introduction to photography

History of photography, Mental Models in Photography, Photographer's Knowledge zones, Camera Basics, Operating a Camera, Types of Film, Exposure, Aperture & Shutter Speeds TTL Light Meter, Depth of Field, Choosing Lenses, Types of lens, Lighting, Flash Photography Filters, Steady Shooting, , Composition.

Objective: *This module will help to understand the students about different types of photography in details*

Module II: Different genres of photography

Mobile Photography, Product Photography, Event Photography, Landscape Photography, Fashion Photography

Objective: *Post production is an important part of photography student will learn post-production in this module*

Module III: Post Processing

Enhancing Photographs, Organizing the Picture, Quality Control, Intermediate/advanced use of post-production software like Adobe Photoshop, LightRoom etc, a variety of photo content management tools (CMS) such as Photo Mechanic, and several online.

Objective: *How to earn the livelihood from selling your images internationally*

Module IV: Stock Photography

Introduction to Stock Photography, How to contribute to various stock photo agencies. Causes of rejections, Submitting Guidelines, Meta Data

Objective: *This module focuses on photojournalism.*

Module V: Photojournalism

Introduction to Photojournalism Ethics of Photojournalism How to photograph the single-image news and feature assignment Techniques for developing and structuring professional calibre long-form photo stories How to edit, caption, keyword and organize large numbers of photos. presentation tools such as iPhoto, Jux, and WordPress. Tools and standards for building a professional portfolio and presenting visual work online.

ZGTM6010: TEACHING METHODOLOGY AND CLASS ROOM MANAGEMENT**(2 Credits)**

Objective: This course, which will be conducted as a short-term workshop, is designed to help the students to prepare for efficient teaching with skills of class room management.

Module I

Introduction to Core teaching Skills.

Micro- teaching.

Introduction to Methods, Maxims, Devices and techniques of teaching.

Practice teaching on Core teaching Skills in Micro-teaching mode.

Approaches and methods of teaching Science - (a) Lecture, demonstration, explanation, Observation. (b) Ensuring Problem solving, laboratory, Project, Heuristic, Discussion for teaching science. (c) Learning by discovery, group work and team teaching. (d) Collaborative strategies, provision in heterogeneous class room.

Module II

Planning and designing for effective instruction in science.

- a) Design of unit and lesson planning approaches to lesson planning, format of lesson plan
- b) Teaching aids and laboratory in science, their necessity and importance.
- c) Museum, field trips and excursion, their relevance to science.
- d) Preparation of simple aids of Science teaching.

Module III

Evaluation of Learners Progress.

- a) Concept and importance of assessment & evaluation.
- b) Techniques of evaluation (Theory & Practical)
- c) Construction of Unit test: Design and blue print, Item construction, Question wise analysis, Construction of Science question paper including marking scheme.

Module IV

Information and Communication Technology (ICT) Integration in Science teaching.

- a) Introduction to ICT
- b) Importance of ICT in Science teaching.
- c) Exploring various ICT tools for Science teaching.
- d) Open Education Resources (OER) and its uses in Science teaching.
- e) ICT Integration in Science teaching.
- f) Exploring FOSS in Science teaching.

ZGEE6011: SPECIALIZATION LAB I – ENTOMOLOGY AND ENVIRONMENTAL BIOLOGY**(2 Credits)**

1. Study of insect collection and preservation
2. Study of different types of mouth parts
3. Study of different types of antenna
4. Study of different types of legs

5. Preparation of arolium, empodium and pollen basket
6. Preparation and identification of haemocytes, quantitative count of haemocytes.
7. Detection of chitin in insect cuticle
8. Detection of Uric acid in insects
9. Estimation of protein from haemolymph of insects.
10. Identification of Pests (Tea, Jute, Paddy stored grain)
11. Identification of insects of forensic importance and forest defoliator
12. Identification of Conservation importance insects (Butterfly, Honeybee and beetles)
13. Identification and anatomical studies of major vector species of Anopheles, Culex and Aedes

ZGCM6012: SPECIALIZATION LAB I- CELL AND MOLECULAR BIOLOGY

(2 Credits)

1. Use of ocurometer-standardization and measurements of cell height, nuclear diameters and tabular diameters
2. Histology of biological tissues and sectioning by microtome
3. Preparation of salivary gland chromosomes from *Drosophila* /Chironomous larva and stain with acetocarmine/aceto-orcein/fuelgen
4. Preparation of mammalian chromosomes from bone marrow or testis and stain with Giemsa stain
5. Determination of pK value of buffer
6. Determination of relationship between absorption and various concentration of a solution using a colorimeter, spectrophotometer/spectrophotometer.
7. Quantization of enzymes: End point techniques (alkaline phosphatase) and enzyme kinetics
8. Permanent Slides: Types of cells (squamous, cuboidal, columnar epithelial cells, blood cells, nerve cells, muscle cells), connective tissues of various types, adipose tissue, mitotic & meiotic chromosomes and their different phases.
9. Preparation of emulsions- syringe method and hubbed needle method
10. Immunization routes: Intradermal, Subcutaneous, Intramuscular, Intraperitoneal, Intravenous,
11. Bleeding Schedules and collection of blood: cardiac puncture, external jugular vein
12. Separation and preservation of serum: Liquid Storage using preservative and by sterilization
13. Report submission- Visit to advanced lab

ZGFS6013: SPECIALIZATION LAB I- FISHERY SCIENCE

(2 Credits)

1. Identification of commercially important fish species of north east India representing all fish groups
2. Fish osteology —preparation of fish skeleton (using KOH and Trypsin).
3. Biological Analysis of fish samples for gut contents, maturity stages and fecundity
4. Dissecting out the pituitary gland and preparing the extract, Weberian Ossicle.
5. Determination of length-weight analysis in fishes.

6. Dissecting out the Weberian Ossicle
7. Determination of gonado somatic index(GSI), hepatosomatic index(HSI),condition factor(CF), and fecundity.
8. External characters, types of scales, fins, types of teeth, structure of alimentary canal, gill rakers.
9. Visit to fish landing centre and fish farms and make Reports of visit

ZGAW6014: SPECIALIZATION LAB I- ANIMAL ECOLOGY AND WILDLIFE BIOLOGY

(2 Credits)

1. Identification of species of butterfly, fishes, amphibia, reptilia, aves and mammalia from collection/model/photographs etc.
2. Identification of fish, amphibian and reptiles (local fauna) using Morphometric land marks.
3. Ecological Sampling techniques:
 - a) point transect,
 - b) line transects,
 - c) belt transect,
4. Behavioural study through Ethogram preparation
5. Time and Activity budgeting using Focal/Scan sampling.
6. Systematic study of common plants: Field and Herbarium techniques.
7. Study of successional stages of various forest communities.
8. Measuring diversity using Diversity :
 - a) Diversity Indices: Shannon Weiner Index, Brillouin's index, Simpson index.
 - b) Similarity Indices: Morisita's index, Sorenson's coefficient, Sorenson's and Dice index, Jaccard index
 - c) Dissimilarity indices: Bray-Curtis, Ochiai index
9. Report Submission: Study of nearby protected areas (forests and grasslands) under various management regimes and make a report

ZGEE6015: SPECIALIZATION LAB II – ENTOMOLOGY AND ENVIRONMENTAL BIOLOGY

(2 Credits)

1. Histological study of foregut, midgut and hindgut of insect.
2. Reproductive system of cockroach
3. Prothoracic gland of cockroach
4. Alimentary canal of house fly with crop
5. Bacterial chamber of termite
6. Salivary gland of Cockroach
7. Pharyngeal, labial and thoracic salivary gland of honey bee
8. Sting apparatus of honey bee
9. Identification of aquatic, terrestrial and boring insects with specific adaptive characteristics.
10. Visit to agricultural field/tea garden and forest for on spot study of pest and damage caused by them

11. Preparation of Phylogenetic tree of Insect species
12. Study of Lifecycle of Mosquito, Housefly, Drosophila
13. Collection and identification of economically important insects and various stages of their life history.

ZGCM6016: SPECIALIZATION LAB II- CELL AND MOLECULAR BIOLOGY

(2 Credits)

1. Tissue homogenization and fractionation by differential centrifugation for isolation of mitochondria, nuclei and cytosol
2. Separation of proteins and DNA by agarose electrophoresis
3. Separation of proteins on SDS-PAGE
4. Separation of amino acids by paper chromatography
5. Separation of by TLC
6. Separation of hemoglobin by column chromatography
7. Detection of Carbohydrate (a) PAS method/(b) Alcian blue method
8. Detection of Proteins (a) Mercury bromophenol blue method/(b) Ninhydrin method
9. Detection of Lipids (a) Phosphomolybic acid method/(b) Copper phthalocynin n method
10. Detection of Nucleic acid (a) Feulgen method /(b) Methylene green- Pyronin method.
11. Isolation and vital staining of lymphocytes from sensitized animals from spleen, lymph nodes
12. Immunodiffusion method

ZGFS6017: SPECIALIZATION LAB II- FISHERY SCIENCE

(2 Credits)

1. Analysis of water samples for various physico-chemical parameters—pH, freeCO₂, dissolved oxygen, alkalinity, chloride, hardness, nitrates, phosphates, BOD, COD
2. Estimation of primary productivity by light and dark method.
3. Composition and biomass of phytoplankton, Collection, enumeration and biomass of Zooplankton
4. Identification of important fish parasites (external and internal).
5. Identification of fishing gears and fish by products.
6. Fieldwork: Visit to fresh water bodies, study of physico-chemical and biological status and make a report
7. Visit to fish processing centers and make a report.

ZGAW6018: SPECIALIZATION LAB II- ANIMAL ECOLOGY AND WILDLIFE BIOLOGY

(2 Credits)

1. Ecological census techniques:
 - a) mark recapture
 - b) quadrat sampling
 - c) plot-less sampling
 - d) pellet group count

2. Animal sign & marks analysis: Pug mark analysis; Scat/ Dung analysis: (parasite identification)
3. Mapping distribution of endangered animal fauna of Northeast India
4. Demonstration and use of equipment- camera traps, remote drug delivery equipments, tags, collars, radio tracking equipment
5. Analysis of Abundance Data
6. Extraction of DNA from biological sample, PCR amplification
7. Preparation of an area map using on field GPS data.
8. Acoustic analysis of birds /amphibians
9. Report Submission: Preparation of conservation statements-through review of literature or via field visit.

ZGBE6019: BIOSYSTEMATICS AND ENVIRONMENTAL BIOLOGY LAB

(2 Credits)

1. Collection, preservation, curation and identification of non-chordate and chordate species(only pest and cultured species)
2. Identification with only diagnostic features (specimen or model/diagnostic photograph) of different phyla
3. Survey and application of biodiversity indices on animal species (any one group)
4. Calculation of Pearson correlationco efficient,Ttest (One samplet-test,Two samplet-test,Pairedt-test); Chi square test, ANOVA, Mann-Whitney test on supplied data.
5. Preparationof Taxonomic key, study of evolutionthrough models/charts.
6. Sequence alignments, Blastn, Blastp, Psi-Blast, Clustal Omega
7. Homology modeling
8. Phylogenetic Analysis using academic software
9. Estimationof CO₂, DO, Nitrites, total alkalinity and hardness of water sample.
10. Study of zooplanktons and its role in a pond ecosystem.
11. Analysis of physical parameters of soil.
12. Study of different types of survey techniques

ZGCI6020: CELL BIOLOGY, GENETICS AND BASIC BIOINFORMATICS LAB

(2 Credits)

1. Use and care and maintenance of common lab equipment (microscope, colorimeter/ spectrophotometer, balance, pH meter, oven, incubator, microtome, electrophoretic apparatus, centrifuge, water bath etc.) and glass wares.
2. Identification of various stages of mitosis and meiosis from prepared slides.
3. Temporary squash preparation of onion root-tip/tadpole tail-tip cells to study stages of mitosis and Grasshopper/ Gryllotalpa testis to study meiotic stage of cell division.
4. Comparison of RBC and WBC in different groups of Vertebrate.
5. Isolation of DNA from animal source.
6. Agarosegel electrophoresis of isolated genomic DNA.
7. Usage of NCBI resources

8. Usage/Retrieval of sequence/structure from databases
9. Visualization of structures
10. Protein Docking and Docking of ligand receptors

ZGDB6021: DEVELOPMENTAL BIOLOGY AND BIOCHEMISTRY LAB

(2 Credits)

1. In vivo/in vitro culture and study of chick embryo.
2. Study of developmental stages of Chick/Frog embryo from permanent slides.
3. Study of different stages of estrous cycle in mice.
4. Histology: Tissue processing, sectioning, staining, analysis
5. Preparation of buffers of different pH using Henderson-Hasselbalch equation and its verification using pH meter.
6. Quantitative estimation of amino acid using ninhydrin reagent.
7. Quantitative estimation of total protein by Lowry method.
8. Estimation of glucose in serum by glucose oxidase peroxidase method/tissue by Anthrone reagent
9. Determination of *invitro* antioxidant property (of plants extracts).

ZGEP6022: ETHOLOGY AND POPULATION GENETICS LAB

(2 Credits)

1. Identification of different behavioral types (States and Events) in any group of animal.
2. Preparation of behavioral catalog (Ethogram)
3. Behavioral sampling Techniques: Scan animal Sampling, Focal animal sampling
4. Time and activity budgeting
5. Social organisation in primates
6. Analysis of gene frequencies using Hardy Weinberg Law using case studies.
7. Thermotactic behaviour in Zooplanktons/ Earthworm
8. Chemotactic behaviour in Zooplanktons/ Earthworm
9. Food preference in *Tribolium* / fish.
10. Study of Deimatic behaviour/ Aposematic behaviour in any group of animal.
11. Analysis of inclusive fitness.

ZGPP6101: NON-CHORDATES I: PROTISTA TO PSEUDOCOELOMATES LAB

(2 Credits)(L-T-P : 0-0-2)

1. Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and Conjugation in Paramecium
2. Examination of pond water collected from different places for diversity in protista
3. Study of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla
4. Study of Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora
5. One specimen/slide of any ctenophore
6. Study of adult Fasciola hepatica, Taeniasolium and their life cycles (Slides/microphotographs)

7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs)
8. To submit a Project Report on any related topic on life cycles/coral/ coral reefs.

ZGPE6102: PERSPECTIVES IN ECOLOGY LAB

(2 Credits)(L-T-P : 0-0-2)

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO₂
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

ZGCL6103: NON-CHORDATES II: COELOMATES LAB

(2 Credits)(L-T-P : 0-0-2)

1. Study of following specimens: Annelids - Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria Arthropods - Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Philoamia, Periplaneta, Termites and honey bees, Onychophora-Peripatus, Molluscs - Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus Echinodermates - Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon
2. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm
3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
4. Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta*
5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

ZGCB6104: CELL BIOLOGY LAB

(2 Credits)(L-T-P: 0-0-2)

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
 - i) DNA by Feulgen reaction
 - ii) DNA and RNA by MGP
 - iii) Mucopolysaccharides by PAS reaction
 - iv) Proteins by Mercurobromophenol blue/Fast Green

ZGAD6105: ANIMAL DIVERSITY LAB

(2 Credits)(L-T-P: 0-0-2)

1. Study of following specimens: Non Chordates: Euglena, Noctiluca, Paramecium, Sycon, Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, Hermitcrab, Daphnia, Millipede, Centipede, Beetle, Chiton, Dentalium, Octopus, Asterias, and Antedon. Chordates: Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Ichthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx, any three common birds-(Crow, duck, Owl), Squirrel and Bat.
2. Study of following Permanent Slides: Cross section of Sycon, Sea anemone and Ascaris(male and female). T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine. Bipinnaria and Pluteus larva.
3. Temporary mounts of Septal & pharyngeal nephridia of earthworm. Unstained mounts of Placoid, cycloid and ctenoid scales.
4. Dissections of Digestive and nervous system of Cockroach or Urinogenital system of Rat

ZGEP6106: ENVIRONMENT AND PUBLIC HEALTH LAB

(2 Credits)(L-T-P: 0-0-2)

1. To determine pH, Cl, SO_4 , NO_3 in soil samples from different locations.
2. To determine pH, CO_2 , DO, Transparency and NO_3 in water samples from different locations.

DEPARTMENT OF BOTANY

DETAILED SYLLABUS

THEORY COURSES

BOBI0001: BIOLOGY

(3 Credits-45 hours)

Objective: *The objective of this course is to make the students to understand the basic concept of cells which bring forth the components building a cell and cellular process, basic structural and functional aspects of Proteins, DNA and RNA. Also enable the students to know about gene and its different aspects in human genetics.*

Module I: Introduction (4 hours)

Importance of Biology: Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft; Aspect of biology as an independent scientific discipline. History of Biology: Biological observations of 18th Century; Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

Module II: Classification (5 hours)

Classification and its criteria: Morphological, Biochemical and Ecological; Hierarchy of Classifications, based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life; Organism from different based on classification for the study :1. E.coli, 2. S.cerevisiae, 3. D. Melanogaster, 4.C. elegance, 5. A. Thaliana, 6. M. Musculus

Module III: Genetics and Information Transfer (13 hours)

- Mendel's laws: Law of segregation and Law of independent assortment, Dominance, Recessiveness; Allele, Gene mapping, Gene interaction, Epistasis ; Meiosis and Mitosis in heredity; Gene – mapping; Genetic disorders in humans; complementation in human genetics.
- DNA as a genetic material; Structure of DNA- single stranded, double stranded and nucleosomes; Genetic code- Salient features; Gene - complementation and recombination.

Module IV: Biomolecules and Enzymes (14 hours)

- Biomolecules of life: Micromolecules and Macromolecules- sugars, starch and cellulose; Amino acids and proteins; Nucleotides and DNA/RNA; Two carbon units and lipids. Structure of proteins: Primary, Secondary, tertiary and Quaternary; Proteins as enzymes, transporters, receptors and structural elements.
- Enzyme classification. Mechanism of enzyme action of any two enzyme. Enzyme kinetics and kinetic parameters; RNA catalysis.

Module V: Metabolism (5 hours)

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Key and its relation to standard free energy.

Spontaneity. ATP as an energy currency; Glycolysis and Krebs cycle; Photosynthesis; Energy yielding and energy consuming reactions. Energy charge

Module VI: Microbiology (4 hours)

Unicellular organisms; Species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of unicellular organisms. Sterilization and media compositions. Growth kinetics.

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO 1:** Recall how biological observations of 18th Century that lead to major Discoveries. (Remembering)
- CO 2:** Convey that classification *per se* is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological (Understanding)
- CO 3:** Apply thermodynamic principles to biological systems (Applying)
- CO 4:** Analyse biological processes at the reductionist level. (Analysing)
- CO 5:** Examine DNA as a genetic material in the molecular basis of information transfer (Evaluating)
- CO 6:** Construct gene mapping in human being.(Creating)

Suggested Readings

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,
2. L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
3. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
4. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
5. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and
6. company, Distributed by Satish Kumar Jain for CBS Publisher
7. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

BOBE0002: BIOLOGY FOR ENGINEERING

(3 credits 45 hours) (L-T-P:3-0-0)

Objective: *The objective of this course is to make the students to understand the basic concept of cells which bring forth the components building a cell and cellular process, basic structural and functional aspects of Proteins, DNA and RNA. Also enable the students to know about gene and its different aspects in human genetics.*

Module I: Introduction (4 hours)

Importance of Biology: Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft; Aspect of biology as an independent scientific discipline. History of Biology: Biological observations of 18th Century; Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

Module II: Classification (5 hours)

Classification and its criteria: Morphological, Biochemical and Ecological; Hierarchy of Classifications, based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life; Organism from different based on classification for the study :1. E.coli, 2. S.cerevisiae, 3. D. Melanogaster, 4.C. elegance, 5. A. Thaliana, 6. M. musculus

Module III: Genetics and Information Transfer (13 hours)

- a. Mendel's laws: Law of segregation and Law of independent assortment, Dominance, Recessiveness; Allele, Gene mapping, Gene interaction, Epistasis ; Meiosis and Mitosis in heredity; Gene – mapping; Genetic disorders in humans; complementation in human genetics.
- b. DNA as a genetic material; Structure of DNA- single stranded, double stranded and nucleosomes; Genetic code- Salient features; Gene - complementation and recombination.

Module IV: Biomolecules and Enzymes (14 hours)

- a. Biomolecules of life: Micromolecules and Macromolecules- sugars, starch and cellulose; Amino acids and proteins; Nucleotides and DNA/RNA; Two carbon units and lipids. Structure of proteins: Primary, Secondary, tertiary and Quaternary; Proteins as enzymes, transporters, receptors and structural elements.
- b. Enzyme classification. Mechanism of enzyme action of any two enzyme. Enzyme kinetics and kinetic parameters; RNA catalysis.

Module V: Metabolism (5 hours)

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Key and its relation to standard free energy.

Spontaneity. ATP as an energy currency; Glycolysis and Krebs cycle; Photosynthesis; Energy yielding and energy consuming reactions. Energy charge

Module VI: Microbiology (4 hours)

Unicellular organisms; Species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of unicellular organisms. Sterilization and media compositions. Growth kinetics.

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO1:** Recall how biological observations of 18th Century that lead to major Discoveries. (Remembering)
- CO2:** Convey that classification *per se* is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological (Understanding)
- CO3:** Apply thermodynamic principles to biological systems.(Applying)
- CO4:** Analyze biological processes at the reductionist level. (Analyzing)
- CO5:** Examine DNA as a genetic material in the molecular basis of information transfer (Evaluating)
- CO6:** Construct gene mapping in human being.(Creating)

Suggested Readings

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,
2. L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
3. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
4. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
5. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and
6. company, Distributed by Satish Kumar Jain for CBS Publisher
7. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

BOPH0003: PHYCOLOGY**(3 Credits- 45 Hours)**

Objectives: To enable the students to get comprehensive knowledge on the diversity, reproduction and economic importance of algae

Module I: Introduction and Classification (5 hours)

Principles, criteria (pigments, flagellation, food reserve and eye spots) and systems of classification.

Module II: Thallus organization and Reproduction (20 hours)

Cell structure, thallus organization and reproduction in Cyanophyta, Chlorophyta, Phaeophyta, Rhodophyta, Xanthophyta, Chrysophyta, bacillariophyta, Pyrrophyta, Euglenophyta, Eustigmatophyta, Prasinophyta and Prochlorophyta.

Module III: Special structures and Processes (10 hours)

Heterocyst and akinete development, chromatic adaptation in Cyanophyta, alternation of generation in Phaeophyta and post fertilization development and site of meiosis in Rhodophyta.

Module IV: Influence of environmental agents and Applications (10 hours)

Algae in diverse habitats, algal blooms and Phycoviruses, Algae as food, biofertilizers and source of phycocolloids.

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO1:** Illustrate the diversity of algae. (Understanding)
- CO2:** Identify the salient features of each of the division of algae. (Applying)
- CO3:** Discuss the economic importance of each of the division of algae. (Creating)

Suggested Readings

1. Sharma OP. Algae, McGraw-Hill Education.
2. van Den Hoek C, D. G. Mann, H. M. Jahns. Algae: An Introduction to Phycology, Cambridge University Press.
3. Bilgrami KS, Saha LC. A textbook of Algae, CBS.
4. Lee RE. Phycology, Cambridge University Press.
5. Bellinger EG Sigeo DC. Freshwater Algae: Identification, Enumeration and use as Bioindicator, Willey Blackwell.
6. Dutta TC. A. C. Dutta A Class-Book of Botany. Oxford University Press.

BOMY0004: MYCOLOGY**(3 Credits- 45 Hours)**

Objectives: To give the students the knowledge about the taxonomy and diversity of fungi, the characteristic features of each of the division of fungi and the structure, reproduction, economic importance of lichens

Module I: Introduction and Classification (5 hours)

Introduction, scope and general principles of classification of fungi

Module II: Myxomycotina (6 hours)

Myxomycotina: Acrasiomycetes, Hydromyxomycetes, Myxomycetes and Plasmodiophorales.

Module III: Mastigomycotina (6 hours)

Mastigomycotina: Chytridiales, Blastocladales, Saprolegniales and Peronosporales

Module IV: Zygomycotina (6 hours)

Zygomycotina: Mucorales and Entomophthorales

Module V: Ascomycotina (6 hours)

Ascomycotina: Endomycetales, Protomycetales, Taphrinales, Erysiphales, Eurotiales, Sphaeriales, Helotiales, Phacidiales and Pezizales.

Module VI: Basidiomycotina (6 hours)

Basidiomycotina: Uredinales, Ustilaginales, Lycoperdales, Nidulariales, Sclerodermatales, Phallales, Agaricales, Aphyllaphorales, Tremellales and Auriculariales.

Module VII: Deuteromycotina (6 hours)

Deuteromycotina: Sphaeropsidales, Melanconiales, Moniliales and Mycelia sterilia.

Module VIII: Lichens (4 hours)

Lichens: Thallus structure, reproduction and economic importance

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO1:** Explain the concepts of taxonomy, diversity of fungi and their salient characteristics. (Understanding)
- CO2:** Develop their concept about structure, reproduction and economic importance of lichens. (Applying)

Suggested Readings

1. Alexopoulos CJ, Mims CW, Blackwell M. Introductory Mycology, Willey.
2. Dube HC. An Introduction to Fungi, Scientific Publishers.
3. Aneja KR, Mehrotra RS. Introduction to Mycology, New Age International Publisher.
4. Sharma OP. Textbook of Fungi, McGraw-Hill Education.
5. Arumugam N, Ragland A, Kumaresan V. College Botany-A Complete Guide (8-volumes), Saras Publication.
6. Peterson JH. The Kingdom of Fungi, Princeton University Press.
7. Whatkinson SH, Boddy L, Money N. The Fungi, Academic Press.
8. Smith AL. Lichens, Wentworth Press.

BOBA0005: BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS**(3 Credits- 45 Hours)**

Objectives: *To understand the diversity and complexity of bryophytes, pteridophytes and gymnosperms. To acquire the information of structural characteristic, pattern of reproduction and economic importance of each of the classes.*

Module I: Bryophytes (15 hours)

Classification of Bryophytes; Comparative account of gametophyte structure; Sporophytic structure and evolution; Peristome structure and its significance in the classification of Mosses; Economic importance of Bryophytes.

Module II: Pteridophytes (15 hours)

Classification of Pteridophytes; Early vascular plants: Rhyniophyta, Trimerophylophyta and Zosterophylophyta; Brief account of the range of structure and reproduction in Ferns; Telome concept, apogamy and apospory, heterospory and seed habit; Economic importance of Pteridophytes.

Module III: Gymnosperms (15 hours)

Classification of Gymnosperms; Kinds of fossils, process of fossilization; General account of Glossopteridaceae; Comparative study of Coniferales (Pinaceae, Cupressaceae, Araucariaceae, Podocarpaceae, Cephalotaxaceae, Taxodiaceae), Taxales and Gnetales (Gnetaceae, Ephedraceae and Welwitschiaceae); Economic importance of Gymnosperms.

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO1:** Demonstrate their knowledge regarding the morphological, reproductive diversity of bryophytes, pteridophytes and gymnosperms. (Understanding)
- CO2:** Discuss about economic importance of classes. (Creating)

Suggested Readings

1. Alam A. Textbook of Bryophyta, I K International Publishing House Pvt Ltd.
2. Johri RM, Lata S, Tyagi K. A Textbook of Bryophyta, Dominant Publishers and Distributors (Cornell University).
3. Vashishta PC, Sinha AK, Kumar A. Botany for Degree Students-Pteridophyta, S. Chand.
4. Mitra JN, Mitra D, Chowdhury SK. Studies in Botany (Vol I & Vol II), Moulik Library.
5. Sharma OP. Pteridophyta, McMillan India Limited.
6. Rashid A, An Introduction to Pteridophyta, South Asia Books.
7. Verma HK. A Textbook of Pteridophyta. Random Pub.
8. Bhatnagar SP. Gymnosperms, New Age International Publishers.

BOAN0006: ANGIOSPERMS**(4 Credits – 60 hours)**

Objectives: *The course aims to impart insight about the classification systems of angiosperms and nomenclature principles. The course will enable student to understand the taxonomic feature of each of the division of angiosperms. The course will give the concepts of numerical taxonomy, chemotaxonomy, biosystematics and will make the students understand the importance of molecular approaches, embryology and experimental embryology in taxonomy.*

Module I: Systematics and Botanical nomenclature (13 hours)

Systematics: Outline of classification of Angiosperms; Hutchinson, Takhtajan, Cronquist, merits and demerits; Botanical nomenclature: International code of Botanic Nomenclature; principles: Rules and recommendations; priority; typification; Rules of effective and valid publications; retention and choice of names; Biosystematics: concepts; biosystematic categories; methods in experimental taxonomy.

Module II: Angiospermic Families (15 hours)

Taxonomic features, systematic phylogeny and economic importance of families: Magnoliaceae, Capparidaceae, Combretaceae, Rosaceae, Asteraceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Scrophulariaceae, Acanthaceae, Bignoniaceae, Lamiaceae, Verbenaceae, Polygonaceae, Euphorbiaceae, Orchidaceae, Zingiberaceae, Araceae, Cyperaceae and Poaceae.

Module III: Numerical taxonomy and Chemotaxonomy (10 hours)

Numerical taxonomy: Aims and objectives, characters and attributes, OTUs, coding, cluster analysis, merits and demerits; Chemotaxonomy: Role of phytochemicals (non-protein amino acids, alkaloids, betalins, cynogenic glucosides, silica, gypsum, raphides, glucosinolate, flavonoids, terpenoids) in taxonomy.

Module IV: Molecular Plant Taxonomy (6 hours)

Molecular approaches to plant taxonomy: Application of DNA markers in angiosperm taxonomy; molecular phylogeny.

Module V: Self-incompatibility (6 hours)

Self-incompatibility: Structural and biochemical aspects; methods to overcome incompatibility - mixed pollination, bud pollination; intra-ovarian pollination, *in vitro* pollination; Embryology in relation to taxonomy.

Module VI: Experimental embryology (10 hours)

Experimental embryology: Haploid production; diploidization of haploids, importance of haploids; embryo culture; culture of differentiated and mature embryos; role of natural plant extracts and growth hormones; embryo-nurse endosperm transplantation; culturing of embryonal segments; practical aspects of embryo culture.

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO1:** Demonstrate their knowledge about the concepts of classification systems and nomenclature principles of angiosperms. (Understanding)
- CO2:** Apply the principles of numerical taxonomy, chemotaxonomy, biosystematics and give emphasis to study of molecular approaches, embryology and experimental embryology in relation to taxonomy. (Applying)

Suggested Readings

1. B. P. Pandey A textbook of Botany: Angiosperms S. Chand.
2. O. P. Sharma Plant Taxonomy McGraw-Hill Education
3. Amal Kumar Mandal Advanced Plant Taxonomy New Central Book Agency
4. R. Nair Taxonomy of Angiosperms Aph Publishing Corporation
5. Ragini Gupta Plant Taxonomy: Past, Present and Future The Energy and Research Institute TERI.
6. Austin Balfour (Editor) Plant Taxonomy Syrawood Publishing House.
7. Gurucharan Singh Plant Systematics: An Integrated Approach. CRC Press.
8. S. S. Bhojwani, S. P. Bhatnagar, P. K. Dantu The Embryology Angiosperms, Vikas Publishing.
9. P. H. Davis, V. H. Heywood Principles of Angiosperm Taxonomy, Scientific Publishers (India).
10. G. H. M. Lawrence Taxonomy of Vascular Plants Scientific Publisher.

BOPE0007: PLANT ECOLOGY**(3 Credits- 45 Hours)**

Objectives: *The course aims in delivering the knowledge about population dynamics and concepts of ecological niches, ecological succession. The course will give the idea about the eco systems classification, energy dynamics and nutrients cycles in the eco systems. The course will help students realize the importance of ecosystem stability with relation to biological diversity, environmental pollution and climate change.*

Module I: Introduction to Ecology (10 hours)

Vegetation organization and characteristics: Concepts of community and continuum; community coefficients, interspecific associations, ordination; ecological niche; species diversity (α , β , γ). Environmental pollution: Kinds, sources, effects on plants and ecosystems. Population concepts: Characteristics, dynamics and control.

Module II: Ecosystem Organization (8 hours)

Structure and functions; primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); decomposition (mechanism, controlling factors); ecosystem nutrient cycles.

Module III: Ecosystem Stability (7 hours)

Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion.

Module IV: Biological Diversity (7 hours)

Concept and levels; distribution and global patterns; terrestrial biodiversity hot spots; role of biodiversity in ecosystem functions; IUCN categories of threat; inventory; conservation, protected area network.

Module V: Ecological Succession (7 hours)

Models and mechanisms of ecological succession; changes in ecosystem properties during succession.

Module VI: Global Warming (6 hours)

Global change: Greenhouse gases, consequences of climate change; ozone layer depletion, causes and consequences.

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO1:** Explain the concepts of population dynamics, ecological niches and ecological succession. (Understanding)
- CO2:** identify eco systems classification, energy dynamics and nutrients cycles in the eco systems. (Applying)
- CO3:** Discuss about the biological diversity and impact of environment pollution on the biological diversity. (Creating)

Suggested Readings

1. Kormondy EJ. Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition
2. Odum EP.. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
3. Singh JS, Singh SP, Gupta S. Ecology Environment and Resource Conservation.
4. Anamaya Publications, New Delhi, India.
5. Wilkinson DM. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
6. Sharma PD. Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition..

BOMI0008: MICROBIOLOGY**(3 Credits- 45 Hours)**

Objectives: *In the course students will give the basic idea about the microbial diversity, nutritional types. The students will learn the various techniques of genetic recombination in bacteria. The course will also teach the concepts of lytic and lysogenic cycles. The course introduces the students to the various water borne pathogenic microbes, role of microbes in waste treatment and bioremediation. The students will also learn the basic design of a fermenter, its types and large scale application.*

Module I: Introduction to microbial world (8 hours)

A brief idea of microbial diversity; present status and future challenges; a general account of Archaea. A brief account of viroids and prions. Water-borne pathogenic microbes.

Module II: Microbial Association (5 hours)

Rhizobium-legume symbiosis and mycorrhiza.

Module III: Mode of Nutrition (7 hours)

Nutritional types of microorganisms, Anoxygenic photosynthesis with special reference to light reaction in purple bacteria; methanogenesis.

Module IV: Bacterial Genetics (10 hours)

Genetics of bacteria: Genetic recombination- an overview; mechanisms of transformation, conjugation and transduction in bacteria; role of microorganisms in genetic engineering.

Module V: Life Cycle and Regulation in Lambda Phase (8 hours)

Lytic cycle in T even phages and its regulation; lysogeny and its regulation in lambda phage.

Module VI: Bioremediation (7 hours)

Role of microbes in wastewater treatment with special reference to activated sludge. Basic design of a fermentor; biosensors; bioremediation of hydrocarbon and metal polluted waters.

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO1:** Explain about the microbial diversity, and its nutritional types. (Understanding)
- CO2:** Interpret how genetic recombination occurs in bacteria and about the lytic and lysogenic cycles. (Understanding)
- CO3:** Identify the various water borne pathogenic microbes and microbes which can be used in waste treatment and bioremediation. (Applying)
- CO4:** Explain how fermenter will work and how it can be used for large scale production of beneficial microbes. (Applying)

Suggested Readings

1. Pelczar MJ. Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
2. Waites MJ, Morgan NL, Rockey JS, Highton G. Industrial Microbiology: An Introduction, Wiley-Blackwell
3. Singh VP and Stapleton RD. Biotransformations: Bioremediation Technology for Health and Environmental Protection. "Progress in Industrial Microbiology Vol. 36", Elsevier Science.
4. Prescott L, Harley JP, Klein DA. Microbiology, McGraw Hill, India. 6th edition.
5. Campbell NA, Reece JB, Urry .A., Cain L, Wasserman SA, Minorsky PV, Jackson RB. Biology, Pearson Benjamin Cummings, USA. 8th edition.

BOCB0009: CYTOGENETICS AND PLANT BREEDING**(3 Credits- 45 Hours)**

Objectives: *To acquaint the students with chromatin organisation, replication, chromosome banding pattern and organisation of eukaryotic genetic material. To enable students, understand the concepts of cytogenetics and its importance in plant breeding. The course will also focus in imparting student with knowledge of plant breeding and its role in crop improvement.*

Module I: Overview of Gene and Genome Organization (10 hours)

Organization of eukaryotic genetic material. Chromatin organization and replication: Chemical constituents- DNA and histones, nucleosome and higher order organization, DNA packaging and genetic activity, nucleosome assembly and deassembly. DNA content and adaptability. Nuclear DNA and C-value paradox.

Module II: Cytogenetics of Haploids (5 hours)

Haploidy/monoploidy, meiosis and breeding behaviour of haploids, uses of haploids in plant breeding and genetic studies.

Module III: Euploidy and Aneuploidy (6 hours)

Induction and characterization of monosomics, trisomics and nullisomics, aneuploid gene mapping, inheritance pattern in autopolyploids, status of allopolyploids in plant evolution.

Module IV: Chromosomal Banding (5 hours)

Chromosome banding patterns: Linear differentiation of chromosome segments, types of chromosome banding, uses of chromosome banding in cytogenetics.

Module V: Plant Breeding and Crop Improvement (7 hours)

Objectives and scope of plant breeding, hybridization in self- and cross-pollinated crops, genetic basis of inbreeding depression and heterosis, breeding for disease and insect resistance, transgenes and transgenic plants.

Module VI: Gene Transfer Technology (7 hours)

Alien gene transfer through chromosome: Transfer of gene through individual chromosome, characterization and utility of alien addition and substitution lines.

Module VII: Types of DNA and Gene Mapping (5 hours)

Repetitive DNA, split genes, overlapping genes. Physical and genetic mapping using molecular markers.

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO1:** Illustrate knowledge about the chromosomal organisation, replication and banding patterns of chromosomes. (Understanding)
- CO2:** Explain the role of cytogenetics in plant breeding. (Understanding)
- CO3:** Apply the concepts of cytogenetics in crop improvements. (Applying)

Suggested Readings

1. Allard RW. Principles of Plant Breeding (2nd Edition), John Wiley and Sons
2. Hartwell LH, Hood L, Goldberg ML, Reynolds AE, Silver LM, Veres RC. Genetics –From Genes to Genomes, 3rd edition, McGraw Hill.
3. Acquaah G. Principles of Plant Genetics and Breeding, Blackwell Publishing Ltd. USA.
4. Hartl DL and Jones EW. Genetics – Analysis of Genes and Genomes, 7th edition, Jones and Barlett publishers.
5. Lewin B. Genes IX, Jones and Barlett Publishers.
6. Strickberger MW. Genetics, 3rd Edition, Pearson (Prentice Hall).

BOPP0010: PLANT PHYSIOLOGY**(3 Credits- 45 Hours)**

Objectives: *The purpose of course is to make students understand the concepts of transport system in xylem and phloem, principles of photosynthesis. The course will enable students understand physiological response of plants to various abiotic stress and sensory photobiology. The students will learn about the growth regulators and physiological effects. The course will teach the basics of photoperiodism and its role in flowering process.*

Module I: Water: The Basic Concept (5 hours)

Water relations: Properties of water, water in tissues and cells, measurement of cellular water.

Module II: Water Transport Mechanism (6 hours)

Uptake of water, comparison of xylem and phloem transports, phloem loading and unloading, passive and active transports, soil-plant-atmosphere continuum.

Module III: Photosynthesis (10 hours)

Basic principles of light absorption, excitation energy transfer, electron transport, proton electrochemical potential, evolution of photosynthetic processes, photosynthetic quantum yield and energy conversion efficiency and photorespiration.

Module IV: Abiotic Factors (7 hours)

Physiological responses to abiotic stresses: Light, temperature, water and salts; acclimation of physiological processes under abiotic stresses.

Module V: Sensory Photobiology (7 hours)

History, discovery of phytochromes and cryptochromes and their photochemical and biochemical properties, photophysiology of light induced responses Cellular localisation, molecular mechanism of action of photomorphogenetic receptors, signalling and gene expression.

Module VI: Plant Growth Regulators (5 hours)

Physiological effects and mechanism of action of plant growth hormones, hormone receptors, signal transduction and gene expression.

Module VII: Photoperiodism (5 hours)

The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development.

COURSE /LEARNING OUTCOMES

At the end of this course, student will be able to:

- CO1:** Demonstrate the knowledge of how the transportation of various nutrients and water occur in plant tissues. (Understanding)
- CO2:** Explain the mechanism of photosynthesis. (Understanding)
- CO3:** Interpret how abiotic stress affects the physiological response, photophysiology induced responses and role of photoperiodism in flowering process. (Understanding)

Suggested Readings

1. Davies PJ. Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
2. Nelson DL and Cox MM. Lehninger Principles of Biochemistry, 4th Edition, W.H.Freeman and Company, New York, USA.

- Jordan BR. The Molecular Biology and Biotechnology of Flowering, 2nd Edition, CAB International, Oxfordshire, U.K.
- Taiz L and Zeiger E. Plant Physiology, 4th Edition, Sinauer Associates Inc. Publishers, Massachusetts, USA.
- Lodish H, Berk A, Kaiser CA and Krieger M. Molecular Cell Biology, 6th Edition, W.H. Freeman and Company, New York, USA.

BOAM0101: ALGAE AND MICROBIOLOGY

(4 Credits-60 Hours) (L-T-P: 4-0-0)

Module I: Introduction to microbial world (7 Hours)

Microbial nutrition, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

Module II: Viruses (7 Hours)

Viruses Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV).

Module III: Bacteria (7 Hours)

Bacteria Discovery, general characteristics; Types-archaeobacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).

Module IV: Algae (11 Hours)

Algae General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar). Role of algae in the environment, agriculture, biotechnology and industry.

Module V: Cyanophyta and Xanthophyta (8 Hours)

Cyanophyta and Xanthophyta Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of Nostoc and Vaucheria.

Module VI: Chlorophyta and Charophyta (8 Hours)

Chlorophyta and Charophyta General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara. Evolutionary significance of Prochloron.

Module VII: Phaeophyta and Rhodophyta (12 Hours)

Phaeophyta and Rhodophyta Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Ectocarpus, Fucus and Polysiphonia.

Suggested Readings

- Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition. 2.Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
- Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.

3. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
4. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
5. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

BOBC0102: BIOMOLECULES AND CELL BIOLOGY

(4 Credits-60 Hours) (L-T-P: 4-0-0)

Module I: Biomolecules (20 Hours)

Types and significance of chemical bonds; Structure and properties of water; pH and buffers. Carbohydrates: Nomenclature and classification; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides. Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides. Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins. Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Module II: Bioenergetics (4 Hours)

Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.

Module III: Enzymes (6 Hours)

Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

Module IV: The cell (4 Hours)

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

Module V: Cell wall and plasma membrane (4 Hours)

Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Module VI: Cell organelles (16 Hours)

Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. Endomembrane system: Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes

Module VII: Cell division (6 Hours)

Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases.

BOMP0103: MYCOLOGY AND PHYTOPATHOLOGY**(4 Credits - 60 Hours) (L-T-P: 4-0-0)****Module I: Introduction to true fungi (6 Hours)**

General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.

Module II: Chytridiomycota and Zygomycota (5 Hours)

Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to Synchytrium, Rhizopus .

Module III: Ascomycota (10 Hours)

General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to Saccharomyces, Aspergillus, Penicillium, Alternaria, Neurospora and Peziza.

Module IV: Basidiomycota (8 Hours)

General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat Puccinia (Physiological Specialization), loose and covered smut (symptoms only), Agaricus; Bioluminescence, Fairy Rings and Mushroom Cultivation.

Module V: Allied Fungi (3 Hours)

General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.

Module VI: Oomycota (4 Hours)

General characteristics; Ecology; Life cycle and classification with reference to Phytophthora, Albugo.

Module VII: Symbiotic associations (4 Hours)

Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.

Module VIII: Applied Mycology (10 Hours)

Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Module IX: Phytopathology (10 Hours)

Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.

Suggested Readings

1. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.

4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

BOAR0104: ARCHEGONIATE

Module I: Introduction (2 hours)

Unifying features of archegoniates; Transition to land habit; Alternation of generations.

Module II: Bryophytes (18 hours)

General characteristics; Adaptations to land habit; Classification; Range of thallus organization. Classification (up to family). Riccia, Marchantia, Peltia, Porella, Anthoceros, Sphagnum and Funaria; Reproduction and evolutionary trends in Riccia, Marchantia, Anthoceros and Funaria (developmental stages not included).

Module III: Pteridophytes (18 hours)

General characteristics, classification, early land plants (Cooksonia and Rhynia). Classification (up to family), morphology, anatomy and reproduction of Psilotum, Selaginella, Equisetum and Pteris. (Developmental details not to be included). Apogamy, and apospory, heterospory and seed habit, telome theory, stellar evolution.

Module IV: Gymnosperms (18 hours)

General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum*. (Developmental details not to be included). Ecological and economic importance.

Module V: Economic Importance (4 hours)

Ecological and economic importance of bryophytes with special reference to *Sphagnum*. Ecological and economic importance of pteridophytes and gymnosperms.

Suggested Readings

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
2. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
5. Vander-Poorteri 2009 Introduction to Bryophytes. COP

LABORATORY COURSES

BOPM6001: PHYCOLOGY AND MYCOLOGY LAB

(2 Credits)

Part I: Phycology

1. Study of range of vegetative and reproductive structures of algae with the help of suitable representatives in each of the following classes: Cyanophyta, Chlorophyta, Phaeophyta, Rhodophyta, Xanthophyta, Bacillariophyta, and Euglenophyta.
2. To study the structure and development of heterocyst.

Part II: Mycology

1. Study of thallus organization, Spore producing organs, Tissue differentiation and accessory structures of following: Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina.
2. Study of morphological and anatomical features of some lichens growing in Assam and adjoining areas.

BOBA6002: BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS & ANGIOSPERMS LAB**(2 Credits)****Part I: Bryophytes, Pteridophytes and Gymnosperms**

1. Study of morphology and reproductive structures of the following bryophytes: *Riccia*, *Marchantia*, *Anthocerus*, *Sphagnum*, *Polytrichum*, *Funeria*, *Porella*.
2. Study of morphology and reproductive structures and observe arrangement of Sori on a receptacle of the following pteridophytes: *Lycopodium*, *Selaginella*, *Marsilea*, *Equisetum*, *Azolla*, *Salvinia*, *Adiantum*.
3. To study the anatomy, morphology and reproductive features of the following gymnosperms: *Zamia*, *Cycas*, *Pinus*, *Ginkgo*, *Cryptomeria*, *Thuja*, *Podocarpus*, *Gnetum*.
4. To prepare permanent slides of pteridophytes and gymnosperms.

Part II: Angiosperms

1. Collection, preparation and documentation of herbarium specimens through non-destructive field collection method so as to get acquainted with herbarium technique.
2. Taxonomic study of selected families of dicots and monocots of angiospermic plants with the help of analytical drawings, botanical description and identification up to the rank of species.
3. Study of various stages of sporogenesis and gametogenesis in selected species of flowering plants.

BOPM6003: PLANT ECOLOGY & MICROBIOLOGY LAB**(2 Credits)****Part I: Plant Ecology**

1. To determine the minimum size of the quadrat by species area-curve method.
2. To determine abundance, density, frequency, basal cover of plant communities by quadrat method.
3. To determine minimum number of quadrats required for reliable estimate of biomass in grasslands.
4. To compare protected and unprotected grassland stands using community coefficients (similarity indices).
5. Estimation of Importance Value Index (IVI) of the species in a grassland/woodland using quadrat method.
6. To estimate the above ground and below ground biomass from unit area.
7. To analyze the edaphic characteristics-soil profile, texture, soil moisture, water holding capacity, porosity, pH, organic matter content, and quantitative estimation of N, P, K.
8. To study the physico-chemical characteristics from polluted and unpolluted water bodies: DO, COD, BOD, pH, Hardness, alkalinity, conductivity, free CO₂, chloride, nitrate and phosphate.

Part II: Microbiology

1. Isolation, enumeration and pure culture of microbes from soil, air and water
2. Identification and characterization of isolated pure cultures
3. Gram staining, flagella staining, capsule staining and acid fast staining of bacteria

4. Estimation of bacterial growth by spectrophotometric method.
5. Effect of physical and chemical factors on growth of microbes.
6. Assessment of plant root colonization by Arbuscular Mycorrhizal Fungi (AMF).

BOCP6004: CYTOGENETICS AND PLANT BREEDING & PLANT PHYSIOLOGY LAB

(2 Credits)

Part I: Cytogenetics and Plant Breeding

1. Identification of different stages of mitosis from suitable plant material. (Onion and garlic root tips).
2. Identification of meiosis from suitable plant material. (Onion, Phlox floral buds).
3. Study of mitotic index from suitable plant material.
4. Study of chromosomal aberrations in plant (*Rhoeo*).
5. Preparation of karyotypes.
6. Study of the effect of chemicals on mitosis.
7. Extraction of genomic DNA from plants by CTAB method.
8. Study of numerical problems involving gene interactions.
9. Experiments on mutagenesis in *E.coli*.
10. Practice of hybridization technique in self and cross pollinated plants species.

Part II: Plant Physiology

1. Determination of osmotic pressure of cell sap by plasmolytic method.
2. Determination of Diffusion pressure deficit in potato tuber.
3. To determine imbibition pressure of seeds of different categories (protein, lipid, carbohydrate containing seeds).
4. To study the effect of different organic solvents (alcohol, formalin, benzene) on the permeability of plasma membrane of beet root.
5. Determination of effect of different Phytohormones on the germination of seeds.
6. To determine the rate of respiration by Ganong's Respirometer.
7. Separation of chlorophyll pigments by paper and thin layer chromatography.
8. Determination of the effect of CO₂ concentration on the rate of photosynthesis by inverted funnel method.
9. Determination of the effect of intensity of light on the rate of photosynthesis.
10. To study the rate of transpiration of plants with the help of Ganong's Potometer.

BOAM6101: ALGAE AND MICROBIOLOGY LAB

(2 Credits)(L-T-P : 0-0-2)

Microbiology

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.
3. Gram staining.
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).

Phycology

Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Volvox, Oedogonium, Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia, Prochloron through electron micrographs, temporary preparations and permanent slides.

BOBC6102: BIOMOLECULES AND CELL BIOLOGY LAB**(2 Credits)**

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo/ Crinum.
3. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.
4. Measurement of cell size by the technique of micrometry.
5. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
6. Study of cell and its organelles with the help of electron micrographs.
7. Cytochemical staining of : DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
8. Study the phenomenon of plasmolysis and deplasmolysis.
9. Study the effect of organic solvent and temperature on membrane permeability.
10. Study different stages of mitosis and meiosis.

Suggested Readings

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H. Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H. Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
8. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 17
9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco

BOMP6103: MYCOLOGY AND PHYTOPATHOLOGY LAB**(2 Credits)**

1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
2. Rhizopus: study of asexual stage from temporary mounts and sexual structures through permanent slides.
3. Aspergillus and Penicillium: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.

4. Peziza: sectioning through ascocarp.
5. Alternaria: Specimens/photographs and temporary mounts.
6. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
7. Agaricus: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, fairy rings and bioluminescent mushrooms to be shown.
8. Study of phaneroplasmodium from actual specimens and /or photograph. Study of Stemonitis sporangia.
9. Albugo: Study of symptoms of plants infected with Albugo; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.
10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)
11. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

Suggested Readings

1. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

BOAR6104: ARCHEGONIATE LAB

(2 Credits)

1. **Riccia** – Study of morphology of thallus.
2. **Marchantia**- Study of morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).
3. **Anthoceros**- Study of morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
4. **Pellia, Porella**- Study of these specimen through permanent slides.
5. **Sphagnum**- Study of morphology of plant, whole mount of leaf (permanent slide only).
6. **Funaria**- Study of morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.
7. **Psilotum**- Study of specimen, transverse section of synangium (permanent slide).
8. **Selaginella**- Study of morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).

9. **Equisetum** - Study of morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).
10. **Pteris** - To study the morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
11. **Cycas** - To study the morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).
12. **Pinus** - To study the morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of /transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section and radial longitudinal sections stem (permanent slide).
13. **Gnetum** - Study of morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)
14. **Botanical excursion.**

Suggested Readings

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
2. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
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SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

DEPARTMENT OF SOCIAL WORK

MASTER OF SOCIAL WORK (MSW)(2019-2021 Batch)

SEMESTER I					
Type	Course Code	Course Name	Category	Credits	Page
Theory	SWHI0035	History, Ideologies and fields of Social Work	DC	3	482
	SWG0036	Human Growth and Development	DC	2	484
	SWIS0037	Introduction to Indian Society, Polity and Economics	DC	2	486
	SWCS0070	Social Work with Communities and Social Action	DC	3	500
Elective 1 : One course to be opted					
	PCEC0013	Eastern Approaches to Psychology and Counselling	SE	3	514
	EDET0015	Education Technology	SE		561
	SWEM0038	Environment and Disaster Management	DE		488
Elective 2 : One course to be opted					
	MCML0027	Media Literacy	SE	3	705
	EDLR0007	Leadership and Social Responsibility	SE		550
	SWGS0039	Gender Studies	DE		490
	LSET0019	English Language Teaching	SE		658
Practicum	SWFR6008	Concurrent Field Work and Rural Practicum	DC	6	502
Total Credits				22	

SEMESTER II						
Type	Course Code	Course Name	Category	Credits	Page	
Theory Practicum/ Lab	SWPF0040	Social Work Practice with Individuals and Families	DC	3	492	
	SWPG0041	Social Work Practice with Groups	DC	3	494	
	SWRS0042	Social Work Research and Statistics	DC	3	495	
	SWWA0043	Social Welfare Administration	DC	3	497	
	Elective 1 : One course to be opted					
		SWDS0044	Introduction to Disability Studies	DE	3	498
		PCPD0007	Personality Development	SE		509
		MCRC0026	Rural Communication	SE		704
	Elective 2 : One course to be opted					
		PCSP0006	Introduction to Social Psychology	SE	3	507
	EDPC0016	Peace Education and Conflict Management	SE	563		
	SWEM0038	Environment and Disaster Management	DE	488		
	LSNE0020	North-East Indian Literature in English	SE	659		
	SWFW6009	Concurrent Field Work II	DC	6	503	
Total Credits				24		

SEMESTER III						
Type	Course Code	Course Name	Category	Credits	Page	
Theory	SWSJ0045	Social Justice, Human Rights & Para-legal Education	DC	3		
	SWES0046	Emerging Social Work Perspectives and Integrated Approach	DC	3		
	SWCA0047	Computer Applications for Social Sciences (Lab)	DC	2		
	Specialization Courses: One area of concentration to be opted					
	Community Development					
	SWRT0048	Community Development: Rural, Tribal and Urban	DE	3		
	SWGC0049	Governance and Community Development	DE	3		
	Family and Child Welfare					
	SWCS0050	Family Centered Social Work Practice	DE	3		
	SWPC0051	Social Work Practice with Children	DE	3		
	Medical and Psychiatric Social Work					
	SWMS0052	Medical Social Work	DE	3		
	SWHS0053	Mental Health and Social Work	DE	3		
	Management of Development Organisations					
SWOD0054	Organisational Structure, Behaviour and Development	DE	3			
SWDO0055	Policies For Development Organisations - Urban, Rural and Tribal Communities	DE	3			
Child Centered Social Work Practice						
SWCP0056	Introduction to Child Psychology and Development	DE	3			
SWRC0057	Rights of the Child – Legal Framework, National And International Instruments	DE	3			
Practicum	SWFW6010	Continuous Field Work I	DC	6		
Total Credits				20		

SEMESTER IV						
Type	Course Code	Course Name	Category	Credits	Page	
Core	SWSP0058	Social Development and Social Policy	DC	3		
	SWPM0059	Project cycle Management and Resource Mobilisation	DC	3		
	SWDI6011	Dissertation	DC	6		
Electives	Specialization Courses: One area of concentration to be opted					
	Community Development					
	SWHP0060	Community Health and Population Management	DE	3		
	SWDC0061	Community Development Practice with Disempowered Communities	DE	3		
	Family and Child Welfare					
	SWWE0062	Development Concerns and Women Empowerment	DE	3		
	SWSN0063	Families With Special Needs	DE	3		
	Medical and Psychiatric Social Work					
	SWPW0064	Psychiatric Social Work	DE	3		
	SWCH0065	Community Health and Services	DE	3		
Management of Development Organisations						

	SWHR0066	Human Resource Management: Social Work Perspective	DE	3	
	SWCI0067	Corporate Social Responsibilities - Concepts & Ideologies	DE	3	
Child Centered Social Work Practice					
	SWSP0068	Children with Special Needs	DE	3	
	SWSW0069	Child Centered Social Work Practice	DE	3	
	SWCF6012	Continuous Fieldwork II	DC	6	
	SWIN6013	Internship	P/NP		
Total Credits				24	

MASTER OF SOCIAL WORK (MSW) (2018-2020 Batch)

SEMESTER III						
Type	Course Code	Course Name	Category	Credits	Page	
Theory	SWSL0011	Social Justice, Human Rights and Social Legislations	DC	3	459	
	SWDM0012	Environmental Studies and Disaster Management	DE	3	460	
	SWCP0013	Conflict Management and Peace Building	DE	3	461	
	Specialization Courses: One area of concentration to be opted					
	Community Development					
		SWRD0014	Community Development: Rural and Urban	DE	4	662
		SWGDD0015	Governance and Community Development	DE	4	464
	Family and Child Welfare					
		SWFW0016	Family Centered Social Work Practice	DE	4	465
		SWSC0017	Social Work Practice with Children	DE	4	466
	Medical and Psychiatric Social Work					
		SWMW0018	Medical Social Work	DE	4	468
		SWMS0019	Mental Health and Social Work	DE	4	469
	Management of Development Organisations					
		SWMD0030	Development Organisations: Establishment and Management	DE	4	478
		SWDO0031	Policies For Development Organisations - Urban, Rural and Tribal Communities	DE	4	479
Practicum	SWFW6004	Continuous Field Work I	DC	3	501	
	SWRP6005	Research Project Phase I	DC	2	503	
	SWST6008	Study Tour	DC	P/NP	NA	
Total Credits				22		

SEMESTER IV					
Type	Course Code	Course Name	Category	Credits	Page
Core	SWIS0020	Introduction to School Social Work	DC	3	470
	SWPR0029	Project cycle Management and Resource Mobilisation	DC	4	477
	SWFW6006	Continuous Field Work II	DC	4	501
	SWRP6007	Research Project Phase II	DC	4	503
	SWBP6009	Block Placement	DC	P/NP	NA

Electives	Specialization Courses: One area of concentration to be opted				
	Community Development				
	SWHM0027	Community Health and Population Management	DE	4	476
	SWPD0022	Community Development Practice with Disempowered Communities	DE	4	471
	Family and Child Welfare				
	SWDW0024	Development Concerns and Women Empowerment	DE	4	472
	SWFS0025	Families With Special Needs	DE	4	473
	Medical and Psychiatric Social Work				
	SWPS0026	Psychiatric Social Work	DE	4	475
	SWHM0027	Community Health and Population Management	DE	4	476
	Management of Development Organisations				
	SWOS0032	Organisational Structure and Behaviour	DE	4	480
	SWHR0033	Human Resource Management	DE	4	481
	Total Credits			23	

DEPARTMENT OF PSYCHOLOGY AND COUNSELLING

BACHELOR OF ARTS – HONOURS IN PSYCHOLOGY

SEMESTER I				
Type	Course Code	Course Name	Credits	Page
IC	LSGE0004	General English I	4	646
DC	PCBP0101	Basic Psychological Processes	4	523
	PCEX0105	Experimental Psychology	3	526
IE / SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSHE0010	History of English Literature I - Elizabethan to Romantic period	4+4	
	EDFE0101	Foundations of Education		650
	MCHE0107	History and Evolution of Media		715
	Open Elective : One course to be chosen from the following			
	LSFN0012	Functional English	3	652
	EDLE0105	Life Skills in Education		605
	PCPG0107	Personal Growth		529
	MCPC0105	Professional Communication		713
	Total Credits			22

SEMESTER II				
Type	Course Code	Course Name	Credits	Page
IC	LSGE0005	General English II	4	647
DC	PCDP0102	Developmental Psychology	4	524
	PCBP0106	Basic Psychological Theories	3	523
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSHL0011	History of English Literature II: Victorian to Contemporary Period	4+4	651
	EDPF0102	Philosophical Foundations of Education		600
	MCMS0113	Media and Society		721
	Open Elective: One course to be chosen from the following			
	LSCW0013	Creative Writing in English	3	654
	EDGE0106	Gender Education		607
	PCPA0108	Psychology of Personal Adjustment		530
	MCBP0106	Basics of Photography		714
	Total Credits			22

SEMESTER III				
Type	Course Code	Course Name	Credits	Page
IC	LSAE0007	Alternative English I	4	648
DC	PCCP0103	Counselling Psychology	4	525
	PCBP0110	Bio Psychology	3	531
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSAD0033	English Essays I - Addison to Dickens	4+4	670
	EDPB0107	Psychological Bases of Education		609
	MCLE0111	Media Law and Ethics		719

Open Elective: One course to be chosen from the following				
	EDPE0109	Population Education	3	611
	PCPP0111	Peace Psychology		532
	LSCO0035	Communication Skills		672
	MCMC0131	Mobile Communication		732
Total Credits			22	

SEMESTER IV				
Type	Course Code	Course Name	Credits	Page
IC	LSAT0009	Alternative English II	4	649
DC	PCBA0112	Basic Abnormal Psychology	4	533
	PCCA0113	Child and Adolescent Development Psychology	3	534
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSLW0036	Life Writing-Biographies, Memoirs and Letters	4+4	673
	EDEI0110	Development of Education in India		
	MCNE0117	Introduction to North East India		613
	Open Elective: One course to be chosen from the following			
	EDEC0112	Early Childhood Care and Education (ECCE: A Perspective)	3	616
	LSSK0038	Soft Skills		674
	PCCM0114	Community Psychology		535
	MCBP0106	Basics of Photography		714
Total Credits			22	

SEMESTER V				
Type	Course Code	Course Name	Credits	Page
IC	EDSM0120	Scientific Methodology	4	631
	CHES0002	Environmental Studies	2	143
DC	PCSP0115	Social Psychology	4	536
	PCFW6101	Field Work	4	NA
	PCPP6102	Psychology Practicum I	4	546
DE	One Course to be chosen from the following			
	PCHP0116	Health Psychology	3	537
	PCEP0117	Environmental Psychology		538
Total Credits			21	

SEMESTER VI				
Type	Course Code	Course Name	Credits	Page
DC	PCPT0118	Psychological Testing	4	539
	PCPP6103	Psychology Practicum II	4	548
	PCPW6104	Project Work	4	NA
DE	Any two courses to be chosen from the following			
	PCPY0119	Positive Psychology	3 + 3	540
	PCOB0120	Organisational Behaviour		541
	PCAA0121	Advanced Abnormal Psychology		542
Total Credits			18	

MASTER OF SCIENCE - PSYCHOLOGY (PSYCHOLOGICAL COUNSELLING)

(2019 -2021 Batch)

SEMESTER I						
Type	Course Code	Course Name	Category	Credits	Page	
Theory	PCFC0016	Foundations of Professional Counselling	DC	4	518	
	PCLS0002	Life Span Development	DC	4	505	
	PCCP0017	Theoretical Perspectives for Counselling Psychology	DC	4	519	
	PCIG0019	Process and Skills of Individual and Group Counselling	DC	4	522	
	Elective 1					
	PCEC0013	Eastern Approaches to Psychology and Counselling	DE	3	514	
	EDET0015	Educational Technology	SE		561	
	SWEM0038	Environment and Disaster Management	SE		488	
	Elective 2 : One course to be opted					
	MCML0027	Media Literacy	SE	3	705	
	EDLR0007	Leadership and Social Responsibility	SE		550	
	SWG50039	Gender Studies	SE		490	
	LSET0019	English Language Teaching	SE		658	
PCPG6002	Personal Growth I	DC	P/NP	543		
Total Credits				22		
SEMESTER II						
Type	Course Code	Course Name	Category	Credits	Page	
	PCMH0004	Concepts of Mental Health and Illness	DC	4	506	
	PCCY0009	Child and Youth Counselling	DC	4	509	
	PCRM0010	Research Methodology and Statistics in Social Science	DC	4	511	
	Elective 1 : One course to be opted					
	SWDS0044	Introduction to Disability Studies	SE	3	498	
	PCPD0007	Personality Development	DE		509	
	MCR0026	Rural Communication	SE	3	704	
	Elective 2 : One course to be opted					
	SWEM0038	Environment and Disaster Management	SE	3	488	
	EDPC0016	Peace Education and Conflict Management	SE		563	
	PCSP0006	Introduction to Social Psychology	DE		507	
	LSNE0020	North-East Indian Literature in English	SE		569	
	Practicum	PCCY6003	Child and Youth Counselling - practicum	DC	2	544
PCFW6004		Field Work	DC	2	544	
PCPG6005		Personal Growth II	DC	P/NP	543	
Total Credits				22		

SEMESTER III					
Type	Course Code	Course Name	Category	Credits	Page
Theory	PCMF0012	Marriage and Family Counselling	DC	4	513
	PCAT0014	Addiction and Trauma Counselling	DC	3	515
Practicum	PCMC6006	Marriage and Family Counselling - Practicum	DC	2	545
	PCCS6013	Case Study and Documentation I	DC	2	NA
	PCRP6008	Research Project Phase I	DC	2	545
	PCSI6014	Supervised Internship I	DC	4	NA
	PCSI6009	Summer Internship	DC	P/NP	545
	PCST6012	Study Tour	DC	P/NP	546
Total Credits				20	

SEMESTER IV					
Type	Course Code	Course Name	Category	Credits	Page
	PCPT0018	Psychological Testing	DC	4	520
	PCDR0015	Disability Studies and Rehabilitation Psychology	DC	3	516
	PCCS6015	Case Study and Documentation II	DC	2	NA
Internship	PCSI6016	Supervised Internship II	DC	8	NA
Project	PCRP6011	Research Project Phase II	DC	8	545
Total Credits				16	

MASTER OF SCIENCE - PSYCHOLOGY (PSYCHOLOGICAL COUNSELLING) (2018-2020 Batch)

SEMESTER III					
Type	Course Code	Course Name	Category	Credits	Page
Theory	PCPT0018	Psychological Testing	DC	4	520
	PCMF0012	Marriage and Family Counselling	DC	4	513
	PCAT0014	Addiction and Trauma Counselling	DC	3	615
	PCDR0015	Disability Studies and Rehabilitation Psychology	DC	3	516
Practicum	PCMC6006	Marriage and Family Counselling - Practicum	DC	2	545
	PCCS6007	Case Study and Documentation	DC	2	545
	PCRP6008	Research Project Phase I	DC	2	545
	PCSI6009	Summer Internship	DC	P/NP	545
		PCST6012	Study Tour	DC	P/NP
Total Credits				20	

SEMESTER IV					
Type	Course Code	Course Name	Category	Credits	Page
Internship	PCSI6010	Supervised Internship	DC	8	546
Project	PCRP6011	Research Project Phase II	DC	8	545
Total Credits				16	

DEPARTMENT OF EDUCATION

BACHELOR OF ARTS - HONOURS IN EDUCATION

SEMESTER I				
Type	Course Code	Course Name	Credits	Page
IC	LSGE0004	General English I	4	646
DC	EDFE0101	Foundations of Education	4	598
	EDTP0103	Theories and Principles of Education	3	602
IE / SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSHE0010	History of English Literature I - Elizabethan to Romantic Period	4+4	650
	PCBP0101	Basic Psychological Processes		523
	MCHE0107	History and Evolution of Media		715
	Open Elective : One course to be chosen from the following			
	LSFN0012	Functional English	3	652
	EDLE0105	Life Skills in Education		605
	PCPG0107	Personal Growth		529
	MCPC0105	Professional Communication		713
Total Credits			22	

SEMESTER II				
Type	Course Code	Course Name	Credits	Page
IC	LSGE0005	General English II	4	647
DC	EDPF0102	Philosophical Foundations of Education	4	600
	EDES0104	Education and Society	3	603
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSHL0011	History of English Literature II: Victorian to Contemporary Period	4+4	651
	PCDP0102	Developmental Psychology		524
	MCMS0113	Media and Society		721
	Open Elective: One course to be chosen from the following			
	LSCW0013	Creative Writing in English	3	654
	EDGE0106	Gender Education		607
	PCPA0108	Psychology of Personal Adjustment		530
	MCIC0110	Introduction to Computer Application		718
Total Credits			22	

SEMESTER III				
Type	Course Code	Course Name	Credits	Page
IC	LSAE0007	Alternative English I	4	648
DC	EDPB0107	Psychological Bases of Education	4	609
	EDHR0108	Human Rights Education	3	610
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSAD0033	English Essays I - Addison to Dickens	4+4	670
	PCCP0103	Counselling Psychology		525
	MCLE0111	Media Law and Ethics		719

	Open Elective: One course to be chosen from the following			
	EDPE0109	Population Education	3	611
	PCPP0111	Peace Psychology		532
	LSCO0035	Communication Skills		672
	MCMC0131	Mobile Communication		732
Total Credits			22	

SEMESTER IV				
Type	Course Code	Course Name	Credits	Page
IC	LSAT0009	Alternative English II	4	649
DC	EDEI0110	Development of Education in India	4	613
	EDET0111	Educational Thinkers	3	615
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSLW0036	Life Writing- Biographies, Memoirs and Letters	4+4	673
	PCBA0112	Basic Abnormal Psychology		533
	MCNE0117	Introduction to North East India		722
	Open Elective: One course to be chosen from the following			
	EDEC0112	Early Childhood Care and Education (ECCE): A Perspective	3	616
	LSSK0038	Soft Skills		674
PCCM0114	Community Psychology	535		
MCBP0106	Basics of Photography	714		
Total Credits			22	

SEMESTER V				
Type	Course Code	Course Name	Credits	Page
IC	EDCI0120	Scientific Methodology	4	531
	CHES0002	Environmental Studies	2	143
DC	EDME0113	Measurement and Evaluation in Education	4	617
	EDTY0114	Educational Technology	4	619
	EDFC0115	Foundations of Curriculum Development	4	621
DE	One Course to be chosen from the following			
	EDGC0116	Guidance and Counselling in Education	4	623
	EDSI0117	Special and Inclusive Education		625
Total Credits			22	

SEMESTER VI				
Type	Course Code	Course Name	Credits	Page
DC	EDTL0118	Teaching Learning Methods and Pedagogy	4	627
	EDEM0119	Educational Management and Administration	3	629
	EDPT06101	Psychological Testing	4	642
	EDPW6102	Project Work	3	643
DE	Any two courses to be chosen from the following			
	EDTE0121	Teacher Education	3+3	632
	EDDA0122	Distance and Adult Education		634
	EDES0123	Elementary Statistics in Education		636
Total Credits			20	

MASTER OF ARTS - EDUCATION (EDUCATIONAL LEADERSHIP / EDUCATIONAL PSYCHOLOGY)

SEMESTER I						
Type	Course Code	Course name	Category	Credit	Page	
Theory	EDFE0011	Philosophical Foundations of Education	DC	4	551	
	EDEP0012	Fundamentals of Educational Psychology	DC	4	554	
	EDTE0013	Emerging Trends in Education	DC	3	557	
	EDDE0014	History and Development of Education in India	DC	3	559	
	Elective Group I					
	PCEC0013	Eastern Approaches to Psychology and Counselling	SE	3	514	
	EDET0015	Educational Technology	DE		561	
	SWEM0038	Environment and Disaster Management	SE		488	
	Elective Group II					
	MCML0027	Media Literacy	SE	3	705	
	EDLR0007	Leadership and Social Responsibility	DE		550	
	SWGS0039	Gender studies	SE		490	
	LSET0019	English Language Teaching	SE		658	
	EDJG6002	Journaling – a Technique for Personal and Academic Growth	DC		3	637
Total Credits				23		

SEMESTER II						
Type	Course Code	Course name	Category	Credit	Page	
Theory	EDSF0017	Sociological Foundations of Education	DC	4	565	
	PCRM0010	Research Methodology and Statistics in Social Science	DC	4	511	
	EDTK0018	Theory of Knowledge	DC	3	568	
	Specialisation Courses: One area of Concentration to be opted					
	Educational Leadership					
	EDEL0019	Developing Educational Leadership	DC	3	570	
	Educational Psychology					
	EDDL0020	Human Development and Learning	DC	3	573	
	Elective Group I					
	SWDS0044	Introduction to Disability Studies	SE	3	498	
	PCPD0007	Personality Development	SE		509	
	MCRC0026	Rural Communication	SE		704	
	Elective Group II					
	PCEC0013	Eastern Approaches to Psychology and Counselling	SE	3	514	
	EDPC0016	Peace Education and Conflict Management	DE		563	
	SWEM0038	Environment and Disaster Management	SE		488	
	LSNE0020	North-East Indian Literature in English	SE		659	
Practicum	EDES6003	Educational Seminar I	DC	2	638	
	SWCA6010	Computer Applications for Social Sciences (Lab)	SE	2	504	
	EDSV6004	School Visits		2	638	
Total Credits				26		

SEMESTER III						
Type	Course Code	Course name	Category	Credit	Page	
Theory	EDCI0021	Curriculum Development and Instruction	DC	3	575	
	EDTP0022	Principles and Techniques of Teaching and Pedagogy	DC	3	578	
	EDTE0023	Teacher Education	DC	3	580	
	EDME0024	Measurement and Evaluation in Education	DC	3	582	
	Specialization Courses:					
	Educational Leadership					
	EDPL0025	Educational Law and Government Policy	DC	3	584	
	EDFM0026	Financial Management and Accounting	DC	3	586	
	Educational Psychology					
	EDLE0027	Life Span Development and Education	DC	3	587	
EDLI0028	Learning and Individual Differences	DC	3	587		
Practicum	EDDI6005	Dissertation Phase I	DC	2	639	
	EDES6009	Educational Seminar II	DC	2	638	
	EDTP6010	Teaching Practice	DC	2	641	
Total Credits				23		

SEMESTER IV						
Type	Course Code	Course name	Category	Credit	Page	
Theory	EDOC0029	Organisational Communication	DC	3	591	
	Specialization Courses:					
	Educational Leadership					
	EDEA0030	Educational Administration	DC	3	592	
	EDSR0031	Ethics and Social Responsibility in Education	DC	3	594	
	Educational Psychology					
	EDSP0032	Counselling Skills for Educational Psychologists	DC	3	595	
	EDCA0033	Child and Adolescent Mental Health	DC	3	597	
Practicum	EDDI6007	Dissertation Phase II	DC	4	639	
	EDIN6008	Internship	DC	3	640	
Total Credits				16		

DEPARTMENT OF LANGUAGE STUDIES

BACHELOR OF ARTS - HONOURS IN ENGLISH

SEMESTER I				
Type	Course Code	Course Name	Credits	Page
IC	LSGE0004	General English I	4	646
DC	LSHE0010	History of English Literature I - Elizabethan to Romantic Period	4	650
	LSPD0014	Poetry, Prose and Drama - Elizabethan to Restoration Period	3	655
IE / SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	EDFE0101	Foundations of Education	4+4	548
	PCBP0101	Basic Psychological Processes		523
	MCHE0107	History and Evolution of Media		715
	Open Elective : One course to be chosen from the following			
	LSFN0012	Functional English	3	652
	EDLE0105	Life Skills in Education		605
	PCPG0107	Personal Growth		529
	MCPC0105	Professional Communication		713
Total Credits			22	
SEMESTER II				
Type	Course Code	Course Name	Credits	Page
IC	LSGE0005	General English II	4	647
DC	LSHL0011	History of English Literature II: Victorian to Contemporary Period	4	651
	LSPF0015	Poetry, Prose and Fiction: Augustan to Romantic Period	3	655
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	EDPF0102	Philosophical Foundations of Education	4+4	600
	PCDP0102	Developmental Psychology		524
	MCMS0113	Media and Society		721
	Open Elective: One course to be chosen from the following			
	LSCW0013	Creative Writing in English	3	654
	EDGE0106	Gender Education		607
	PCPA0108	Psychology of Personal Adjustment		530
	MCIC0110	Introduction to Computer Application		718
Total Credits			22	
SEMESTER III				
Type	Course Code	Course Name	Credits	Page
IC	LSAE0007	Alternative English I	4	648
DC	LSAD0033	English Essays I - Addison to Dickens	4	670
	LSPR0034	Poetry - Restoration to Romantic Period	3	671
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	EDPB0107	Psychological Bases of Education	4+4	609
	PCCP0103	Counselling Psychology		525
	MCLE0111	Media Law and Ethics		719

Open Elective: One course to be chosen from the following			
EDPE0109	Population Education	3	611
PCPP0111	Peace Psychology		532
LSCO0035	Communication Skills		672
MCMC0131	Mobile Communication		732
Total Credits		22	

SEMESTER IV				
Type	Course Code	Course Name	Credits	Page
IC	LSAT0009	Alternative English II	4	649
DC	LSLW0036	Life Writing-Biographies, Memoirs and Letters	4	673
	LSLC0037	Literary Criticism: Aristotle to I. A. Richards	3	673
Subsidiary 1 and 2: Two courses to be chosen from the following				
IE/SE	EDEI0110	Development of Education in India	4+4	613
	PCBA0112	Basic Abnormal Psychology		533
	MCNE0117	Introduction to North East India		722
Open Elective: One course to be chosen from the following				
	EDEC0112	EDEC0112 Early Childhood Care and Education (ECCE): A Perspective	3	616
	LSSK0038	Soft Skills		674
	PCCM0114	Community Psychology		535
	MCBP0106	Basics of Photography		714
Total Credits			22	

SEMESTER V				
Type	Course Code	Course Name	Credits	Page
IC	EDSM0120	Scientific Methodology	4	631
	CHES0002	Environmental Studies	2	143
DC	LSPW0055	Post-Colonial writings	4	689
	LSMD0056	Modern English Drama	4	690
	LSAL0057	American Literature	4	691
One Course to be chosen from the following				
DE	LSIL0058	Indian English Literature	3	692
	LSLL0059	English Language and Linguistics I		693
Total Credits			21	

SEMESTER VI				
Type	Course Code	Course Name	Credits	Page
DC	LSAF0060	African Literature	4	694
	LSDW0061	Indian Diasporic Writings	4	695
	LSPW6009	Project Work	2	NA
Any two courses to be chosen from the following				
DE	LSCT0062	Literary and Cultural Theory: 20th Century and After	3	696
	LSWL0063	Women and Literature		696
	LSEL0064	English Language and Linguistics II		697
Total Credits			16	

MASTER OF ARTS - ENGLISH

SEMESTER I						
Type	Course Code	Course name	Category	Credit	Page	
Theory	LSEP0021	Chaucer to Elizabethan Period – Poetry, Drama and Romance	DC	4	660	
	LSL0022	Literary and Social History of England -Chaucer to Elizabethan Period	DC	3	661	
	LSSD0023	Shakespearean Drama I – Comedy and History Plays	DC	4	662	
	LSRP0024	Rhetoric and Prosody		2	663	
	Elective I One course to be chosen					
	LSTS0025	T.S. Eliot	DE	3	664	
	LSTH0026	Thomas Hardy	DE		664	
	Elective II One course to be chosen					
	MCML0027	Media Literacy	SE	3	705	
	EDLR0007	Leadership and Social Responsibility	SE		550	
	SWGS0039	Gender studies	SE		490	
LSET0019	English Language Teaching	DE		658		
Seminar	LSSM6005	Seminar and Presentation I	DC	1	698	
Total Credits				20		

SEMESTER II						
Type	Course Code	Course name	Category	Credit	Page	
Theory	LSRR0027	Restoration to Romantic Period – Poetry and Drama	DC	4	665	
	LSLC0028	Literary Criticism – Plato to F.R. Leavis	DC	4	666	
	LSSH0029	Shakespearean Drama II – Tragedy and Tragi-Comedy	DC	4	667	
	LSAL0030	Approaches to Language and Literary Research	DC	3	668	
	Elective I One course to be chosen					
	LSTR0031	Classics in Translation	DE	3	669	
	LSIW0032	Indian Women Writers	DE		669	
	Elective II One course to be chosen					
	SWEM0038	Environment and Disaster Management	SE		488	
	EDPC0016	Peace Education and Conflict Management	SE		563	
	PCSP0006	Introduction to Social Psychology	SE		507	
LSNE0020	North-East Indian Literature in English	DE	659			
Seminar	LSSP6006	Seminar and Presentation II	DC	1	701	
Total Credits				20		

SEMESTER III					
Type	Course Code	Course name	Category	Credit	Page
Theory	LSVP0042	Victorian to Post-Modern Period – Poetry, Drama & Fiction	DC	4	677
	LSPC0043	Post-Colonial Literature – Poetry, Drama & Fiction	DC	3	678
	LSAL0044	American literature – Poetry, Drama & Fiction	DC	3	679
	LSLC0045	Literary and Critical Theory	DC	4	680
	LSLL0046	Gender and Literature	DC	2	681
	Specialisation Course: Language and Linguistics				
	LSL0047	Linguistics and Stylistics I	DC	3	682

	Specialization Paper: European Literature				
	LSCE0048	Introduction to Modern European Literature I	DC	3	683
	Specialization Paper: African Literature				
	LSCP0049	Colonial and Post- Colonial African Literature I	DC	3	684
Project	LSPP6007	Project Phase I	DC	2	NA
Total Credits				21	

SEMESTER IV					
Type	Course Code	Course name	Category	Credit	Page
Theory	LSIW0050	Indian Writing in English – Poetry, Drama & Fiction	DC	4	685
	LSSA0051	South-Asian Literature	DC	4	686
	Specialization Paper: Language and Linguistics				
	LSLT0052	Linguistics and Stylistics II	DC	3	686
	Specialization Paper: European Literature				
	LSEL0053-	Introduction to Modern European Literature II	DC	3	687
Specialization Paper: African Literature					
	LSAL0054	Colonial and Post- Colonial African Literature II	DC	3	688
Project	LSPP6008	Project Phase II- Dissertation	DC	8	NA
Total Credits				19	

DEPARTMENT OF MASS COMMUNICATION

BACHELOR OF ARTS – HONOURS IN MASS COMMUNICATION

SEMESTER I				
Type	Course Code	Course Name	Credits	Page
IC	LSGE0004	General English I	4	646
DC	MCHE0107	History and Evolution of Media	4	715
	MCCM0108	Communication Theories and Models	3	716
IE / SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSHE0010	History of English Literature I - Elizabethan to Romantic Period	4+4	650
	EDFE0101	Foundations of Education		598
	PCBP0101	Basic Psychological Processes		523
Open Elective : One course to be chosen from the following				
	LSFN0012	Functional English	3	652
	EDLE0105	Life Skills in Education		605
	PCPG0107	Personal Growth		529
	MCPC0105	Professional Communication		713
Total Credits			22	

SEMESTER II				
Type	Course Code	Course Name	Credits	Page
IC	LSGE0005	General English II	4	647
DC	MCMS0113	Media and Society	4	721
	MCFM0109	Traditional Folk Media	3	717
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSHL0011	History of English Literature II : Victorian to Contemporary Period	4+4	651
	EDPF0102	Philosophical Foundations of Education		600
	PCDP0102	Developmental Psychology		524
	Open Elective: One course to be chosen from the following			
	LSCW0013	Creative Writing in English	3	654
EDGE0106	Gender Education	607		
PCPA0108	Psychology of Personal Adjustment	530		
MCIC0110	Introduction to Computer Application	718		
Total Credits			22	

SEMESTER III				
Type	Course Code	Course Name	Credits	Page
IC	LSAE0007	Alternative English I	4	648
DC	MCLE0111	Media Laws and Ethics	4	719
	MCIJ0112	Introduction to Journalism	3	720
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following			
	LSAD0033	English Essays I -Addison to Dickens	4+4	670
	EDPB0107	Psychological Bases of Education		609
	PCCP0103	Counselling Psychology		525

	Open Elective: One course to be chosen from the following			
	EDPE0109	Population Education	3	611
	PCPP0111	Peace Psychology		532
	LSCO0035	Communication Skills		672
	MCMC0131	Mobile Communication		732
Total Credits			22	

SEMESTER IV					
Type	Course Code	Course Name	Credits	Page	
IC	LSAT0009	Alternative English II	4	649	
DC	MCNE0117	Introduction to North East India	4	722	
	MCRP0118	Introduction to Radio Production	3	722	
IE/SE	Subsidiary 1 and 2: Two courses to be chosen from the following				
	LSLW0036	Life Writing-Biographies, Memoirs and Letters	4+4	673	
	EDEI0110	Development of Education in India		613	
	PCBA0112	Basic Abnormal Psychology		533	
	Open Elective: One course to be chosen from the following				
		EDEC0112	Early Childhood Care and Education (ECCE): A Perspective	3	616
		LSSK0038	Soft Skills		674
		PCCM0114	Community Psychology		535
		MCBP0106	Basics of Photography		714
Total Credits			22		

SEMESTER V				
Type	Course Code	Course Name	Credits	Page
IC	EDSM0120	Scientific Methodology	4	631
	CHES0002	Environmental Studies	2	143
DC	MCVC0119	Visual Communication	4	723
	MCAD0120	Advertising	4	724
	MCIV0121	Introduction to Video Production	4	725
DE	One Course to be chosen from the following			
	MCAV0122	Animation & VFX	3	726
	MCCM0123	Community Media		727
Total Credits			21	

SEMESTER VI				
Type	Course Code	Course Name	Credits	Page
DC	MCGD0124	Graphic Designing	4	727
	MCFS0125	Film Studies	4	728
	MCIN6101	Internship	3	735
	MCPW6102	Project Work	2	732
DE	Any Two courses to be chosen from the following			
	MCCD0128	Communication for Development	3	729
	MCWD0129	Web Designing		730
	MCME0130	Media Entrepreneurship		731
Total Credits			16	

MASTER OF ARTS – MASS COMMUNICATION

Semester I						
Type	Course Code	Name	Category	Credits	Page	
Theory	MCHD0028	History and Development of Communication Media	DC	3	706	
	MCPC0029	Philosophy of Communication	DC	3	707	
	MCTC0030	Theoretical Perspectives of Communication	DC	4	707	
	MCPJ0031	Principles and Practices of Journalism	DC	4	708	
	Elective 1: One course to be opted					
	PCEC0013	Eastern Approaches to Psychology and Counselling	SE	3	514	
	EDET0015	Education Technology	SE	3	561	
	SWEM0038	Environment and Disaster Management	SE	3	488	
	Elective 2: One course to be opted					
	MCML0027	Media Literacy	DE	3	705	
	EDLR0007	Leadership and Social Responsibility	SE	3	550	
	SWGS0039	Gender Studies			490	
	LSET0019	English Language Teaching			658	
Practicum	MCTP6015	Techniques of Photography and Image Editing	DC	2	733	
	MCJG6016	Journaling	DC	1	733	
Total Credits				23		
Semester II						
Theory	MCID0032	Investigative and Data Driven Journalism	DC	3	707	
	MCTS0033	Theories of Development Communication and Social Change	DC	4	710	
	MCRM0034	Communication Research Methodology	DC	4	711	
	MCDM0035	Digital Media	DC	3	712	
	Elective 1 : One course to be opted					
	SWDS0044	Introduction to Disability Studies	SE		498	
	PCPD0007	Personality Development	SE		509	
	MCRC0026	Rural Communication	DE	3	704	
	Elective 2 : One course to be opted					
	PCSP0006	Introduction to Social Psychology	SE		507	
	EDPC0016	Peace Education and Conflict Management	SE		563	
	SWEM0038	Environment and Disaster Management	SE		488	
		LSNE0020	North-East Indian Literature in English	SE		659
Practicum	MCDI6017	Dissertation Phase-I	DC	2	734	
	MCAV6018	Audio-Video Production	DC	2	734	
Total Credits				24		
Semester III						
Theory		Media Laws, Ethics and Social Responsibility	DC	3		
		Advertising, Marketing and Public Relations	DC	3		
Practicum		Dissertation Phase-II	DC	2		

Theory	Specialization: Electronic Media			
		Script Writing	DC	3
		Audiography	DC	3
		Television Production	DC	4
		Video Editing	DC	4
	Specialization: Print Media			
		Specialized Writing	DC	3
		News Reporting and Editing	DC	4
		Political Communication	DC	4
		Health and Environmental Communication	DC	3
	Specialization: Communication for Development			
		Communication for Development: Indian and Global Context	DC	4
		Situation Analysis for Communication Strategy	DC	3
		Strategy Design: Planning Models, Process and Levels of Intervention	DC	3
	Legal Provisions in Development	DC	4	
Total Credits			22	
Semester IV				
Theory		Media and Cultural Studies	DC	3
Internship		Internship	DC	4
Specialization: Electronic Media				
Theory		Media Appreciation	DC	3
		Film Making	DC	3
		Final Project	DC	5
Specialization: Print Media				
Theory		Human Rights and Conflict Reporting	DC	3
		Sports Journalism	DC	3
		Final Project	DC	5
Specialization: Communication for Development				
Theory		Monitoring and Evaluation	DC	3
		Programme Management	DC	3
		Final Project	DC	5
Total Credits			18	
Grand Total			87	

DEPARTMENT OF SOCIAL WORK

SWSL0011: SOCIAL JUSTICE, HUMAN RIGHTS AND SOCIAL LEGISLATIONS

(3 Credits–45 hours)

Objectives:

- *To provide an understanding on social legislation and social action with relevance to social work practice;*
- *To develop an understanding about various social welfare legislations with specific reference to different groups of people;*
- *To understand the provisions of the legal system and the mechanisms available in the country for addressing issues of social change.*

Module I: Social Justice and Human Rights (7 hours)

Meaning of Justice, Forms of Justice, Theories of Justice, Law and Social Justice, Human Rights and Social Justice, Issues in Social Justice.

Module II: Social Legislation and Social Work (7 hours)

- a) Understanding concepts of law, social justice and social legislation, Legislation as an instrument of social justice and control.
- b) The Constitution of India: preamble and fundamental rights; Directive Principles of State Policy
- c) Classification of law: civil and criminal law. Relevance of law and legal systems to social work practice, partnership and interface between social workers and legal system.

Module III: Reformatory Law and Laws related to Protection of Human Rights (7 hours)

- a) Major provisions of the law for the protection of human rights, Structure, functions and powers of National and State Human Rights Commissions.
- b) Major provisions in Indian Penal Code (IPC) related to family violence, murder, suicide, rape.
- c) Meaning of cognizable and non-cognizable offences and conditions and procedures for bail; Importance and Procedures for filing a First Information Report (FIR)

Module IV: Social legislations: Major Provisions (20 hours)

- a) Laws Related to Children: Juvenile Justice Act, Laws relating to Adoption and Guardianship, Child Marriage Restraint Act, Prohibition and Regulation of Child Labour Act. Protection Of Children from Sexual Offences (POCSO) Act Laws Related to Family: Personal laws and the Civil law related to Marriage, Divorce, Maintenance and Succession; Law against Domestic Violence; Law of Family Court. Laws Related to Women: Immoral Trafficking Prevention Act (ITPA), The Sexual harassment of Women at Workplace (Prevention, Prohibition, Redressal) Act, 2013. Medical termination of pregnancy, Prohibition against Prenatal diagnostic tests (for sex determination). Laws Related to Scheduled Castes and Scheduled Tribes: Protection of Civil Rights; Law against Atrocities. Laws Related to Disabled: Mental Health Act, Persons with Disabilities Act, National Trusts Act. Laws Related to Workers: Minimum wages, Workmen's compensation. Laws Related to Consumers and Citizens: Consumer protection, Food adulteration, Right to information, Project affected persons.
- b) Protection of Children from Sexual Offences Act (POCSO) and Sexual harassment of women in workplace act.

Module V: Justice System and Legal Aid provisions (4 hours)

- a) Agencies of the justice system: police, judiciary, correctional systems, their structure and functions

- b) Structure and jurisdiction of courts: district and sessions courts, high court, Supreme Court. Distinction between civil and criminal courts; Consumer courts Special courts/tribunals – accident, corruption
- c) Concept of legal aid, Lok Adalat; Public Interest Litigation (PIL)

Suggested Readings

1. Samaddar Ranabir (Ed), State of justice in India-issues of social justice, sage publication, 2009.
2. Acharya, Basu Durga Das : Introduction to the Constitution of India, New Delhi : Prentice Hall of India Pvt.Ltd., (7th. Edition)
3. Ahuja, Ram: Criminology, Jaipur : Rawat Publications
4. Biju, M. R , Human Rights in a Developing Society, New Delhi : Mittal Prakashan, 2005
5. Diwan, Paras and Diwan, Peeyush, Child and Legal Protection, New Delhi : Deep and Deep Publications, 1994
6. Flavia ,Give us this Day, Our Daily Bread, Procedures and Case Law on Maintenance, 1997
7. Gaikwad, P E, Law Basic Concepts, Pune : YASHADA,2004
8. Galanter, Marc, Law and Society in Modern India, Delhi : Oxford University Press, 1992
9. Gangrade, K.D, Social Legislation in India (Vol-1 and Vol.2), Delhi : Concept Publishing Company.
10. Gaur K. D, A TextBook on the Indian Penal Code, Delhi: Universal Law Publication Co. Ltd., 2004
11. Kant, Anjani,Women and the Law, New Delhi : APH Publication Corporation., 1997
12. Matthew, P D, Constitution of India Simplified, New Delhi : Indian Social Institute, 1993
13. Pradhan, V. P, The Indian Constitution, New Delhi :Ombudsman Publishing House, (1st Edition).
14. Prakash, Ravi, Constitution of Fundamental Rights and Judicial Activism in India, Jaipur : Mangal Deep Publications
15. Purohit, B. R. and Joshi, Sandeep (Ed)) Social Justice in India, Jaipur : Rawat Publication, 2003
16. Qureshi, M. A, Muslim Laws of Marriage, Divorce and Maintenance, New Delhi : Deep and Deep Publications, 1992
17. Sastry, T. S. N, India and Human Rights, Delhi : Concept Publishing Company, 2005
18. Saxena, D. R, Law Justice and Social Change, New Delhi : Deep and Deep Publications, 1996
19. Shah, Ghanshyam,Social Justice- A Dialogue, Jaipur : Rawat Publication, 1998
20. Sharma, S. S, Legal Aid to the Poor, New Delhi : Deep and Deep Publications, 1993
21. Siddiqi, Fatima E. and Ranganathan Sarala: Handbook on Women and Human Rights – A Guide for Social Activists (Part 1 and Part 2), New Delhi : Kanishka Publication.
22. Singh, Alka, Women in Muslim Personal Law, New Delhi :Rawat Publications, 1992
23. Singh, Shiv Sahai,Unification of Divorce Laws in India.1992
24. South Asia Human Rights Documentation Centre. HandBook of Human Rights and Criminal Justice in India, New Delhi : Oxford University Press, 2006

SWDM0012: ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

(3 Credits–45 hours)

Objectives:

- To understand the *interrelatedness of human life and environment*;
- To develop an understanding of *problems arising out of environmental degradation and globalization*;
- To study the role of *social work practice in tracking environmental issues and disaster management*.

Module I (10 hours)

- a) Concepts: Environment and Ecology; the Interrelatedness of living organisms and natural Resources

- b) Global Environmental Crisis and its linkages to the development process. Global warming, Environmental politics and resource development regimes; Sustainable development: Management and Conservation changes.

Module II (10 hours)

- a) State of India's Environment: Waste Management; Pollution – Air, Water, Soil, Noise; Laws Related to environment.
- b) Social Work and Environment: Environment Education, Environment Ethics, Promotion Environment Movements, Environment Management – EIA.

Module III (10 hours)

- a) Disaster: Definition, Natural and Human made disasters; multiple causes and effects; Stages of disaster; Development and Disaster; Preventive Measures.
- b) Models of Disaster: Crunch Model and Release Model

Module IV (15 hours)

- a) Disaster Management and phases. Pre-disaster: prevention, preparation, education vulnerability and preparedness. Actual Disaster: contingency, short term and long term plans, search, relief, rescue, recovery and restoration. Post Disaster: rehabilitation and commemorations.
- b) Role of Social workers and Voluntary agencies: role of social work professionals at different levels: resource mobilization, working with other professionals, working with government and voluntary organizations. Voluntary agencies working on disaster management.

Suggested Readings

1. Abbasi S.A., Wetlands of India: Ecology and Threats Vol. 1-3, 1997.
2. Dorr Donal, Social Justice Agenda: Justice, Ecology, Power and the Church, 1990.
3. Goel P.K., Environmental Guidelines and Standards in India, 1996.
4. Madhav Godgil; Ramachandra Guha, Ecology and Equity: The use and abuse of nature in contemporary India, 1995.
5. Neugeboren Bernard, Environmental Practice in the Human Services: Integration of Micro and Macro Roles, Skills and Contexts, 1996.
6. Shukla S.K., Srivastava P.R., Human Environment: An analysis, 1992.
7. Shukla S.K., Srivastava P.R., Environmental Pollution and Chronic Diseases.

SWCP0013: CONFLICT MANAGEMENT AND PEACEBUILDING

(3 Credits–45 hours)

Objectives:

- *To develop an understanding of the concepts related to peace and conflict theories;*
- *To know about the different approaches towards conflict resolution and the impact of violence on specific groups;*
- *To understand specific issues related to North East and the rise of different groups and conflict movements in North East India.*

Module I: Understanding Peace and Conflict (15 hours)

Meaning and Definition; Gandhi's Approach to Peace and Nonviolence; Positive and Negative Peace. Introduction to Peace and Conflict Studies- meaning and definition of Conflict theories- Frustration- Aggression Theory; Social Learning and Social Identity Theory; The Enemy System Theory; The Human Needs Theory; Protracted Social Conflict; Reconstructive and Transformative Peacebuilding and Peacemaking

Module II: Conflict Resolution Techniques (8 hours)

Unofficial Approach to Conflict; Role of Civil Society/ Organizations; Third-Party Mediation; Role of Track II and Multi-Track Approach in Conflict Resolution; Role of Media, Peace Journalism; UN Arbitration.

Module III: Types of Violence (12 hours)

Structural violence, social violence, communal violence, and political violence - Terrorism, Insurgency, Extremism, Militarisation.

Module V: State Identity and Conflict in North East India (10 hours)

Society in North east – Basic Demography, Social Groups; The Naga Conflict; Post colonial political Movements in Assam; Issues of Asomiya Identity, Bodo Identity and Other smaller identities; ethnic identity Issues; Rise of Insurgency in North-east; Boundary Conflict; AFSPA; Inner Line Permit.

Suggested Readings

1. Bhaumik Subir, Troubled Periphery
2. Boasson, Charles, In search of Peace Research (edited by Peter van den Dungen) Macmillan. London: 1991
3. Boulding, Kenneth, The War Trap in Richard Falk et al. Toward a Just world Order, Boulder: West view 1982.
4. Choudhury Sujit, The Bodos: Emergence and Assertion of an Ethnic Minority, IIAS Shimla
5. Galtung, Johan, The True Worlds: Free Press. New York 1980
6. Hazarika Sanjay, Stranger in the Mist.
7. Lawler, Peter, A question of Values: Johan Galtung's Peace Research, Boulder: Lynne Rienner. 1995,
8. Machel Graca, Impact of Armed Conflict on Children. 1996
9. Mack, Andrew, Peace Research in the 1980's, Australian National University. Canberra:1985
10. Maitra Kiranshankar, The Noxious Web: Insurgency in NE India, Kanishka Publication, 2001
11. Patomki, Heikki, The Challenge of Critical Theories: Peace Research at the start of the New Century, Journal of Peace research, vol. 38, no. 6, 723-737, 2001,
12. David P. Barash and Charles P. Webel, Peace and Conflict Studies (second edition), Sage, 2002
13. Johan Galtung, Carl G. Jacobson, Searching for Peace: the Road to TRANSCEND (second edition) Pluto Press, 2002
14. Sanjib Baruah, Durable Disorder; Understanding the Politics of Northeast India, OUP, 2005
15. Singh, Koireng, Aheibam, Ethnicity and Inter Community Conflict: A Case of Kuki Naga in Manipur, Akansha Publication, 2008
16. The Hague Agenda for peace and Justice for the 21st Century, 777 UN Plaza, New York, 1999

SWRD0014: COMMUNITY DEVELOPMENT: RURAL AND URBAN

(4 Credits – 60 hours)

Objectives:

- *To understand the concept, approaches and principles of Urban Community Development*
- *To gain knowledge about the existence of slums, and pavement dwellers well as their concerns.*
- *To develop an in-depth understanding of rural communities.*
- *To provide knowledge of the various methods, programmes strategies and developmental efforts towards community development.*
- *Understand, Rural social systems and their problems*
- *To Understand the challenges for interventions by community workers*

Module I: Community Development and Rural Community Development (15 Hours)

Concept and definition and objectives of community development: Approaches, philosophy and principles of rural development and rural community development. Rural development and rural community development. Rural demography, social structure, economic structure, political structure, Rural community: Characteristics.

Module II: History of Rural community development in India (10 Hours)

Pioneering period: Sriniketan, Marthandam, Gurgaon. Probation trial period: Firka, Nilokheri and Etawah projects

Module III: Urbanization and Urbanism (10 hours)

Concept and characteristics, urbanization and economic development. Urbanization and industrialization. Urbanisation and social problems. Urban ecology: growth of cities, characteristics of town, Metropolis. Megapolis, satellite towns, -commuter town / bedroom community- Suburbs- Edge cities- Multi-polar cities- Metropolitan areas. Leisure time theories and leisure time in cities.

Module IV: Urban Development and Urban Community Development (15 hours)

Urban development and urban community development: origin of urban community development in India. concept and principles, meaning, Need, scope, and Structure; Approaches to community development in urban area: Welfare, extension project of central welfare Board, Hyderabad project, Baroda Project .

Module V: Slums (10 hours)

Definition-causes, characteristics, theories of slums, consequences. Slums in Indian cities, slum clearance board. Pavement dwellers: employment for pavement dwellers, Urban poverty and its impact. Major agencies engaged in urban community development.

Suggested Readings

1. Desai, A. R. Rural Sociology in India, Bombay: Popular Prakashan, (1961)
2. Narang, Ashok. Indian Rural Problems,,: Murari Lal and Sons, New Delhi (2006)
3. Shah, Dilip. Rural Sociology, ABD Publisher, India : (2005)
4. Butter W Edgar . Urban Sociology- A Systematic Approach,,: Harper and Row Publishers, New York, (1976)
5. Loornis and Beegle. Rural Sociology (The Strategies of change), Englewood, Cliffs, New Jersey : Prentice Hall, Inc, (1957)
6. Sharma, K Rajendra. Rural Sociology,: Atlantic Publishers and Distributors, New Delhi (2004)
7. Sharma Ramnath Indian Rural Sociology,: Munshiram Manoharlal Publishers Pvt. Ltd. New Delhi (1979)
8. Doshi S L Rural Sociology: Rawat Publications, Jaipur (2002)
9. Singh S, Rural Sociology Prakashan Kendra Lucknow (1980)
10. Bhanti, Raj. Social Development (Analysis of some social work and field), Himanshu Publication, New Delhi, (2001)
11. Dasgupta, Bilap. Village Society and Labour Use,: Oxford University Press, New Delhi.
12. Doshi, S.L. and Jain, P.C. Social Anthropology,: Rawat Publications, New Delhi (2001)
13. Dubey, S.C. Indian Society, National Book Trust in India, New Delhi.
14. Jain, Netra Pal. Rural Reconstruction in India and China(A comparative study), Writers and Publishers Corporation, (1970)
15. Khadria, Binod (1999) The Migration of Knowledge workers, New Delhi, London : Sage Publications
16. Khan, Mumtaz Ali. Scheduled Caste and their status in India,,: Uppal, Publishing House, New Delhi, (1980)

17. Mishra, Anil Kant, Rural Tension in India, Discovery Publishing House, New Delhi : (1998)
18. Mishra, Omprakash (Ed.) Forced Migration, Manak Publication, Delhi : (2004)

SWG0015: GOVERNANCE AND COMMUNITY DEVELOPMENT

(4 Credits – 60 hours)

Objectives:

- *Understand the context, meaning and relevance of decentralised governance for urban, rural and tribal areas.*
- *Develop knowledge about the structure and functioning of governing bodies at various levels.*
- *Understand contemporary issues and challenges in accessing governance bodies for people's development.*

Module I: Rural Governance (15 hours)

- a) Democratic Decentralization: Meaning, objectives and importance, Governance : meaning and structures.
- b) Concept and Evolution of Panchayati Raj: Historical development of the concept, National level committees in the evolution of Panchayati Raj (Balwantrai Mehta, Ashok Mehta, Singhi committees)
- c) The Constitutional Amendment of 73rd Amendment, Review of 73rd Constitutional Amendment

Module II: The Functions of Panchayati Raj Institutions (15 hours)

Structure, functions and powers at each level, revenue sources, committees in village level Panchayati Raj bodies, gram sabha (including mahila gram sabha), Its role and importance, Community participation in governance. PESA (Panchayat Extension in Scheduled Areas) : Context of its emergence and its significance; issues and challenges in its implementation.

Module III: Urban Governance: Urban Local Self Government in India (15 hours)

- a) Types of Urban Local Self Government in India, Municipal Corporation, Municipal Council/ Nagar Palika; Sources of Revenue; Structure, powers and functions at each level, Committees and their functions, System of elections to Urban Local Self Government, Relation of Urban Local Self Government with bodies of Governance at the state level issues.
- b) 74th Constitutional Amendment Review of content and implementation

Module IV: Role of Urban LSG bodies in Urban Development (15 hours)

- a) Contemporary Issues and Potentials through Local Self Government
- b) Women's participation; participation of marginalized groups (SC and ST and minorities); political parties; autonomy and control; factionalism in governance.
- c) Challenges in developing partnerships between elected bodies, bureaucracy and civil society.

Suggested Readings

1. Gender, Alochana, Women and Panchayat Raj, Alochana Centre for Documentation and Research on Women, Pune : (2007),
2. Chahar, S.S. (Ed.) Governance of Grassroots Level in India, New Delhi: (2005), Kanishka Publishers
3. Devas, Nick and Others, Urban Governance, Voice and Poverty in Developing World, London : Earthscan, (2006)
4. Haldipur, R.N. Paramahansa V R K (Eds.) Local Government Institutions in India, National Institute of Community Development, Hyderabad : (1970)
5. Hooja, Prakash and Hooja, Meenakshi, Democratic Decentralization and Planning, Rawat Publications, Jaipur, (2007)

6. Jain, S. C. Community Development and Panchayat Raj, Allied Publishers Pvt. Ltd, Madras: (1967)
7. Kumar, Krishna, Direct Democracy and Village Governance, Deep and Deep Publication, New Delhi.
8. Lele, Medha. Kotwal, Kulkarni, Vandana Power and Empowerment, Alokana Centre for Documentation and Research on Women, Pune.
9. Mishra, S.N., Mishra Sweta and Pal, Chaitali Decentralized Planning and Panchayati Raj Institutions, Mittal Publications, New Delhi : (2000)
10. Palenithurai, G. (Ed.) New Panchayati Raj System – Status and Prospects, Kanishka Publishers, New Delhi (1966)
11. Sharma, B. D. Taming the Transition in Scheduled Areas, Sahyog Pustak Kutir, New Delhi: (2001)
12. Singh, Amita (Editor) Administrative Reforms (towards sustainable practice), Sage Publications, New Delhi: (2005)
13. Singh, U. B. Urban Administration in India, Serial Publications, New Delhi: (2004)
14. Baluchamy, S. Panchayat Raj Institutions, Mittal Publication, New Delhi (2004)

SWFW0016: FAMILY CENTERED SOCIAL WORK PRACTICE

(4 Credits - 60 hours)

Objectives:

- *To understand family and marriage as social institutions and to analyze the legislations with regard to marriage and divorce in India.*
- *To understand the dynamics of family relationships*
- *To analyse the institution of family within the context of globalised economic and political system.*
- *To become familiar with the Governmental efforts for strengthening families and to identify techniques and interventions required for working with family.*

Module I: Family and Marriage as Social Institutions (14 hours)

- a) Concept of family, Origin of family, Types of family, Functions of family, Family dynamics – power, myths, role, relationship. Concept of marriage, types of marriage.
- b) Constitutional legislations on family, marriage and divorce in India

Module II: Equity and equality -Dynamics of Family Relationships (13 hours)

- a) Equity and equality, Gender and patriarchy: Implications of the patriarchal social structure.
- b) Crisis of violence against women: Global, national, local.

Module III: The Family in the context of Globalization (16 hours)

- a) Review of changing situations in family, marriages and marital relationship
- b) Alternative Family and Marriage Patterns and Structures. Dual earner/career families, Single parent families, female headed households, Childless families, Reconstituted/ step families, Homosexual families, Consensual unions, and live in relationships
- c) Displacement and disaster generated changes in the family (war, conflict, riots and natural calamities) and its implications: vulnerability of families, marginalized families due to poverty, caste

Module IV: Social Work with families: interventions, techniques and skills (17 hours)

- a) Family life cycle, Family centred social work – problem solving approach, Life enrichment programmes – developmental approach, Programmes for family empowerment and protection of human rights.

- b) Efforts of government in strengthening families – Policy, Legislation and programmes, Micro-credit, component plan, Schemes for families, Public Distribution System,
- c) Health – Family Welfare Programme, Health Insurance.

Suggested Readings

1. Burgess, Ernest W, Locke Harvey J., Thomes Mary Margare. The Family from Traditional to companionship (4th edition), New York :Van Nostrand Reinhold Co. 1978
2. Chowdhury, Aparajita. Carson and Carson. Family Life Education in India: Perspectives, Challenges and Applications. Rawat Publications: Jaipur, 2006
3. Desai,Murli. Family and Intervention – Some Case Studies. Mumbai: TISS. 1986
4. Elliott and Merrill. Social Disorganization. New York : Harper and Brother Pub. 1960.
5. Gore, M S. Urbanization and Family Change. Mumbai : Poplar Prakashan. 1968
6. Green Arnold W. Sociology (Analysis of life in Modern Society), MacGraw Hill Book, Co. 1964
7. Harris, C. C. The Family an Introduction. London : George Allen and Unwin Ltd. 1969
8. Jayapalan N. Indian Society and Social Institutions – Vol. I. New Delhi : Atlantic Publishers and Distributors. 2001
9. Kumar, S., Chacko, K. M. Indian Society and Social Institution. New Delhi: New Heights Publishers and Distributors. 1985
10. Lal, A. K. The Urban Family : A Study of Hindu Social System, Concept. New Delhi : Publishing Company. 1989
11. Larlton E, Munson. Social Work with Families – Theory and Practice. New York :1970
12. Lavania, Vinita. Childless Couples: Social Consequences of Sterility and Infertility. New Delhi: Rawat Publications. 2006
13. Nichols,Michall P and Richard, C. Family Therapy Concepts and Methods (2nd edition). London : Allyn and Bacob. 1991
14. Singh, Yogendra,Social Stratification and Change in India. New Delhi : Manohar The Free Press, 1983
15. Williamson, Robert C. Marriage and Family Relations. Sydney: John Wiley and Sons, Inc. 1967

SWSC0017: SOCIAL WORK PRACTICE WITH CHILDREN

(4 Credits - 60 hours)

Objectives:

- *To understand the process of socialization of a child and children's health; both mental and physical well-being.*
- *To analyze the difficult situations faced by children in the present context.*
- *To know the national and international efforts for child welfare and the child related laws.*
- *To understand and acquire the skills for working with children.*

Module I: Understanding Child and Socialization process (12 hours)

- a) Understanding Child- Definitions and Concepts.
- b) Concept and process of socialization, Theories of socialization, Child rearing practices.
- c) Agents of socialisation – family, neighbourhood, school, peer group, mass media, religion. Socialization of children with special needs- special schools.

Module II: Children's Health (14 hours)

- a) General Health of Children: common diseases, malnutrition problem, infant mortality and morbidity, health of adolescent girls.
- b) Child Mental Health: Concept of mental health, child mental health and psycho-social development. Mental health needs and mental health problems in children of various age

groups, mental health disorders related to children: Learning Disabilities, emotional disorders, conduct disorder, pervasive developmental disorder

Module III: Children in Difficult situations (13 hours)

Street child, destitute, children in conflict with law, abandoned, orphaned, child abuse, child labour, child trafficking, natural calamity affected children, children in conflict situation, HIV-AIDS affected and infected children, tribal child, child beggar, child prostitute, children from poverty infested groups, special problems of girl child.

Module IV: Child Welfare Policies, Programmes and Acts (15 hours)

Constitutional Provisions, National Policy for Children, UNCRC, National Charter for Children, National Action Plan for Children, Commissions for Protection of Child Rights and State policy for children, Juvenile Justice (Care and Protection of Children) Act, 2000, Guardianship and Wards Act, Hindu Adoption and Maintenance Act, Central Adoption Regulatory Agency (CARA guidelines), Child Labour (Prohibition and Regulation) Act 1986. Current initiatives- ICDS, ICPS, SSA and RTE, NRHM: School Health Programme. Developmental services (for example, non-formal education, bridge schools) Remedial services (e.g. residential care, child guidance clinic),

Module V: Skills in Working with Children (6 hours)

Communication – individual and group, use of creative activities, skills in behaviour modification techniques, skills in advocacy and campaigning for children, relationship building skills.

Suggested Readings

1. Anandaraj, Hannah. Children at Risk. Hyderabad: Neelkamal Publications. 2007
2. Banerjee, B. G. Child Development and Socialisation. New Delhi : Deep and Deep Publication. 1987
3. Baroocha, Pramila Pandit. Handbook on Child. New Delhi : Concept Publishing Com. 1999
4. Berk, Laura E. Child Development (8th edition). New Delhi: Pearson Prentice Hall. 2009
5. Bhalla, M. M. Studies in Child Care, Delhi : Published by NIPCCD. 1985
6. Bossare, James H. S. The Sociology of Child Development. New York : Harper and Brothers. 1954
7. Chandra Kulshreshtha Jinesh. Child Labour in India. New Delhi : Ashish Publishing House. 1978
8. Chaturvedi, T. N. Administration for Child Welfare. New Delhi : Indian Institute of Pub. 1979
9. Choudhari, D. Paul. Child Welfare / Development, Delhi : Atma Ram and Sons. 1980
10. Ghathia, Joseph. Child Prostitution in India. New Delhi : Concept Publishing Company. 1999
11. Gokhale, Sharad D. and Sohoni, Neera K. Child in India, Mumbai : Somaiya Pub. 1979
12. Gopalakrishnan B. Rights of Child. Jaipur: Aavishkar Publishers. 2004
13. Hugh, Jolly. Diseases of Children. Oxford: The English Language book society and Blackwell Scientific Publications. 1981
14. Hurlock, Elizabeth B. Child Development, New Delhi : Tata McGraw Hill Pub; Com; Ltd. 1968
15. Kumar, Arvind. Fundamentals of Child Rights: Concepts, Issues and Challenges. Lucknow: Laxmi Shikshan Sansthan. 2002
16. Nanda, V. K. Nutrition and Health for child Development, New Delhi : Anmol Publication Pvt. Ltd. 1998
17. Pandya, K. C. Element of Child Development. New Delhi : Kalyani Pub. 1988
18. Pimpley, P. N., Singh K. P., A. Mahajan. Social Development Process and Consequences. Jaipur : Rawat Publication. 1989
19. Rao, M. Koteswar. Exploited children, New Delhi : Kanishka Publishers, Distributors. 2000
20. Sharma and Sharma. Child Psychology. Atlantic Publishers: New Delhi. 2006
21. Skinner, Charles E., Harriman, Phillip L. Child Psychology: Child Development and Modern Education. Surjeet Publications: New Delhi, 2008

SWMW0018: MEDICAL SOCIAL WORK

(4 Credits - 60 hours)

Objectives:

- *To understand the relevance and the need for social work in the field of health*
- *To gain insight into the impact of ill health on the individual and his social system*
- *To understand and develop competence about the roles and functions of medical social workers in various settings*

Module I: Historical overview (15 hours)

Medical Social work:- Historical development of medical social work in Western countries and in India, Social workers in General health Care system in India, Challenges in the field of medical social work in India.

Module II: Disease, illness and sickness and concept of care (15 hours)

Illness as a social problem and its effect on the individual, family and community. The concept of patient as a person, Social and emotional factors involved in disease, Social Work with terminally ill, social work with dying and bereaved, Palliative Care, Hospitalization and its implications on patient and the family members, rights of Patients, Modern trends in treatment of illness. Care in different medical settings – hospitals, outpatient departments, emergency, crisis care, hospice, special clinics.

Module III: Skills (10 hours)

Skills and qualities of Medical social Worker. Teamwork and multidisciplinary approach in the treatment of illness. Role and functions of a medical Social worker, Organization and administration of medical social work department in hospitals. Assessment and Diagnosis- Interviews, Reporting and Record maintenance. Medical Social Worker and Public Relations.

Module IV: Medical Social Work in different departments in hospitals (20 hours)

Medical Social Work in different Departments in hospitals: Oncology, Nephrology, Reproductive Health, family welfare and family planning, Sexual health (STD, HIV/AIDS), Geriatrics, Diabetology, Cardiology, Accident, disability and burns department

Suggested Readings

1. Anderson R. and Bury M.. Living with Chronic Illness – the Experience of Patients and their Families. Unwin Hyman. London: (eds.) 1988
2. Bajpai R.K.. Social Work Perspectives in health.: Rawat Publications. New Delhi (Ed.) 1997
3. Barlett H.M.. Social Work Practice in the Health Field. New York: National Association of Social Workers. 1961
4. Dimatteo, M. Robin and Leslie R. Martin.. Health Psychology.: Dorling Kindersley (India) Pvt. Ltd. New Delhi, 2007
5. Field M.. Patients are People – A Medical – Social Approach to Prolonged Illness. Columbia University Press. New York: 1963
6. Narasimhan, M. C. and Mukherjee A.K. Disability – A Continuing Challenge. Wiley Eastern Ltd. New Delhi: . 1987
7. Pathak S. H. Medical Social Work in India. New Delhi: DSSW. 1961
8. Pokarno K.L. Social Beliefs, Cultural Practices in Health and Diseases. Rawat Publications. New Delhi: 1996

SWMS0019: MENTAL HEALTH AND SOCIAL WORK**(4 Credits - 60 hours)**

Objective: *The main purpose of this course is to enable students understand the concept of mental health and relevance of social work in the field of mental health. It would also provide an opportunity to be oriented about various mental illness affecting people and the significance of community mental health.*

Module I: Understanding mental health and mental illness (13 hours)

Mental health: A Conceptual Framework: Historical background of the concept. Definitions of mental health components. Mental health in the changing society. Concept of normal and abnormal behaviour. psychiatry – definition, history and growth of psychiatry. Traditional and modern attitude towards psychiatric illness. Symptomatology – Disorders of perception, thought, speech, memory, emotion.

Module II: Psychiatric assessment (13 hours)

Assessment in psychiatry. Psychiatric interviewing, case history recording and mental status examination (MSE). Classification in psychiatry- need, types - ICD and DSM.

Module III: Major Psychiatric disorders (21 hours)

Prevalence, etiology, clinical manifestation, course and outcome and different treatment modalities of the following disorders:

- a) Neurotic and somatoform disorders – Phobia, anxiety disorders, Obsessive compulsive disorders, dissociative (conversion) disorders, somatoform disorders
- b) Mood (affective) disorders
- c) Organic mental disorders – dementia, (Alzheimers), Amnesic syndrome, delirium
- d) Schizophrenia and Delusional disorders
- e) Disorders of adult personality and behaviour _ paranoid, schizoid and histrionic personality disorders. Gender identity disorders, disorders of sexual preference
- f) Disorders of psychological development – developmental disorders of speech and language and scholastic skills; learning disability, mental retardation, pervasive developmental disorders – autism, Rett’s and Asperger’s syndrome
- g) Behavioural and emotional disorders in childhood and adolescence – Hyperkinetic and conduct disorders, anxiety, phobia and depression
- h) Disorders due to substance use

Module IV: Community mental health (12 hours)

Community psychiatry – concept and meaning, evolution of community psychiatry; Community mental health in India, Social – cultural factors in psychiatric disorders with special reference to India, culture bound syndrome.

Suggested Readings

1. American Psychiatric Association, Diagnostic and Statistical Manual of Mental Disorders. 4th Edition. DSM –IV-TR. APA. Washington DC: 2000.
2. Carlson R. Neil, Foundations of Physiological Psychology. 6th Ed. Pearson Education. India: 2007.
3. Chaube S.P, Abnormal Psychology, Educational Publishers.
4. Clifford T. Morgan, Richard A. King, John R. Weisz, John Schopler, Introduction to Psychology, Tata Mc. Graw Hill Edition.
5. Colman. M. Andrew, Oxford Dictionary of Psychology. Oxford University Press. New York: 2009 (3rd Ed).

6. Correy Gerald. Theory and Practice of Counseling and Psychotherapy. Student Manual. 8th Ed. Brooks Cole Cengage Learning. USA: 2005.
7. Fernald/Fernald, Munn's Introduction to Psychology, 5th Edition, AITBS Publishers, India.
8. James D. Page, Abnormal Psychology, Tata McGraw Hill Edition.
9. Kring M. Ann, Johnson L. Sheri, Davison C. Gerald, Neale M. John, Abnormal Psychology. 11th Ed. Wiley India Pvt. Ltd. New Delhi: 2010.
10. Kumar Updesh, Mandal .Manas. (Editors), Suicidal Behaviour. Assessment of People-at-Risk. Sage Publications India Pvt. Ltd. New Delhi: 2010.
11. Maxmen S. Jerrold, Ward G. Nicholas, Essential Psychopathology and its Treatment. 2nd Ed. Revised for DSM IV. W.W. Norton and Company. New York: 1995.
12. Mishra. A.K., Psychology of Aging. Sublime Publications. Jaipur: 2007.
13. Patel Vikram, Thara R.(Editors), Meeting the Mental Health Needs of Developing Countries. NGO Innovations in India. Sage Publications. New Delhi: 2003.
14. Ranjana, Cognitive Psychology. RBSA Publishers. Jaipur: 2010.
15. Robert A. Baron, Psychiatry, 5th Edition, Pearson Education.
16. Robert C. Carson, James N. Kutcher, Susan Minela, Jill M. Hooley, Abnormal Psychology, 13th edition, Pearson Education.
17. Santrock W. John, Educational Psychology 2nd Ed. Tata McGraw- Hill Edition. New Delhi: 2006.
18. Scileppi A. John, Teed L. Elizabeth and Torres D. Robin, Community Psychology. A common sense approach to mental health. Prentice Hall. USA: 2000.
19. Shepherd, Michael et al..Childhood Behaviour and Mental Health. University Press. London: 1971.
20. World Health Organization, The ICD 10 Classification of Mental and Behavioural Disorders, Clinical Description and Diagnostic Guidelines; Oxford University. Press, Geneva: 1992.

SWIS0020: INTRODUCTION TO SCHOOL SOCIAL WORK

(3 Credits - 45 hours)

Objectives:

- *To develop analytical skills in understanding the educational system of schools*
- *To develop an understanding of the theoretical perspectives in the area of School Social Work*
- *To understand the concept of Child Mental Health and develop skills in social work intervention*

Module I (7 hours)

School as a field of Social Work practice- school as a living environment within the community; historical development of school social work models and theoretical perspectives in school social work.

Module II (8 hours)

Child Mental Health - concept of mental health, child mental health and psychosocial development. Mental health needs and mental health problems in children of various age groups.

Module III (15 hours)

Social work prospects in the schools- Preventive- early detection of disabilities in the children - early intervention programmes for children. Remedial- understanding and helping pupils with problems. Detection and referral of behaviour problem children, helping children cope with stress, crisis resolution. Case management, case coordination, collaboration, case conference, consultation. Developmental- promoting psychosocial competence in children life skills for children. School social work practice- promote partnership of schools, families and communities.

Module IV (15 hours)

Learning Disabilities- introduction, subtypes, academic skills deficit and language problems of children with learning disabilities, education mandate for children with disabilities school policies. pointers for classroom identification assessment and diagnosis- multidisciplinary approach, assessment report, support services, working with learning disabled, skill requirements of a social worker.

Suggested Readings

1. Alderson, J. Models of School Social Work Practice in R Sarri and Maple eds School in the Community, National Association of Social Workers, Washington DC, 1972
2. Robert, Constable; Mc Donald Shirley; Flynn, John P. School Social Work Practice, Policy and Research perspective, Lyceum Books, Inc., Chicago, 1999
3. Arlien, Johnson. School Social Work- its contribution to professional education. National Association of Social Workers, New York, 1962
4. NASW standards for social work services in schools, National Association of Social Workers, New York, 1979
5. Nelson, C. A job analysis of the characteristics of the School Social Workers. Princeton Press, New Jersey, 1990.

SWPD0022: COMMUNITY DEVELOPMENT PRACTICE WITH THE DISEMPOWERED COMMUNITIES**(4 Credits - 60 hours)****Objectives:**

- *To understand histories, meanings and issues of marginalization, oppression and disempowerment of vulnerable communities such as the dalits, tribes and the indigenous peoples and women ;*
- *To build capacity for critical reflection and analysis of community development issues pertaining to the disempowered;*
- *To build upon the existing understanding of community dynamics, structures and experiences; and*
- *To strengthen skills and capacity for intervention at different levels taking an “empowerment” and anti-oppressive stance.*

Module I: Power, Privilege and Oppression (12 Hours)

Conceptual Frameworks and Theoretical Perspectives; Systems Theory; Critical Theories; Understanding oppression, privilege and oppression.

Module II: Political economy of the Dalit Development (12 Hours)

Social stratification; Caste; Casteism; Colonialism and State; Ambedkar and the annihilation of Caste

Module III: Political Sociology of the Tribes and Tribal Development (12 hours)

Perspectives on Tribes; History of Tribes/Adivasis in India; Evolution of Tribal Policy; Administration and Local Governance; Politics of Tribal Welfare and Development

Module IV: Specific Identity Constructs and Populations at Risk (12 hours)

Gender and Sexism- Gender, Culture, and Society; Race, Sexuality, and Culture (Intersections); Gendered Relations; Health, Sex, and Gender.

Module V: Towards an emancipatory community development practice (12 hours)

Critical Social Work; Anti-oppressive Approach; Structural Social Work

Suggested Readings

1. Chacko, P.M. (Ed.), Tribal Communities and Social Change
2. Freire, A. M. A., and Macedo, D. (Eds.) (1995). The Paulo Freire reader. New York: Continuum.
3. Freire, P. (1990). Pedagogy of the oppressed. (M. B. Ramos, Trans.) New York: Continuum.
4. Freire, P. (1969/1998). Education for critical consciousness. New York: Continuum.
5. Freire, P. (1998). Pedagogy of freedom: Ethics, democracy, and civic courage. (P. Clarke, Trans.) Lanham, MD: Rowman and Littlefield Publishers, Inc.
6. Freire, P., and Macedo, D. P. (1995). A dialogue: Culture, language, and race. Harvard Educational Review, 65(3), .
7. Fultner, B. (ed.) (2012). Jurgen Habermas: Key Concepts. Rawat Publications. Jaipur
8. Ghurye, G.S., The Scheduled Tribes
9. J.S. Bhandari et al (ed.), Tribes and Government Policies
10. Prasad, Archana. Against Ecological Romanticism
11. Rath, G.C. (Ed.), Tribal Development in India
12. Sharma, B.D. Planning for Tribal Development
13. Taylor, D. (ed.) (2011). Michael Foucault: Key Concepts. Rawat Publications. Jaipur
14. Elwin, V. The Philosophy of NEFA
15. Feminist Legal Theory (Bartlett and Kennedy eds. 1991)
16. Critical Race Feminism: A Reader (Wing ed. 1997)
17. Ortner, S. (1974) —Is Female to Male as Nature is to Culture?|| in M.Rosaldo and L. Lamphere (eds.), Women, Culture and Society, Stanford University Press, pp. 67-88.
18. Moore, H.L. (1988), Feminism and Anthropology, Ch.2, Cambridge: Polity Press, pp. 12-41.
19. Kimmel M. 2000, The Gendered Society. Introduction and Chapters 1, 2 and 4.
20. Hollway, W. (1984) 'Gender difference and the production of subjectivity', in Helen Crowley and Susan Himmelweit (eds.) Knowing Women, p240 - 275, Oxford: Polity.

SWDW0024: DEVELOPMENT CONCERNS AND WOMEN EMPOWERMENT

(4 Credits - 60 hours)

Objectives:

- *To develop an understanding of the feminist perspective and methodology*
- *To understand the status of women in the social, political and economic trend*
- *To develop an understanding of the women's problems and issues*
- *To know the national and international efforts for the welfare of women and gender parity*

Module I (20 hours)

Feminism - Introduction to Women's Studies; Feminist Theory – Theoretical Perspective, Concepts and Debates; Feminist Research Methodology; Feminist Economics.

Module II (8 hours)

Women in Indian Society - the changing profile - women in early India, pre-colonial period and modern India, Women's Movement and its impact, The history of women's education.

Module III (20 hours)

Concerns relating to Women – social, economic and political determinants of women's health; women's right and legal advocacy; violence against women; women in conflict areas; migration, displacement, disaster – impact on women; women and climate change; working women in organized and unorganized sector; women and globalization, PRIs and women in India, reproductive technology, women empowerment.

Module IV (12 hours)

Women Empowerment - Policies and programmes for poverty alleviation and economic empowerment of women, micro-finance, SHGs, cooperatives, SEWA, gender budgeting, Women Reservation Bill, Towards Gender Equality Report, CEDAW, National Commission for Women, State Commission for Women, National Policy for Women Empowerment, Social Work Practice in women centric organization and agencies.

Suggested Readings

1. Kumar, Radha. (1993). The History of Doing. New Delhi: Zubaan.
2. Ferber, A , Marriane. Nelson, A, Juie. (2003). Feminist Economics Today: Beyond Economic Man. London: The United Chicago Press Inc.
3. Gordon, L. P. (2002). Violence against Women. New York: Nova Publishers.
4. Kumar, Girish (ed.). (2009). Health Sector Reforms in India. New Delhi: Manohar
5. Harding, Sandra G(ed.). (2004). The Feminist Standpoint Theory Reader. New York: Routledge.
6. Lalkima, C. Lalneihzovi. (2009). Changing Status of women in north-eastern states. New Delhi: Mittal Publications.
7. Pandya, Rameshwari. Patel, Sarika. (2010). Women in the Unorganised Sector of India. New Delhi: New Century Publications.
8. Mies, M., Shiva, V. (1993). Ecofeminism. London: Zed Books.
9. Agnes, Flavia. (2004). Law and Gender Inequality: The Politics of Women's Rights in India. Delhi: Oxford University Press.
10. Arya, Sadhna. Roy, Anupama. (2006). Poverty Gender and Migration. New Delhi: Sage Publications.
11. Ramazanouglu, Caroline. Holland, Jannet. (ed) (2002). Feminist Methodology: Challenges and Choices. London: Sage Publications Inc.
12. Addlakha, Renu. (2008). Deconstructing Mental Illness: An Ethnography of Psychiatry, Women, and the Family. New Delhi: Zubaan.
13. Ganesamurthy, V.S. (2008). Empowerment of Women in India: Social, Economic and Political. New Delhi: New Century Publications.
14. Datar, Chaya. (2003). Integrating activism and academics. In Jain, Devika and Rajput, Pam (Eds.), Narratives from the Women's Studies Family: Recreating Knowledge (pp. 136-149). New Delhi: Sage Publication.

SWFS0025: FAMILIES WITH SPECIAL NEEDS**(4 Credits - 60 hours)****Objectives:**

- *To understand the context, responses and practice framework for special-care-needs families*
- *To imbibe and become familiar with practice principles, values and ethics while dealing with families with special needs*
- *To develop skills required for meaningful intervention and care-planning for families with special needs*

Module I: Understanding the context (15 hours)

- a) Understanding early childhood development: Disabilities, diseases, gender; Issues of care planning for children, Youths, women, men with special care needs; Special needs of families in Northeast India: families in conflict, disasters, displacement, superstition, homelessness and poverty.
- b) Emerging concerns of seniors and elderly: global, national and regional contexts.

Module II: Understanding the Responses (15 hours)

Understanding the theoretical foundations for Social Work Support, counseling, resource coordination and advocacy services for families with special care needs; Overview of service systems for special needs groups; Issues, challenges and practice approaches with children and parents in Adoptions and Foster care, Clients and care-providers in Institutional care; Adoption system: pregnant women, adoptive parents and adopted children; Disability, Pregnancy, LGTBs, geriatric care, Long-term care needs of terminally ill; Social Work Practice principles and values in these settings.

Module III: Advanced Practice Skills (30 hours)

- a) Case/Care Management of families with special needs :terminally ill person, mental health care, addictions, long-term care, aging, HIV/AIDS, disabilities, occupational services, child welfare, and immigrant/refugee families; Assessment; Care planning, and Resource linkages: programmes, schemes and services.
- b) Family Therapy: Communication-pattern approach; Family sub-system approach; Cognitive Behavioral Approach: cognitive restructuring, contingency contracting, skills.
- c) Working with Parents in families with special needs: Child Development Knowledge and Care, Positive Interactions with Child, Responsiveness, Sensitivity, and Nurturing, Emotional Communication, Disciplinary Communication, Discipline and Behavior Management, Promoting Children's Social Skills or Prosocial Behavior, Promoting Children's Cognitive or Academic Skills

Suggested Readings

1. Bhumali, A. (2009). Rights of disabled women and children in india. New Delhi: Serials Publications.
2. Bindra, A. (2010). HIV/AIDS health care and human rights. Delhi: Mangalam Publishers
3. Boyd-Franklin, N., Steiner, G.L., and Boland, M.G. (1995). Children, Families, and HIV/AIDS: Psychosocial and Therapeutic Issues. The Guilford Press.
4. Burke, Peter (2008). Disability and Impairment: Working with Children and Families. Jessica Kingsley Publishers
5. Cambridge, P., and Carnaby, S. eds. (2005). Person centred planning and care management with people with learning disabilities. Philadelphia: Jessica Kingsley Publishers
6. Cosis-Brown, H., and Cocker, C. (2011). Social Work with Lesbians and Gay Men. New Delhi: Sage
7. Dasgupta, S., and Lal, M. (eds.) (2007). The Indian family in transition: reading literary and cultural texts. New Delhi: Sage.
8. Emmatty, L.A. (2009) An insight into dementia care in india. New Delhi: SAGE
9. Gorman, J.C. (2004). Working with challenging parents of students with special needs. New Delhi: Sage
10. Grobman, L.M., and Bourassa, D.B. (2007). Days in the Lives of Gerontological Social Workers: 44 Professionals Tell Stories from "Real-Life" Social Work Practice with Older Adults. White Hat Communications
11. Humphrey, G.M., and Zimpfer, D.G. (eds.) (2012). Counselling for grief and bereavement, 2nd ed. New Delhi: Sage.
12. Lobo, A., and Vasudevan, J. (2002). The penguin guide to adoption in india. Delhi: Penguin Books.
13. McInnis-Dittrich, K. (2008). Social Work With Older Adults (3rd Edition). Pearson
14. McKenzie, R.B. (1998). Rethinking orphanages for the 21st century. New Delhi: Sage
15. Nayar, U.S. (ed.). (2012). Child and adolescent mental health. New Delhi: Sage.
16. Riddick-Grisham, S., and Deming, L. (2011). Pediatric life care planning and case management, second edition. Taylor and Francis Group
17. Satia, J., Misra, M., Arora, R., and Neogi, S. (2013). Innovations in maternal health: case studies from india. New Delhi: Sage

18. Singhal, A., and Rogers, E.M. (2003). Combating aids: communication strategies in action. New Delhi: Sage.
19. Srivastava, V. (2010). Women ageing: social work intervention. Guwahati: Rawat Publications.
20. Venkatesan, S. (2005). Children with developmental disabilities: a training guide for parents, teachers and caregivers. New Delhi: Sage
21. Webb, Nancy Boyd. (2003). Social work practice with children (2nd ed.). New York: Guilford.
22. Yuen, Francis K.O. (2005). Social Work Practice with Children and Families: A Family Health Approach (Haworth Health and Social Policy). Routledge
23. Zastrow, C.H. (2009). Social work with groups. New Delhi: Cengage.

SWPS0026: PSYCHIATRIC SOCIAL WORK

(4 Credits – 60 hours)

Objectives:

- *To be oriented to the field of psychiatric social work and comprehend the roles and responsibilities of psychiatric social workers;*
- *To familiarize with the practice of psychiatric social work in varied mental health settings and the application of different therapeutic interventions;*
- *To be equipped with the skills and techniques for practice and design programmes for the care of the mentally ill.*

Module I: Psychiatric Social Work and its application in the field (15 hours)

Psychiatric social Work - Definition and historical development in UK, USA and India. Present status and challenges in the field. Multi-disciplinary team approach in the treatment of psychiatric illness. Role and functions of psychiatric social worker in the team. Psychiatric social worker in the field of community mental health. Skills and techniques used in psychiatric social work practice.

Module II: Rehabilitation and practice of psychiatric social work in various clinical settings (13 hours) Psychiatric rehabilitation - definition, principles and strategies. The concept of social diagnosis and social work interventions in psychiatric settings.- psychiatric departments /hospitals/clinics, halfway homes, day care centres, child guidance clinics and de- addiction centres.

Module III: Therapeutic approach to mental illness (20 hours)

Treatment and after care of mentally ill patients, application of social work methods in the treatment of mental disorders. Various therapeutic methods: Psychotherapy, Electroconvulsive Therapy, Occupational Therapy, Group Therapy, Client Centered Therapy, Gestalt Therapy, Reality Therapy, Behaviour Therapy, Play Therapy, Rational Emotive Therapy, Therapeutic Community, Motivational Enhancement Therapy and Psychoeducation.

Module IV: Policies and programmes in the field of mental health (12 hours)

Mental health policies and legislation in India - National Mental Health Programmes. Designing and implementing programmes on mental health in communities, monitoring and evaluation of programmes. Research – qualitative and action research on mental health issues.

Suggested Readings

1. Bhattacharya, Sanjay Dr, Social Work: Psycho-Social and Health Aspects. Deep and Deep New Delhi: 2008
2. Carson C. Robert, Kutcher N. James, Minela Susan, Hooley M. Jill, Abnormal Psychology. 13th Edition. Pearson Education. 2010
3. Francis, C. M., Promotion of Mental Health with Community Participation. The Center for Health Care Research and Education. Kerala: 1991
4. Hudson Barber, Social Work with Psychiatric Patients. Macmillian Publishers. New Delhi: 1960

5. Maxmen S. Jerrold, Ward G. Nicholas, Essential Psychopathology and its Treatment, 2nd Edition. W.W. Norton and Company. USA: 1994
6. Murphy Joseph, Dr., The Power of Your Subconscious Mind, Embassy Books Distributors. India: 2010
7. Patel Chhaya, Social Work Practice – Religio – Philosophical Foundations. Essays in Honour of Professor Indira Patel. Rawat Publications. Jaipur: 2009
8. Patel Vikram, Thara R., Meeting the Mental Health Needs of Developing Countries – NGO Innovations in India. SAGE Publications. New Delhi: 2003
9. Pritchard Colin, Mental Health Social Work, Routledge. USA: 2006
10. Rukadhikar A., Rukadhikar P, Mental disorders and You, Psychiatric Centre. Miraj: 2007
11. Scileppi A. John, Teed L. Elizabeth, Torres D. Robin, Community Psychology, A Common Sense Approach to Mental Health, Prentice Hall. New Jersey: 2000
12. Segal, E. A., Gerdes, K.E. and Steiner, S., Professional Social Work.. Rawat Publications. New Delhi: 2010
13. Stroup H. Herbert, An Introduction to the Field. 2nd Edition, Surjeet Publications. New Delhi: 2008
14. Verma, Ratna, Psychiatric Social Work in India. Sage Publications. New Delhi: 1991

SWHM0027: COMMUNITY HEALTH AND POPULATION MANAGEMENT

(4 Credits - 60 hours)

Objectives:

- *To equip students with an understanding of health and epidemiology.*
- *To analyse health and population related policies and programmes in relation to the development and its implications in social work practice.*
- *To impart knowledge of community health, people's participation, vital health indicators and demographic data and its uses in health planning process- at national and regional levels.*
- *Impart understanding of prevention, counseling and management of HIV/AIDS patients.*

Module I (15 hours)

Meaning and Scope of Health and Epidemiology: Concepts and Models of Health and Disease. Factors associated with health and diseases. Concepts of sickness, illness and diseases. Environmental Health, Nutritional Health, Occupational Health, Mental Health and Reproductive Health, Tribal Health.

Module II (13 hours)

Health Statistics and health Indicators: Morbidity and Mortality: MMR, IMR, TFR. Communicable and non-communicable diseases. HMIS – computer systems, data sources, collection, analysis and uses. Primary Health Care, and Public and Community Health Services: Structure, Organization, and Community Participation. Physical and psychological aspects of community health. Aspects of Community Health: drugs and alcoholism. Preventive and promotive health care in Indian context.

Module III (12 hours)

Health and Population Policies: Health Policy: Alma Ata Declaration, National Health Policy, Mental Health Act, NRHM, Assam Public Health Act. Population Policy. Population dynamics- national and the North East context.

Module IV (12 hours)

Health Education, Consumer Health and Health Products: Meaning, importance, principles and components of health education. IEC for health: mass media, audio-visual. Agencies for Health

Education Programmes-Voluntary and Government. Analysis of Health Education in India. Formal and Informal health care providers, Modern and traditional practices, safe and risk health behavior and practices. Quackery, Consumer Law on health, consumer agencies.

Module V (8 hours)

Role of Social Work in dealing with HIV/AIDS infected and affected persons- skills and abilities. Laws and provisions, and social reality for persons with HIV/AIDS. Preventive, Promotive and Rehabilitative programmes.

Suggested Readings

1. Abelin, T, Brzenski Z.J., and Carstairs, V.D., Measurement in Health Promotion and Protection, WHO, Copenhagen,1987
2. AIDS Prevention through Health promotion by WHO, end of pub.
3. Alderson, M., An Introduction to Epidemiology, 2nd edition, . Mac-Millan, London, 1983
4. Anssi. Perakyla, AIDS Counselling – Institutional Interaction and Clinical Practice, Cambridge, University Press, 1995
5. Bhore, J., Report of the Health Survey and Development Committee. Vol. 2., Government of India., New Delhi, 1946
6. Dutta, I. and Bawari, S., Health and Healthcare in Assam: A Status Report, CHEAT and OKD, Mumbai, 2007
7. Francis, C.M., Pomotion of Mental Health with community participation- The center for Health Care Research and Education, Kerala,1991.
8. Government of India (GOI). Operational Guidelines for Programme Managers and Service Providers for Strengthening STI/RTI Services, GOI, Ministry of Health and Family Welfare, New Delhi, 2011
9. Green LW and Anderson, C.L., Community Health 5th edition, Times Mirror Mosby, St. Louis 1986
10. Park,K., Park's Textbook of Preventive and Social Medicine, 20th edition, Bhanot, 2009
11. Thomas, G., AIDS and Family Education – Gracious Thomas, Rawat, Jaipur, 1995
12. Thomas, G., Sinha, N.P and Thomas, K.J. AIDS'S Social Work and Rawat, Jaipur, 1997

SWPR0029: PROJECT CYCLE MANAGEMENT AND RESOURCE MOBILISATION

(4 Credits - 60 hours)

Objective: *The course is developed to enable students*

- *To understand the importance and process of planning*
- *learn the methodology for planning and formulating projects using the Logical Framework Analysis*
- *Develop an understanding of the problems and issues faced by the poor and the marginalized*
- *Develop relevant programme management competencies, leadership skills and analytical capabilities*
- *Develop an insight into the different strategies and approaches commonly adopted by Development Organisations for project management*
- *Learn Skills to develop project proposals, implement, monitor and evaluate project, enhance process documentation and reporting skills*
- *Develop an understanding and skills to mobilize resources and develop insight into the compliance of legal requirements in project management*

Module I: Overview (8 hours)

- a) Planning for projects; importance and scope, stakeholders involved in planning.
- b) Overview of Project Cycle Management: Identification, Design, Implementation, Review, Monitoring, Evaluation, Identification of the best practices.

Module II: Project Identification and Project Design (15 hours)

- a) Needs assessment: Situational analysis, Data collection, Methods and Tools, Observation, Interview, Focus Group Discussion.
- b) Research: Principles of Participation and Participatory Methods.
- c) Capacity assessment: Human, Social, Natural, Physical, Economic and Cultural.
- d) Stakeholders analysis: User groups, interest groups, beneficiaries, decision makers; Primary and Secondary Stakeholders.
- e) Identifying appropriate stakeholders at different level of participation
- f) Formulation of objectives: Problem analysis, problem tree analysis

Module III: Logical Framework Analysis (12 hours)

Terms, Purpose, Structure; Objectives, Assumptions and their assessment; Indicators and Means of Verification; Activities, Activity Schedule, Proposal Planning and Budget

Module IV: Monitoring and Evaluation (7 hours)

The need, monitoring, reviewing and evaluation, learning the lessons; documentation, reporting; Critical Path Method (CPM) of Monitoring

Module V: Resource Mobilization (10 hours)

Internal and External Resources; Fundraising – principles, sources, ethics, methods and their implications.

International sources for Funding – Concept note; application, procedure and FCRA, record keeping, documentation and legal compliance

Module VI: Corporate Social Responsibility as a source of Funding (8 hours)

Concept and Definitions, Scope and Challenges, Role of Government and NGO in CSR, Triple Bottom line Approach of CSR: Economic, Social, Environmental Stakeholders, Social Preferences: Customer, Employees, Communities, and Investors

Suggested Readings

1. Blackman, R. (2003). Project Cycle Management. UK: Tearfund. (Downloaded available at www.tearfund.org/tilz)
2. Preskill, H., & Russ-Eft, D. (2005). Building Evaluation Capacity. London: Sage Publications.
3. Capezio, P. (2000). Powerful Planning Skills. Mumbai: Jaico Publishing House.
4. Smith, S. (2002). Plan to Win. New Delhi: Kogan Page India.
5. Dale, R. (2001). Evaluation Frameworks for Development Programmes and Projects. New Delhi: Sage Publications.
6. Loehle, C. (2000). Thinking Strategically. New Delhi: Foundation Books. Padaki, V. (1995). Development Intervention and Programme Evaluation. New Delhi: Sage Publications.

SWMD0030: DEVELOPMENT ORGANISATIONS - ESTABLISHMENT AND MANAGEMENT

(4 Credits - 60 hours)

Objective: This course takes the student of this specialisation through the processes and policies that have to be kept in mind when establishing a development organisation, The course also gives an insight into the managerial skills required for managing such an organisation.

Module I: Basic concepts of Management (20 hours)

Concept, Nature and Process of Management; Managerial Skills and Level of Management; Functions of Management: Planning, Organizing, Leading and Controlling; Theories and principles of Management

Module II: Development Organizations: Concept and historical growth (15 hours)

Concept of Development Organizations; Historical growth of Development Organizations; Functions and types of Development Organizations; Development organizations as voluntary organizations/ non-governmental organizations, civil society organisations, community based organization, faith based organizations, charity based organizations; Voluntary Action: ideological basis of voluntary organization; changing context of voluntary organizations; Various forms of organising - Societies, Cooperatives, Trusts and Trade unions

Module III: Perspectives and Policies (10 hours)

- a) Evolution of perspectives in development organizations, the rights based approach
- b) International and National policies for voluntary sector: NGO-Government interface;
- c) Transparency, accountability and credibility of the NGO sector

Module IV: Establishment and Management of Development Organisations in India (15 hours)

- a) Registration; Procedure and Laws
- b) Formation of an Organisation: Relevant Legislations- Society's registration Act 1860,, Companies Act 1956 and 2013 , Public Trust Act, 1882, and the Indian Trusts (amendment) Act, 2016, Indian Cooperatives society Act, 1904 and 2013, The Foreign Contribution (Regulation) Act, 2010, Income tax Act, 1961 (12A, 80 G), the shops and establishments Act 1953
- c) Taxation and Income tax Exemption for Development Organizations

Suggested Readings

1. Brody, R., Effectively Managing Human Service Organizations. New Delhi: Sage.
2. Bryson, J.M., Strategic Planning for Public and Nonprofit Organizations: A Guide to Strengthening and Sustaining Organizational Achievement. Jossey-Bass.
3. Dadrawala, N.H., The Art of Successful Fund Raising. New Delhi: CAP
4. Mukherjee, K.K. and Mukherjee, S., A Guide Book for Strengthening Voluntary Organizations. Ghaziabad: Gram Niyojan Kendra.
5. Nanavatty, M.C., and Kulkarni, P.D., NGOs in the Changing Scenario. New Delhi: Uppal Publishing House.
6. Netting, F.E., & O'Connor, M.K., Organization Practice: A Social Worker's Guide to Understanding Human Services. Allyn and Bacon.
7. Padaki, V., & Vaz, M., Management Development and Nonprofit Organizations. New Delhi: SAGE
8. Pynes, J.E., Human Resources Management for Public and Nonprofit Organizations. Jossey-Bass.
9. Sidel, M. and Zaman, I., Philanthropy and Law in South Asia. New Delhi: APPC
10. Smith, D.H., Grassroots Organizations. Thousand Oaks, CA: Sage.

SWDO0031: POLICIES FOR DEVELOPMENT ORGANISATIONS - URBAN, RURAL AND TRIBAL COMMUNITIES**(4 Credits-60 hours)**

Objectives: *This Course enables a student*

- *To develop an understanding about the social policies and decision making process of the government in planning for development in India.*

- *To understand the Governmental efforts for development of Rural, Tribal and Urban communities*
- *To understand and analyze Governance issues at local, regional, state and national levels*

Module I: Introduction to Social Policies (12 hours)

Meaning and Definition of Policy and social policy; History and process of Social Policy development in India; Evolution of planning – Planning commission , NITI Aayog .

Module II: Policies and Schemes in Urban Areas (12 Hours)

Challenges for urban development; Urban poverty management; Urban governance systems; Government schemes and policies

Module III: Policies and Schemes in Rural Areas (12 Hours)

Challenges for rural development; Rural poverty management; Rural governance systems - decentralization processes; Government schemes and policies

Module IV: Policies and Schemes in Tribal Areas (12 Hours)

Challenges for tribal development; Poverty management; Governance systems; Government schemes and policies

Module V: Issues of Governance and Planning (12 hours)

Issues of Development and Displacement; Diversity and Citizenship Issues

Suggested Readings

1. Akhup, A., Identities and their struggles in Northeast India (TAS 2). Kolkata: Adivaani.
2. Bodhi, S.R., Social Work in India: Tribal and Adivasi Studies- Perspectives from Within. Kolkata: Adivaani.
3. Choudhary, D.P., Voluntary efforts in social welfare and development. New Delhi: Siddarth
4. Dahl, R., Who Governs? New Haven: Yale University Press.
5. Goel, S.L. & Jain, R.K., Social welfare administration, Vol.I-II. New Delhi: Deep & Deep Publication.
6. Jacob, K.K., Social Policy in India. Udaipur: Himalaya Publications.
7. Shivaramkrishnan, K.C., Kundu, A. & Singh, B.N., Handbook of Urbanization in India. New Delhi: Oxford University Press.
8. Mishra, R. ,Globalisation and the welfare state. London: Edward Elgae.
9. Sendoc, B., Role of Banks in Tribal Development II.
10. Sharma, B.D., Tribal Development- The concept and the Frame.
11. Sharma ,B.D., Planning for Dispersed Tribals. Kurukshetra.
12. Singh, B., Tribal Development at Cross Road : A Critique and a Plea, Man In India.
13. Turner, M., & Hulme, D., Governance Administration and Development : Making the State Work. London: Macmillan

SWOS0032: ORGANISATIONAL STRUCTURE AND BEHAVIOUR

(4 Credits - 60 hours)

Objective: *Understanding the structure and functioning of an organisation is essential for establishment and management of any development organisation. This course introduces the student to organisational structure and management. It also familiarizes the student with the skills and legal base for managing the workforce of an organisation.*

Module I: Organizational Structure (10 hours)

- a) Organizational Structure: Definition, Concept and Nature Formation of Organizational Structure
- b) Types of organizational Structure

Module II: Basic concepts in Organisational Behaviour (10 hours)

Organizational Behaviour: concept and theories; Models of Organizational Behavior: Development and Types; Organisation Climate, Culture and Team building; Employee counseling, Work life balance, managing occupational stress

Module III: Basic skills for Organisational Development (10 hours)

Leadership - traits, typology and theories; Motivation: need, significance, theories, methods and practices; Communication - concept, significance, modes, channels, impact

Module IV: Legal Base for Practice (15 hours)

- Legislations for industrial relations-Factories Act, 1948, Industrial Dispute Act,1947, Industrial Employment Standing Orders Act, 1946,
- Legislations related to Wages – Minimum Wages Act,1948, Payment of Wages Act, 1936, Equal Remuneration Act, 1976, The Payment of Bonus Act, 1965, Payment of Gratuity Act , 1972
- Equal Opportunities, Protection of Rights & Full Participation) Act,1995
- Provisions related to employees behaviour : discharge, misconduct, domestic enquiry and disciplinary action; sexual harassment at workplace,
- Legislations related to employment- Inter-state Migrant Worker’s Act,1979, Contract Labour Act, 1970

Module V: Liberalization, Privatization, Globalization (LPG) and the workforce (15 hours)

LPG and its impact on industry; Industrial restructuring and the employee response-emerging concerns; International Labour organisation and international commitment; Impact of changing economic scenario on workers and work organisations – downsizing, displacement, rehabilitation, employment, employee benefits

Suggested Readings

- Daft, R.L. (2004). Organization: Theory and Design. Mason: OH: South Western Publishing.
- Jacoby, S.M. (ed.). (1994). The Workers of Nations: Industrial Relations in Globalised Economy. New York: Oxford University Press.
- Mallick, P.L. (2002). Industrial Law. Lucknow : Eastern Book Company
- Mathis, R. L., & Jackson, J.H. (1997). Human Resource Management. U.K: Prentice Hall International.
- Pareek. U., & Rao, TV. (1992). Designing and Managing HR Systems. New Delhi: Oxford & IBH Publishing.
- Ramnarayan, S., Rao, TV., & Singh, K. (1998). Organization Development: Interventions and Strategies. New Delhi: Sage Publications.
- Robbins, S.P (2002). Organizational Behaviour (10th ed.). New Delhi: Prentice Hall of India.
- Silvera, D.M. (1990). Human Resource Management: The Indian Experience. New Delhi: New India Publications.
- Sivananthiran, .A., & Venkatratnam, C.S. (2003). Best Practices in Social Dialogue. New Delhi: ILO.
- Veena, A.K., Kochan R.D., & Lansbury, R.D. (1995). Employment Relations in the Growing Asian Economics. London : Routledge.

SWHR0033: HUMAN RESOURCE MANAGEMENT**(4 Credits - 60 hours)**

Objectives: *This Course is designed to enable students*

- to understand the concepts of Human Resource Management*
- to understand the processes in Human Resource management and Development*

Module I: Introduction to Human Resource Management (15 hours)

Human Resource Management: Concept, Objectives, Nature, Scope, Importance and functions, Evolution, Goals and Approaches

Module II: Human Resource Development (15 hours)

- a) Human Resource Development: concept, goals, approaches, and management of change
- b) HRD sub systems: Human resource planning, recruitment, selection, induction, retention, performance management, retirement and redeployment, exit strategies

Module III: Human Relations in Organisations (15 Hours)

Industrial organisation as a sub-system of society; Human relations in industry - history, determinants, reflectors and prospects ; Role of State as third party in industrial relations, Collective bargaining; Trade unionism – historical development, strengths and weaknesses, law relating to trade unions; Problems and status of Trade unionism in post globalisation period.

Module IV: Policy base for Human Resource Development (15 hours)

- a) Inclusive HR Policies and practices: Recruitment, Selection and Induction, Capacity Building, Compensation, Retention and Separation
- b) Development of Human resources: Capacity Building, Training and Development, Communication and Leadership.
- c) Human Resource Planning : concept and processes, job analysis

Suggested Readings

1. Aswathappa, K., Organization Behaviour. New Delhi: Himalaya Publishing House
2. Aswathappa, K., Human Resource and Personnel Management: Text and Cases, New Delhi: Tata McGraw Hill.
3. Aswathappa, K., Human Resource Management. New Delhi: Tata McGraw Hill.
4. Bedian, A. G., & Glueck, W.F., Management, Japan: Dryden Press.
5. Bosotia, G.R., Human Resource Management. Jaipur: Mangal Deep Publications.
6. Chhabra, T.N. , Human Resource Management. New Delhi: Dhanpat Rai.
7. Chopra, R.K. , Management of Human Resources. Bareilly: V. K. Publishing House.
8. D'Enzo, D.A., & Stephen, P. R., Human Resource Management. New Delhi: John Wiley & Sons.
9. Heing, W, & Koontz, H., Management: A Global Perspective. New Delhi: MCGraw Hill.
10. Ian, B., & Holden, L., Human Resource Management. Delhi: Macmillan.
11. Newstrom, J.W. & Keith, D., Organizational Behavior – Human Behavior at Work, (11th Ed.). New Delhi: Tata McGraw Hill.
12. Kondalkar, V.G., Organizational Behaviour. New Delhi: New Age International.
13. Prasad, L. M., Organizational Behaviour. New Delhi: S. Chand & Sons.
14. Robbins, S. P. , Organizational Behaviour, New Delhi: Prentice - Hall.
15. Saiyadain, M.S., Human Resource Management. New Delhi: Tata McGraw-Hill.
16. Sekaran, U., Organizational Behaviour: Text and Cases. New Delhi: Tata McGraw Hill.
17. Singh, B.P, & Singh, A. K., Essentials of Management. New Delhi: Amexcel Books.
18. Singh, B.P, & T.N Chhabra. , Management Concepts and Practices. New Delhi: Dhanpat Rai.

SWHI0035: HISTORY, IDEOLOGIES AND FIELDS OF SOCIAL WORK

(3 Credits - 45 hours)

Objectives:

- *To introduce the basic concepts of social work to the students.*
- *To introduce to the students the history and philosophy of social work, its methods and fields.*

- *To introduce social work as a profession*
- *To motivate the students to appreciate social work as a profession and to recognize the need and importance of social work education, training and practice.*

Module I: Introduction to Social Work (11 hours)

Concepts and Definitions: – Social Work, Social Service, Social Welfare, Social Reform, Social Defense, Social Policy, Social Action, Social Legislation and Social Advocacy ; Principles, Objectives, Scope and Goals ; Process of Social Work; Professional values and Code of ethics; Skills of social worker

Module II: History and Ideologies of Social Work (11 hours)

Historical development of Social Work in UK, USA and India: The Elizabethan poor law (1601); Charity Organization Society (1869);The Settlement House Movement, (USA); The Poor Law Commission of 1905; The Beveridge Report (1941); Social Reforms and Social Movements; Gandhian Philosophical Foundation to Social Work in India.

Module III: Social Work Profession (11 hours)

Social Work Theories; Professional organizations; Indian Association of Professional Social Workers; National Association of Social Workers; International/Indian Council of Social Workers; International Association of Schools of Social Work

Module IV: Fields of Social Work Practice (12 hours)

Family, Child and Youth Welfare; Social Work Practice in Industries/ Industrial Social Work; Social Work for weaker sections: Aged, Persons with Disability, Women Welfare; Environment/Ecology; Healthcare: Medical and Psychiatric; School Social Work; Correctional Administration

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define Social Work, Social Service, Social Welfare, Social Reform, Social Defense, Social Policy, Social Action, Social Legislation and Social Advocacy ; Principles, Objectives, Scope and Goals ; Process of Social Work; Professional values and Code of ethics; Skills of social worker. (Remembering)
- CO2:** Explain Historical development of Social Work in UK, USA and India: The Elizabethan poor law (1601); Charity Organization Society (1869);The Settlement House Movement, (USA); The Poor Law Commission of 1905; The Beveridge Report (1941); Social Reforms and Social Movements; Gandhian Philosophical Foundation to Social Work in India. (Understanding)
- CO3:** Develop Social Work Practice in all the areas. (Applying)
- CO4:** Analyze critically the Social Work Theories; Professional organizations; Indian Association of Professional Social Workers; National Association of Social Workers; International/Indian Council of Social Workers; International Association of Schools of Social Work. (Analyzing)
- CO5:** Appraise Family, Child and Youth Welfare; Social Work Practice in Industries/ Industrial Social Work; Social Work for weaker sections: Aged, Persons with Disability, Women Welfare; Environment/Ecology; Healthcare: Medical and Psychiatric; School Social Work; Correctional Administration. (Evaluating)
- CO6:** Adapt Social Work Theories, Social Work Practice. (Creating)

Suggested Readings

1. Gore. M.S, Social Work and Social Work Education, Asia, Publication house, Mumbai, 1965
2. Jainendra Kumar Jha, Practice of Social work, Anmol Publications, New Delhi, 2002,
3. Joshi.S.C, The Handbook of Social work, Akansha Publishing House, New Delhi, 2004.
4. Paul Chowdhury, Introduction to Social Work, ATMA RAM and SONS, Delhi, 2000.
5. Sanjay Bhattacharya, Social work – An Integrated Approach, Deep and Deep Publications Pvt Ltd, New Delhi, 2003
6. Walsh Joseph, Theories of Direct Social work practice, Thomson Brooks, Cole, 2006
7. Allan, June, Bob Pease and Linda Briskman (ed.). Critical Social Work – An Introduction to Theories and Practices, Rawat Publications, Jaipur, 2003.
8. Bhattacharya, Sanjay, Social Work Interventions and Management, Deep and Deep, New Delhi, 2008
9. Bogo, Marion, Social Work Practice – Concepts, Processes and Interviewing, Rawat Publications, Jaipur, 2007
10. Cox, David and Manohar Pawar, International Social Work – Issues, Strategies and Programs, Vistar Publications, New Delhi, 2006
11. Desai, Murli, Ideologies and Social Work, Rawat Publications, Jaipur, 2002
12. Dominelli, Lena, Social Work: Theory and Practice for a Changing Profession, Polity Press, London, 2004
13. Skidmore AR and Milton G Thackeray, Introduction to Social Work, Prentice Hall, New Jersey
14. Lukose P J, Social analysis: A guide for the Social Workers, Media House Publications, New Delhi-2015.

SWG0036 - HUMAN GROWTH AND DEVELOPMENT

(2 Credits - 30 hours)

Objectives:

- *To gain an understanding of human psychology, knowledge of the developmental stages and personality theories related to human beings;*
- *To get an understanding of the concept of health, principles of healthy living, major diseases and mental disorders affecting an individual;*
- *To understand the role of institutions and agencies in dealing with the promotion of health.*

Module I: Meaning of Growth and Development (8 hours)

- a) Meaning of growth, development and maturity, Principles of human development
- b) Approaches to the study of human development: biological, maturational, psychoanalytic, behavioural, cognitive-developmental, ecological, Social
- c) Influence of socialization and development - family, social groups, institution, community and culture.

Module II: Developmental Stages and Personality Theories (10 hours)

Physical, Emotional, Cognitive and Social aspects of the following developmental stages with special reference to Indian conditions – Infancy, Babyhood, childhood, adolescence, adulthood, old age.

Personality theories – Freud, Jung, Adler, Erikson, Rogers, Maslow

Module III: Mental health (5 hours)

Concept of Normalcy and abnormality

Symptoms, Causes and treatment of neuroses and psychoses, personality disorder and mental retardation.

Role of Social Workers in Promoting Mental Health.

Module IV: Physical Health (7 hours)

- a) Concept of health, hygiene, WHO definition of health; nutrition, malnutrition and its impact on growth
- b) Communicable and non-communicable diseases - Symptoms, causes, treatment, prevention and control of some common diseases – communicable: T.B., Leprosy, STD, HIV, Typhoid, Chickenpox, Malaria, Hepatitis; non communicable: Hypertension, Diabetes, Cancer, Malnutrition and deficiency diseases.
- c) Institutions and agencies intervening in human growth and development- family, education, Health care systems

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept of growth and development, list the principles and relate the approaches of growth and Development. (Remembering)
- CO2:** Define the physical, emotional, cognitive and social development of different stages of human life and to state the different personality theories. (Remembering)
- CO3:** Recall the concept of Health and Mental Health; list the symptoms, causes and treatment of different disorders and diseases. (Remembering)
- CO4:** Illustrate the different form of socialization process and its influences on human growth and development. (Understanding)
- CO5:** Explain the concept of Normalcy and Abnormality. (Understanding)
- CO6:** Apply the knowledge of different approaches in the understanding of human development and behavior. (Applying)
- CO7:** Identify the symptoms, causes and treatment of different disorders and diseases in the field of work. (Applying)
- CO8:** Analyze critically the influence of socialization in human development. (Analyzing)
- CO9:** Evaluate the different institutions and agencies intervening in human growth and development. (Evaluating)
- CO10:** Build the network of agencies working and intervening in Human Growth and Development. (Creating)
- CO11:** Design a plan of action for improving the Health and Mental Health condition in the society from the Social Work perspective. (Creating)

Suggested Readings

1. Berk, Laura E. Development through the Lifespan, 5th edition. Allyn and Bacon. London: 2009
2. Ahuja, Niraj., A Short textbook of Psychiatry, Himalaya Publishing House. New Delhi: 2005
3. Bhattacharya, Sanjay Dr. 2008. Social Work: Psycho-Social and Health Aspects. New Delhi: Deep and Deep.
4. Clifford T. Morgan, Richard A. King, John R. Weisz, John Schopler, Introduction to Psychology, Tata Mc.Graw Hill Edition.
5. Coleman James. C, Abnormal Psychology and Modern Life, D.B. Taneporevela. Mumbai: 1975
6. Dandapani S., General Psychology, Neelkamal Publications Pvt. Ltd. Hyderabad: 2007
7. Diagnostic and Statistical Manual of Mental Disorders – 4th Edition. DSM – IV-TR. American Psychiatric Association. Washington DC:2000
8. Hurlock, Elizabeth, Developmental Psychology, Tata Mc Graw Hill. New York: 2001
9. Kaplan Saddock, Synopsis of Psychiatry. 7th Ed. BI Waverly Pvt. Ltd. New Delhi: 1994
10. Park. J.E and Park. K, Text Book of Preventive and Social Medicine, Bansaridas Bhanot. Jabalpur: 2003

11. Robert A. Baron, Psychology, 5th Edition. Pearson. Prentice Hall: 2001
12. Steinberg, Laurence, Adolescence, McGraw Hill Inc. New York: 1993
13. WHO, The ICD – 10 Classification of Mental and Behavioural Disorders, Diagnostic Criteria for Research, AITBS Publishers and Distributors (Regd.). Delhi: 2004
14. Archambeault, John. (2009). Social Work and Mental Health, UK: Learning Matters Pvt Ltd.
15. Paula Nicolson, Rowan Bayne and Jenny Owen. (2006). Applied Psychology for Social Workers, UK: Palgrave Macmillan Ltd. (3rd Edition).

SWIS0037: INTRODUCTION TO INDIAN SOCIETY, POLITY AND ECONOMICS

(2 Credits- 30 hours)

Objectives

- *To understand the major social institutions, structure, stratification and to develop an understanding on the different social problems in the society;*
- *To understand and define basic concepts of economic and political theories;*
- *To explain how the economic and political institutions are organised, and how they have a bearing on human society;*
- *To critically analyse and present the growth and development experience of India;*
- *To identify and evaluate the political institutions, processes and experiences of India, with special reference to North East India*

Module I: Basic Sociological Concepts (6 hours)

- a) Social structure and stratification: Caste, Class, Tribes, Gender, Religion
- b) Structural Functionalism approach; Conflict/ Dialectical approach; Symbolic Interactionism
- c) Inclusion-exclusion: Power, Privilege and Oppression

Module II: Social Institutions (4 hours)

- a) Social Institutions: Marriage, Family, Religion, Education, Economy, Politics, etc.
- b) Social problems: Causes and Consequences of different Social Problems in India

Module III: Economics and development (5 hours)

- a) Concept and definition: economy, demand and supply, national income, standard of living, per-capita income, poverty and its measurement
- b) Economic systems: capitalism, socialism, communism, mixed economy, neoliberalism
- c) Global economic institutions: World bank, IMF, WTO, Asian Development Bank
- d) Globalisation and Indian economy: Special Economic Zones and MNCs
- e) Growth, development and social justice

Module IV: India's development experience (5 hours)

- a) India's experience of colonialism
- b) Ideological hues impacting India's economic policy
- c) Rise of self-reliance and economic nationalism during the independence movement
- d) Post-independence trajectory- agrarian reforms and rural development
- e) Liberalisation of India's economy and its impact on welfare measures of the state; Planned Economy to NITI Aayog shift

Module V: Politics and political systems (5 hours)

- a) State: origins and elements

- b) Sovereignty, power, authority, legitimacy, liberty, equality and justice
- c) Political thought: behaviouralism, post behaviouralism, liberalism, idealism, anarchism, and Marxism
- d) Citizenship: rights and duties

Module VI: Indian political system (5 hours)

- a) Making of India: political nationalism- India as a nation of diversity
- b) Idea on state and nation: Gandhi, Nehru and Ambedkar
- c) The Constitution of India, and the Federal characteristic of Indian state
- d) North East India: decentralised governance- philosophy, practice, and experiences
- e) Political movements in Northeast India

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define and understand the major social institutions, structure, and stratification. (Remembering)
- CO2:** Define and explain the basic concepts of economic and political theories. (Remembering)
- CO3:** Develop an understanding on the different social problems in the society. (Applying)
- CO4:** Identify, evaluate and form an opinion on the political institutions, processes and experiences of India, with special reference to North East India. (Applying)
- CO5:** Analyze how the economic and political institutions are organised, and how they have a bearing on human society. (Analyzing)
- CO6:** Evaluate and present the growth and development experience of India. (Evaluating)

Suggested Readings

1. Abbas, H. (2010). *Indian government and politics*. New Delhi: Dorling Kindersley.
2. Ananth, V.K. (2010). *India since independence: making sense of Indian politics*. New Delhi: Dorling Kindersley.
3. Anthony, G. (2001). *Sociology*. Cambridge: Cambridge Polity Press.
4. Behera, M.C. (Ed.). (2004). *Globalization and development dilemma: reflection from North East India*. New Delhi: Mittal Publications.
5. Boyes, W., & Michael, M. (2005). *Textbook of economics: Indian adaptation (6th ed.)*. New Delhi: Houghton Mifflin Co.
6. Desai, S. B. et al. (2010). *Human Development in India: challenges for a society in transition*. Hyderabad: OUP.
7. Dreze, J., & Sen, A. (2013). *Uncertain glory: India and its contradictions*. New Delhi: OUP.
8. Gupta, D. (Ed.). (1997). *Social Stratification*. New Delhi: Oxford University Press.
9. Guru, G., & Sarukkai, S. (2017). *The Cracked Mirror: An Indian Debate on Experience and Theory*. New Delhi: OUP
10. Hayami, Y., & Godo, Y. (2010). *Development economics: from poverty to the wealth of nations, (3rd ed.)*. New Delhi: OUP.
11. Johari, J.C. (2006). *Contemporary political theory: new dimensions, basic concepts and major trends*. New Delhi: Sterling Publishers.
12. Mankiw, N. G. (2008). *Principles of economics*. Manson OH South West: Cengage Learning.
13. Menon, N. (1999). *Gender and Politics in India*. New Delhi: Oxford University Press.
14. Schrems, J. (2007). *Understanding principles of politics and the state*. Maryland: University Press of America.

15. Sen, A. (1999). *Development as freedom*. New York: OUP.
16. Sesagiri, N. (Ed.). (2013). *Survey of rural India: a comprehensive study of gram panchayat and community development block, (Vol. 26)*. New Delhi: Gyan Prakashan.
17. Xaxa, V. (2014). *State Society and Tribes*. New Delhi: Pearson Education.

SWEM0038: ENVIRONMENT STUDIES AND DISASTER MANAGEMENT

(3 Credit- 45 hours)

Objectives:

- *To understand the interrelatedness of human life and environment;*
- *To develop an understanding of problems arising out of environmental degradation and globalization;*
- *To understand the roles of State in disaster management*
- *To study the role of social work practice in tracking environmental issues and disaster management.*

Module I: Environment and Sustainable Development (11 hours)

Concepts: Environment and Ecology; the Interrelatedness of living organisms and natural Resources; Global Environmental Crisis and its linkages to the development process. Global warming, Environmental politics and resource development regimes; Sustainable development: Management and Conservation changes.

Module II: The State and the Environment (11 hours)

State of India's Environment: Waste Management; Pollution – Air, Water, Soil, Noise; Laws Related to environment; Social Work and Environment: Environment Education, Environment Ethics, Promotion Environment Movements, Environment Management – EIA.

Module III: Concept of Disaster and Models of Disaster Management (11 hours)

Disaster: Definition, Natural and Human made disasters; multiple causes and effects; Stages of disaster; Development and Disaster; Preventive Measures; Models of Disaster: Crunch Model and Release Model

Module IV: Roles of Organizations in Disaster Management (12 hours)

Disaster Management and Phases. Pre-disaster: Prevention, Preparation, Education, Vulnerability and Preparedness. Actual Disaster: Contingency, Short Term and Long Term Plans, Search, Relief, Rescue, Recovery and Restoration. Post Disaster: Rehabilitation and Commemorations; Role of Social Workers and Voluntary Agencies: Role of Social Work Professionals at different levels

COURSE/LEARNING OUTCOMES

At the end of this course, the students will be able to :

- CO1:** Define and state the concept of environment, ecology, waste management, pollution, pollutants pollution- air, water, soil and noise, waste management, sustainable development, management and conservation of environment, natural resources, global warming, natural and human made disasters, stages of disaster, disaster management, different environmental movements around the world and environment education. Show the relationship between living and non living beings, list out natural disaster and men made disaster. (Remembering)
- CO2:** Summarize the relation between living and non living beings, understand the relation between natural resources and men made development induced disasters, interpret global environmental challenges, explain the importance of conservation

and management, different models of environment management, demonstrate the knowledge on different environmental laws of India, Environmental Impact Assessment- the inter relatedness of socio-economic, cultural and human health-impacts both beneficial and adverse, Sustainable Development Goals, interpret the environmental politics around the world, and show the relation between social work and environment. (Understanding)

- CO3:** Explain the stages of disaster- pre and post disaster issues, Crunch model and Release model of disaster, classify different models of environment management, explain environment education and importance of environment education, and Illustrate the role of voluntary and government organizations working on disaster management. (Understanding)
- CO4:** Use the knowledge of relationship between living and non living things to understand the world around, pollution- its causes and develop waste management strategies, identify the role of social workers on environment protection. Apply EIA framework while studying any development projects, identify and plan short term and long term disaster management intervention programmes, application of crunch and release model of disaster to understand and reduce the risk of disaster. (Applying)
- CO5:** Classify different pollution and ways to manage the pollution, Critically analyze the different disasters around the world- its causes and effects, compare and categorize the best practices of disaster management – voluntary organizations and government organizations, analyze the root cause of disaster by application of models of disaster, reflect the EIA reports of the government, critically comment on the environmental policies of the country. (Analyzing)
- CO6:** Assess the environment laws of the country, evaluate the disaster management strategies of the government and voluntary organization, explain the conservation policies of government and its relevance in ever changing climate variation, Appraise and compare the models of understating disaster, Appraise any development project with EIA framework. (Evaluating)
- CO7:** Design a short term and long term programme for working around issue of disaster – pre and post, Contextualize and develop EIA framework. Formulate environmental policies that is inclusive of traditional communities living in and around forest, Develop environment education teaching learning models for curriculum, develop waste management programme for communities, minimize the use of pollutants that causes pollution, Modify or change people’s behavior towards environment through proposing alternative solutions. (Creating)

Suggested Readings

1. Abbasi S.A., Wetlands of India: Ecology and Threats Vol. 1-3, 1997.
2. Dorr Donal, Social Justice Agenda: Justice, Ecology, Power and the Church, 1990.
3. Goel P.K., Environmental Guidelines and Standards in India, 1996.
4. MadhavGodgil; Ramachandra Guha, Ecology and Equity: The use and abuse of nature in contemporary India, 1995.
5. Neugeboren Bernard, Environmental Practice in the Human Services: Integration of Micro and Macro Roles, Skills and Contexts, 1996
6. Shukla S.K., Srivastava P.R., Human Environment: An analysis, 1992.
7. Shukla S.K., Srivastava P.R., Environmental Pollution and Chronic Diseases.
8. Auf Der Heide. *Disaster Response: Principles of Preparation and Coordination*. St. Louis: Mosbe, 1989.
9. Canton, Lucien G. *Emergency Management: Concepts and Strategies for Effective Programs*. Hoboken NJ: Wiley Inter-Science, 2007.

10. Cutter, Susan L. (Ed.). *American Hazardscapes: The Regionalization of Hazards & Disasters*. Wash DC: Joseph Henry Press, 2001.
11. Godschalk, David R., Timothy Beatley, Philip Berke, David Brower, and Edward Kaiser. *Natural Hazard Mitigation: Recasting Disaster Policy & Planning*. Island Press. 1999.
12. Haddow, George D. and Jane A. Bullock. *Introduction to Emergency Management (2nd Ed.)*. Burlington, MA: Elsevier Butterworth-Heinemann, 2006.
13. May, Peter J, et al. *Environmental Management and Governance: Intergovernmental Approaches to Hazards and Sustainability*. London & NY: Routledge, 1996.
14. National Research Council. *Facing Hazards and Disasters: Understanding Human Dimensions*. Washington, DC: National Academies Press, 2006.
15. Noji, Eric K. (Ed.). *The Public Health Consequences of Disasters*. New York and Oxford: Oxford University Press, 1997.
16. Platt, Rutherford H. *Disasters and Democracy: The Politics of Extreme Natural Events*. Washington, DC: Island Press, 1999.
17. Quarantelli, E.L. (ed.) *What is a Disaster – Perspectives on the Question*. London
18. and New York: Routledge, 1998.
19. Tobin, Graham A. and Burrell E. Montz. *Natural Hazards: Explanation and Integration*. New York and London: The Guilford Press, 1997.
20. Waugh, William L. *Living With Hazards/Dealing With Disasters-An Introduction To Emergency Management*. Armonk, NY: M.E. Sharpe, Inc., 2000.
21. Wisner, Ben, Piers Blaikie, Terry Cannon, and Ian Davis. *At Risk: Natural Hazards, People's Vulnerability and Disasters (2nd Ed.)*. London and New York: Routledge, 2004.

SWGSO039: GENDER STUDIES

(3 Credit- 45 hours)

Objectives:

- *To understand the concept of gender, patriarchy, gender roles and relationships.*
- *To study the feminist theories, women's movements, and women's development*
- *To critically study the intersectionality i.e. how race/ethnicity, sexuality, class, age, citizenship, and other identities crosscut and shape gender identities and roles*
- *To critically understand concerns of gender issues, and aim to analyze everyday gendered experiences from Social Work perspectives.*

Module I: Understanding gender, gender and society, gender studies (11 hours)

Introduction – Gender, Sex, Sexuality, Gender Perspectives of Body, Social Construction of Femininity, Social Construction of Masculinity, Patriarchy, LGBTQ, Gender roles,

Gender Lens: Political and Legal Systems, Gender and Education, Inter-sectionality, Social Dynamics of Gender, Women's Studies and Gender Studies

Module II: History, Theory and Women's Movement (11 hours)

Historical Overview of Feminist Movements, Feminist Movement in Europe and the US, Women's Movement in India, Changing profile of women in India- pre and post independent India, History of women's education; Theory- Feminism and types of feminism, Gender Schema theory, Queer theory; Approaches to understanding women and development

Module III: Gender Concerns (11 hours)

Violence against women, conflict, poverty, displacement, migration, disaster –impact on women, women working in organized and unorganized sector, reproductive health, social, cultural and political determinants of health,

Module IV: Constitutional Rights of Women, Policies and Programmes (12 hours)

CEDAW, Dowry Prohibition Act 1961, Equal Remuneration Act 1976, Maternity Benefit Act 1961, Plantation Labour Act 1951, Medical Termination of Pregnancy Act 1971, Pre-natal Diagnostic Techniques (Regulation and Prevention of Misuse Act 2002, Protection of Women from Domestic Violence Act 2005, The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act 2013, Functions of National Commission for Women and State Commission for Women,

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define gender, sex, sexuality, gender perspectives of body, patriarchy, LGBTQ, relate socialization and gender roles, women's movement, choose and label different forms of violence against women. (Remembering)
- CO2:** Explain gender and sex, Intersectionality, social construction of femininity, social construction of masculinity, compare and interpret the socio-cultural and political systems through gender lens, outline the importance of women and gender studies, Illustrate the changing profile of women in India, summarize the feminist movement around the world, Relate gender and education and gender and development. Explain the constitutional provisions for protection of women and the laws for protection of women. (Understanding)
- CO3:** Identify different forms of violence against women, choose different laws for protection of women – case specific, identify how inter-sectionality affects every-day experiences of women, develop projects and programmes for addressing different forms of violence. (Applying)
- CO4:** Analyze social construction of masculinity and femininity and changing profile of women in India, identify different forms of violence against women and laws applicable, and examine the existing laws for protection of women. (Analyzing)
- CO5:** Assess the causes of violence against women, critically analyze the existing laws of the country for protection of women. Analyze the function of national and state commission for women. (Evaluating)
- CO6:** Develop intervention programmes for working with violence affected women. Formulate women friendly policies. (Creating)

Suggested Readings

1. Bhasin, K. (2000). Understanding Gender. Kali for Women Publication.
2. Bhasin, K. (2000). What is Patriarchy? Kali for Women Publication.
3. Ckhakravati, U (2003). Gendering Caste: Through a Feminist Lens (Theorizing Feminism). Stree; UK ed. edition (January)
4. Cook, R.(1994). Human Rights of Women: National and International Perspectives. Philadelphia, University of Pennsylvania Press
5. Harding, Sandra G(ed.). (2004). The Feminist Standpoint Theory Reader. New York: Routledge.
6. Gordon, L. P. (2002). Violence against Women. New York: Nova Publishers.
7. Kumar, Girish (ed.). (2009). Health Sector Reforms in India. New Delhi: Manohar
8. Lalkima, C. Lalneihzovi. (2009). Changing Status of women in north-eastern states. New Delhi: Mittal Publications.
9. Pandya, Rameshwari. Patel, Sarika. (2010). Women in the Unorganised Sector of India. New Delhi: New Century Publications.
10. Joshir, T.S. (1999). Women and Development. New Delhi, Mittal Publications
11. Mies, M., Shiva, V. (1993). Eco-feminism. London: Zed Books.

12. Agnes, Flavia. (2004). Law and Gender Inequality: The Politics of Women's Rights in India. Delhi: Oxford University Press.
13. Arya, Sadhna, Roy, Anupama. (2006). Poverty Gender and Migration. New Delhi: Sage Publications.
14. Ramazanoglu, Caroline. Holland, Jannet. (ed) (2002). Feminist Methodology: Challenges and Choices. London: Sage Publications Inc.
15. Ganesamurthy, V.S. (2008). Empowerment of Women in India: Social, Economic and Political. New Delhi: New Century Publications.
16. Datar, Chaya. (2003). Integrating activism and academics. In Jain, Devika and Rajput, Pam (Eds.), Narratives from the Women's Studies Family: Recreating Knowledge (pp. 136-149). New Delhi: Sage Publication.

SWPF0040 : SOCIAL WORK PRACTICE WITH INDIVIDUALS AND FAMILIES

(3 Credits – 45 hours)

Objectives:

- *To understand social casework as a method of social work practice and its application in the field*
- *To equip learners with theoretical knowledge to work with individuals and families.*
- *To equip learners with values, skills and attitudes and develop competencies necessary for working with individuals and families.*
- *To understand the relevance of casework with respect to other methods of social work.*

Module I: Introduction to Nature and Development of Social Casework (11 hours)

Social Casework: Meaning, Nature, Assumptions, Principles, Ethics and Process of Social Casework; Tools – Observation, Listening, Relationship, Interview, Home Visit, Collateral Visit, Family group conferencing; Casework and Counseling, Casework and Psychotherapy

Module II: Approaches to Casework Practice (11 hours)

Diagnostic and Functional approach; Psycho-social approach; Problem solving approach; Task centered approach; Client centered approach; Pearlman approach;

Module III: Process and technique of social casework (11 hours)

Phases of casework intervention: Intake, Problem identification, Diagnosis of the problem, Treatment, Assessment, Monitoring and Evaluation, Termination/ Follow up; Techniques of Casework Intervention -Supportive Techniques, Enhancing Resources Techniques; Casework recording: Types and Principles of recording

Module IV: Social Casework Practice (12 hours)

Application of Social Case Work in different settings and Clientele groups- Casework with Children, Correctional Settings, Clinical Settings, Geriatric Care, the Terminally Ill people, and Crisis Situations; Discussion of Case Records in different Agency Settings, Relations of Casework with other methods of social work.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain the concept of social casework- meaning, nature, assumptions, principles, ethics and process of social casework; tools – observation, listening, relationship, interview, home visit, collateral visit, family group conferencing; casework and counseling, casework and psychotherapy. (Understanding)
- CO2:** Explain the historical evolution of social case work in India and abroad. (Understanding)

- CO3:** Explain the stages and phases of social case work intervention. (Understanding)
- CO4:** Identify the symptoms, causes and treatment by applying the stages and phases of social casework techniques in intervention with clients. (Applying)
- CO5:** Identify social case work as a primary method of social work practice and explain the different approach to social casework practice- diagnostic and functional approach; psycho-social approach; problem solving approach; task centered approach; client centered approach; pearlman approach. (Applying)
- CO6:** Analyze critically how environmental factors which affect an individual's behavior. (Analyzing)
- CO7:** Evaluate the programme plans of the different field settings for casework intervention. (Evaluating)
- CO8:** Develop the skills required for professional social case worker. (Creating)
- CO9:** Choose the different fields of practice for the application of social casework; develop and design case by case intervention plan. (Creating)

Suggested Readings

1. Biestek Felix, *The Casework Relationship*, Unwin University Books, London, 1968
2. Government of India, *Encyclopedia in Social Work*, Publication Division (Social Welfare Ministry), New Delhi, 1987
3. Hamilton, Gordon, *The New York School of Social Work: Theory and Practice of Social Case Work*, Columbia University Press, New York and London, 1970
4. Holis, Florence and Woods, Mary E., *Casework – A Psycho-social Therapy*, Fantom House, New York, 1981
5. Kadushin, Alfred, *The Social Work Interview*, Columbia University Press, New York, 1990
6. Keats, Daphne, *Interviewing – A Practical Guide for Students and Professionals*, Viva Books Pvt. Ltd., New Delhi, 2002.
7. Mathew Grace, *An Introduction to Social Case Work*, Tata Institute of Social Sciences, Bombay, 1992
8. Nelson Jones, Richard, *Practical Counseling and Helping Skills*, Harper and Row, London, 1984
9. Nursten, Jean, *Process of Case Work*, Pitman Publishing Corporation, 1974
10. O'Hagan, Kieran, Kingsley, Jessica, *Competence in Social Work Practice – A Practical Guide for Professionals*, London, 2003
11. Perlman, Helen Harris, *Social Case Work – A Problem Solving Process*, University of Chicago Press, London, 1964
12. Rameshwari Devi, Ravi Prakash, *Social Work Methods, Practices and Perspectives (Models of Casework Practice)*, Vol. II, Ch.3, Mangal Deep Publication, Jaipur, 2004
13. Richmond, Mary, *Social Diagnosis*, Free Press, New York, 1970
14. Thompson, Neil, *People Skills*, 2nd Ed., Palgrave Macmillan, New York, 2006
15. Aptekar Herbert, *The Dynamics of Casework and Counseling*, Houghton Mifflin Co., New York, 1955.
16. Babara, J. G., *Beyond Case Work*, London, 1991
17. Fisher Joe, *Effective Case Work Practice – An Elective Approach*, MacGraw Hill, New York, 1978
18. Garrett, Annett, *Interviewing – Its Principles and Methods*, Family Service Association of America, New York, 1972
19. Lishman, Joyce, *Communication in Social Work*, Palgrave MacMillan, New York, 1994
20. Sena, Fine and Glass, Paul H., *The First Helping Interview Engaging the Client and Building Trust*, Sage Publications, New York, 1966
21. Sheafor, Bradford, Horejsi, Charles, Horejsi, Gloria, *Techniques and Guidelines for Social Work Practice*, Allyn and Bacon, London, 1997
22. Timms, Noel, *Social Case Work*, Routledge and Kegan Paul, London, 1966

SWPG0041 : SOCIAL WORK PRACTICE WITH GROUPS

(3 Credits- 45 hours)

Objectives:

- *To understand the concept of groups and its importance and influence on individuals*
- *To understand social group work as a method of social work*
- *To develop skills to apply group work methods in various settings*
- *To identify and acquire the skills needed to work with groups effectively*

Module I: The Concepts (11 hours)

Concept of group: definition, characteristics, Classification of different social Groups, Functions of Groups and Group as a medium of Social change.

Module II: Methods of Social Group Work (11 hours)

Social group work as a method of social work: definition, values, principles, assumptions, ethics, and functions of social group work; Techniques and skills used in Social Group work practice, Roles of Social group worker.

Module III: Process and Phases of Social Group Work (11 hours)

Group work process; Identification of the needs and interest; Program Planning and Program Development; Criteria of effective process and programme in SGW; Phases of Group Work: Pre-group, initial, treatment, and critical phase, evaluation and termination; Stages of Group Development (Forming, Norming, Storming, Performing and Adjourning) and Group Dynamics

Module IV: Social Group Work Practice in Agency Settings (12 hours)

Social Group Work in Different Settings: Self Help Groups, Groups in community setting, Groups in institutional settings (Hospitals, Rehabilitation Centers, Children's Home, Old Age Homes and Educational Settings); Discussion of Group records.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define, identify and explain the social phenomenon of group, group identity, cohesion, and its characteristics, and thereby analyse life as a process of adjustment with different types of groups. (Remembering)
- CO2:** Explain the significance of groups as instruments of individual and social change. (Understanding)
- CO3:** Identify social group work as a primary method of social work practice, remember the different models of group work, and trace its historical evolution in India and abroad. (Applying)
- CO4:** Apply the principle of purposeful use of self while leading or facilitating groups. (Applying)
- CO5:** Categorize and explain the stages and phases of group development and comprehend the dynamics and factors that come into play during the group process. (Analyzing)
- CO6:** Analyze the requirements of group at its different points of progression, and identify areas of work in the agency settings that could be addressed using social group work method. (Analyzing)
- CO7:** Assess group dynamics and facilitate meaningful intervention through group programming. (Evaluating)
- CO8:** Evaluate and monitor groups through systematic record-keeping procedures. (Evaluating)

CO9: Choose fields of practice for the application of group work, draft a concept note for an intervention in the field setting using group work method, and carry out the intervention plan in the agency setting. (Creating)

Suggested Readings

1. Cooper, Cary L, Theories of Group Processes, London: John Wiley and Sons, 1976
2. Douglas, Tom, Group Work Practice, London: Tavistock Publications, 1976
3. Douglas, Tom, Basic Group Work, London: Tavistock Publications, 1978
4. Ely, P.J. and M.K.McCullough, Social Work with Groups, London: Routledge and Kegan Paul, 1975
5. Kanopka G, Social Group Work – A Helping Process, Engelwood Cliff: Prentice Hall (later version), 1963
6. Siddiqui, H.Y, Group Work: theories and practice; India, Pakistan, Bangladesh and Srilanka, Jaipur: Rawat Publications, 2007
7. Toseland, W. and Rivas, R.S. An Introduction to Groups Work Practice, Boston: Allyn and Bacon, 2000
8. Trecker, H.B., Social Group, New York: Association Press, 1975.

SWRS0042: SOCIAL WORK RESEARCH AND STATISTICS

(3 Credits- 45 hours)

Objectives:

- *To understand the significance of research and application of statistics in social work practice.*
- *To understand the research process and acquire the attitudes and skills essential for social work.*
- *To develop skills for interpretation, documentation and presentation of results of the research.*
- *To familiarize with statistical methods and techniques needed for social work research.*
- *To understand the process of report writing and publication.*

Module I: Introduction to Social Work Research (7 hours)

- a) Research and Social Work Practice- Philosophical Foundations of Research.
- b) Natural and social science research - characteristics and scientific attitude.
- c) Social work research as a social research - relevance, ethics and values. Scope of social work research - basic and applied research.

Module II: Research designs, approaches and types (7 hours)

- a) Research designs: Descriptive, Exploratory and Experimental: meaning, scope, characteristics, application in social work setting.
- b) Research Approaches: Qualitative and Quantitative Research: meanings, scope, methods, steps, sampling, data collection, analysis, interpretation and reporting. Strengths and weaknesses.
- c) Evaluative research: Programme and projects evaluation: concept, types, steps, reports.
- d) Participatory research and action research: concepts, scope, application and steps.

Module III: Steps in Research Process (12 hours)

- a) Problem Formulation: Identifying research issue, formulating research topic and problem, review of literature (library work), theoretical framework, formulating objectives, clarifying concepts, variables - conceptual and operational, formulating hypothesis.

- b) Population and Sampling: Inclusion and exclusion criteria of population, the logic of sampling size and techniques: probability and non-probability sampling.
- c) Tools for data collection: Levels, Types of measurements, reliability and validity of tools. Constructing tools for data collection: questionnaire, interview schedule, scales. Quantification of qualitative data.
- d) Sources, Collection and Analysis of Data: Secondary and primary sources. Data collection data editing, coding, master sheet, analysis, report writing. Using computer for data analysis: coding, analysis- graphs and results.

Module IV: Introduction to Statistics (12 hours)

- a) Statistics: Definitions, Uses and Limitations. Classification and tabulation of data, univariate and bivariate, diagrammatic and graphic presentations. Measures of central tendency, Mean, Median and Mode and their uses; Measures of variability - range, variance and standard deviation.
- b) Correlation: Meaning and computation of coefficient of correlation as product moment, Spearman's Rank Correlations, interpretation of correlations.
- c) Test of Hypotheses: Basics, Probability distribution, normal distribution. t-test, Chi-Square Test

Module V: Application of Statistics and Reporting Research (7 hours)

- a) Application of Statistics in Social Work Research.
- b) Ethical guidelines in social work research.
- c) Professional writing.
- a) Introduction to software packages for statistical analysis.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define and show social science research and social work research and the application of statistics in social work practice. (Remembering)
- CO2:** Explain and discuss social work research as a method of social work and its application in addressing social issues. (Understanding)
- CO3:** Apply the knowledge, skills for interpretation, documentation and presentation of results of social work research and statistics in carrying out applied research in addressing social issues. (Applying)
- CO4:** Analyze various social issues and use research methods, strategies and data to suggest solutions. (Analyzing)
- CO5:** Assess relevant research methods and techniques in carrying out social work research. (Evaluating)
- CO6:** Create critical methods to carry out research in social work practice and suggest solutions to social issues. (Creating)

Suggested Readings

1. Ahuja, Ram, Research Methods, Rawat, Jaipur, 2001
2. Alston, M. Bocoles, W., Research in Social Workers- An Introduction to the Methods, Rawat, Jaipur, Indian Edition 2003
3. Baker, T.L., Doing Social Research, McGraw Hill, Singapore, 1994
4. Dooley, D., Social Research Methods, Prentice Hall of India Pvt. Ltd., New Delhi, 1997
5. Goode, W.J. and Hatt, P.K., Methods in Social Research, McGraw Hill Singapore, 1981
6. Grinell, R. M., (Jr.), Social Work Research and Evaluation, F.E. Peacock Pub. Inc., Illinois, 1988

7. Gupta, C.B., Introduction to Statistical Methods, Vikas Publishing House, 1995
8. Gupta, S.C., Fundamentals of Statistics, Himalaya Publishing House, Delhi, 1997
9. Gupta, S.P., Statistical Methods, Sultan Chand and Sons, New Delhi 1997
10. Jacob, K.K., Methods and Fields of Social Work in India, Asia Publishing, Bombay, 1996
11. Kothari, C.R., Research Methodology: Methods and Techniques, 2nd edition reprint, New Age International New Delhi, 2004
12. Krishnaswamy, O.R., Methodology for Research in Social Science, Himalaya, Bombay, 1993
13. Laldas, D.K., Practice of Social Research, Rawat, Jaipur, 2000
14. Mikkelsen, B., Methods for Development Work and Research-A New Guide for practitioners, Sage, New Delhi, 2005
15. Ramchandran, P., Social Work Research and Statistics, Allied Publishers, Bombay, 1968
16. Rubin, A. and Babbie, E., Research Methods for Social Work, 4th edition, Wadsworth, West, Brooks/Cole and Schirmer, 2001
17. Sarantakos, S., Social Research, Palgrave Macmillan, New York, 2005
18. Sharma, B.A.V., Prasad, R.D. and Satyanarayana, C., Research Methods in Social Sciences, Sterling, New Delhi, 2002
19. Sharma, K.R., Research Methodology, National Publishing House, Jaipur, 2002
20. Wilkinson, T.S. and Bhandarkar, P.L., Methodology and Techniques of Social Research, Himalaya, Bombay, 1984
21. Young, p., Scientific Social Surveys and Research, Asian Students edition, Asia Publishing House, Japan, 1960

SWWA0043: SOCIAL WELFARE ADMINISTRATION

(3 Credits- 45 hours)

Objectives:

- *To develop an understanding of social welfare administration as a method of social work*
- *To understand the various components of social welfare administration*
- *To understand the concept and theories of Development*
- *To familiarize the students with the concepts of Management of Organisations and its principles*

Module I: Social Welfare Administration (11 hours)

Social Welfare Administration: Definition, Characteristics, Principles and Functions of Social Welfare Administration; Types of Social Welfare Administration: Social Welfare Administration and Public Administration; Establishment, Objectives and Importance of Central Social Welfare Board, State Social Welfare Board and International Organizations

Module II: Management of an Organization (11 hours)

Management: Principle and Significance of Management for Social Work; Components of Programme Management, Finance Management, Human Resource Management and Office Management

Module III: Strategies and Mechanisms of Administration (11 hours)

Processes related to Registration of Societies, Trust and Non Profit Organization: Societies Registration Act 1860, Trusts and Non-Profit Organizations under Indian Companies Act: Foreign Contribution Regulation Act 1976 and Income Tax Rules applicable to Development / Charitable Organisations under Income Tax Act 1961; Role of Social Workers in Decision Making Process, Communication and Networking, and Sustainability of Programmes

Module IV: Social Welfare Programmes (12 hours)

Social Welfare Programmes and Policies: Children, Youth, Women, Widows, Elderly and Differently-able and marginalized Groups; Recent trends and Changes in Social Welfare Administration

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define Social Welfare Administration; Public Administration; Central Social Welfare Board, State Social Welfare Board and International Organizations; Communication and Networking, and Sustainability of Programmes. (Remembering)
- CO2:** Explain Characteristics, Principles and Functions of Social Welfare Administration; Types of Social Welfare Administration: Establishment, Objectives and Importance of Central Social Welfare Board, State Social Welfare Board and International Organizations. (Understanding)
- CO3:** Apply Social Welfare Programmes and Policies for Children, Youth, Women, Widows, Elderly and Differently-able and marginalized Groups. (Applying)
- CO4:** Analyze Social Welfare Programmes and Policies and Recent trends and Changes in Social Welfare Administration; Trust and Non Profit Organization: Societies Registration Act 1860, Trusts and Non-Profit Organizations under Indian Companies Act: Foreign Contribution Regulation Act 1976 and Income Tax Rules applicable to Development / Charitable Organisations under Income Tax Act 1961. (Analyzing)
- CO5:** Appraise Programme Management, Finance Management, Human Resource Management and Office Management; Processes related to Registration of Societies, Role of Social Workers in Decision Making Process. (Evaluating)
- CO6:** Adapt Principle and Significance of Management for Social Work; Processes related to Registration of Societies and Sustainability of Programmes. (Creating)

Suggested Readings

1. Chowdry, Paul, Social Welfare Administration, Atma R Ram and Sons, Delhi, 1992
2. Sankaran and Rodrigues, Handbook for the Management of Voluntary Organisations, Alpha Publications Chennai, 1983
3. Kulkarni, P.D., Social Policy and Social Development in India Association of schools of social work in India
4. Fred, Luthans, Organization Behaviour, III and IV edition
5. Rao, Subba, GCV. Family Law in Law, S. Gogia and Company, Hyderabad, 1999
6. Sullivan, Michael, Sociology and Social Welfare, Allen and Unwin, Winchester, USA, 1987
7. Reider, Dale, Evaluating Development Programmes and Projects, Second edition, Sage Publications, 2004
8. Gupta, N.S. Organization Theory and Behaviour. Delhi, 2009
9. Chatvervedi, A.N, Rights of the Accused under Indian Constitution.: Deep and Deep Delhi. 1984
10. Donnison, D & Chapman, Social Policy and Administration. London. 1989
11. P.J. Lukose, Inclusive Development : A Human Rights Approach, Media House, New Delhi, 2014

SWDS0044: INTRODUCTION TO DISABILITY STUDIES

(3 Credits- 45 hours)

Objectives:

- To gain knowledge about the concept of and different types of disabilities.
- To develop an attitude of respect and dignity towards persons with disability
- Facilitate the integration and synthesis of theoretical concepts and social work tasks
- To facilitate the process of Inclusive Education through appropriate Social Work Intervention

Module I: Understanding Disability (11 hours)

Disability: Definition, Causes, Types of Disabilities; Magnitude of various disabilities and their impact on persons with disability and their families; Needs and problems of persons with disability and their families across the life span; Social attitudes towards persons with disability.

Module II: Legislation, Programme and Schemes for PWD (11 hours)

Legal instruments related to PWDs: Persons with Disability Act-1995; Rehabilitation Council of India Act – 1992; National Trust Act-1999; Mental health Act; Rights of the Person with Disability Act 2016,

Module III: Inclusive Education (11 hours)

Concept and Meaning, Needs and importance; issues and challenges in implementing Inclusive education in India; Planning and managing an inclusive curriculum in schools; Measures for implementing Inclusive Education.

Module 1V: Management of Disability and Policies (12 hours)

Prevention and Management of Disabilities at Primary, Secondary and Tertiary levels;. Models -Social, Medical, Educational and Institutional ; National Policy on Persons with Disabilities, UN Conventions and Declarations on Persons with Disabilities; Different Governmental Schemes and programmes for Persons with Disabilities.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept and list the different types of Disability. (Remembering)
- CO2:** Recall the important legislation, programmes and schemes for Person with Disability. (Remembering)
- CO3:** Explain the magnitude of various disabilities and their impact on persons with disability and their families. (Understanding)
- CO4:** Classify the needs and problems of persons with disability and their families across the life span. (Understanding)
- CO5:** Develop an understanding on social attitudes towards person with disability and to have an attitude of respect and dignity to a person with disability. (Applying)
- CO6:** Utilize the knowledge on the laws, programmes and schemes to response and help the person with disability in the field of work. (Applying)
- CO7:** Examine the need and importance, the issues and challenges of inclusive education in India (Analyzing)
- CO8:** Evaluate the different Governmental schemes for person with disability. (Evaluating)
- CO9:** Propose measures for implementing inclusive education. (Creating)
- CO10:** Plan out intervention for person with disability at primary, secondary and tertiary level. (Creating)

Suggested Readings

1. Albrecht G.L, Katherine D Seelman. & Michael Bury. (2001). Hand Book of Disability
2. Bacquer, A. and Sharma, A. (2007). Disability: Challenges vs Responses, Delhi: CAN Publications
3. Hans, A. and Patri, A. (2003). Women and Disability, Delhi: Sage.
4. Hegarty Seamus & Mithu Alur. (2002). Education and Children with special needs, London: Sage.
5. Karanth, Pratibha & Joe Rozario. (2003). Learning disability in India, London: Sage
6. Grant. (2005). Learning disability: A lifecycle approach to valuing people, London: Open University Press

7. Moore. (2005). Researching disability issues, London: Open University Press
8. Rothman, J.C. (2003). Social Work Practice Across Disability. Boston: Allyn& Bacon.
9. Oliver, M. & Sapey, B. (ed.) (1998). Social Work with Disabled People. London: Palgrave Macmillan
10. Banerjee, G. (2001). Legal Rights of Person with Disability. New Delhi: Gyan Publishing House.
11. WHO. (2010). Community-based rehabilitation: CBR guidelines. Geneva: WHO Press.
12. Karna, G.N. (2001). *Disability Studies in India: Retrospect and Prospects*, New Delhi: Gyan Publishing House.
13. NCF (2005). National Curriculum Framework. New Delhi: NCERT.
14. Bhumali, A (2010). Rights of disabled Women and Children In India. New Delhi: Serials Publications
15. Burke, Peter (2008). Disability and Impairment: Working with children and families. Jessica Kingsley Publications.

SWCS0070: SOCIAL WORK WITH COMMUNITIES AND SOCIAL ACTION

(3 Credits – 45 hours)

Objective:

- *This course aims at acquainting the student with the concept of the community and its dynamics*
- *To understand community organisation as a method of social work and as an effective tool for development.*
- *To expose the students to the different models of community organization*
- *To familiarize the students with the role of social action in social work and community organization.*

Module I: Concepts of Community (11 hour)

Understanding Community: Definition, Concept, Types (Urban, Rural, Tribal and Open Communities), Structure and Functioning; Community Power Structure and Leadership; Community Dynamics.

Module II: Community Organization (11 hours)

Community Organization: Definition, Scope, Philosophy, Principles; Community Organization and Community Development; Approaches to Community Organization; Role and Skills of Social Worker in the Community; Techniques and Strategies of Community Organization.

Module III: Phases of Community Organization (11 hours)

Process of Community Organization - Study and Survey, Analysis, Assessment, Discussion, Organization, Action, Reflection, Modification and Continuation.

Module IV: Models of Community Organization, Community Development and Social Action (12 hours)

Models of Community Organization; Social Action –Principles and Process of Social Action and its Scope in India; Approaches to Social Action: Radical and Right based; Models of Community Development: Locality Development, Social Planning Model, Social Action Model, Saul Alinsky Model.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define and spell community organisation and social action as methods in social work education and practice. (Remembering)
- CO2:** Explain the concepts related to community organisation and social action as methods of social work education and practice. (Understanding)

- CO3:** Apply the understanding of the concepts of community organisation and social action in the fields of practice. (Applying)
- CO4:** Analyze various field situations and apply the relevant methods to address social concerns. (Analyzing)
- CO5:** Assess and choose community organisation or social action strategies to address social issues. (Evaluating)
- CO6:** Combine effectiveness of community organisation or social action models and strategies and make modification if required for effective intervention in communities. (Creating)

Suggested Readings

1. Bhattacharya, Sanjay, *Social Work an Integrated Approach*, Deep and Deep, New Delhi, 2006
2. Christopher, A.J., and Thomas William, *Community Organization and Social Action*, Himalaya Publications, New Delhi, 2006
3. Freire, Paulo, *Education for the Oppressed*, Seaburg Press, New York, 1970
4. Freire, Paulo, *Cultural Action for Freedom*, Penguin, HarmondsWorth, 1972
5. Kumar, Somesh, *Methods for Community Participation – a Complete Guide for Practitioners*, Vistaar Publications, New Delhi, 2002
6. Prasad, Ankit, *Social Welfare and Social Action*. New Delhi: Mittal Publications
7. Ross. M.G., *Community Organisation. Theories, Principles, and Practices*, Harper and Row, New York, 1955
8. Siddqui, H.Y., *Working with Communities*, Hira Publication, New Delhi, 1997
9. Skidmore, A. Rex and Milton. G. Thackeray, *Introduction to Social Work*, Prentice Hall, New Jersey, 1976
10. Shrivasta, S. K (1988) *Social Movements for development*, Allahabad : Chugh Publications
11. Siddique, H.Y. (1984) *Social Work and Social Action*, New Delhi : Harnam Publications
12. Zastrow H. Charles –*The Practice of Social Work – A Comprehensive Worktext*, BROOKS/COLE – Cengage Learning Publications, 9th Edition
13. Alinsky Saul (1971) *Rules for Radicals : A Practice Primer for Realistic Radicals*, Vintage
14. RM Mac Iver and Charles H Page, *Society – An Introductory Analysis*, Surjeet Publications

SWFW6004: CONTINUOUS FIELD WORK I

(3 Credits)

SWFW6006: CONTINUOUS FIELD WORK II

(4 Credits)

The field work practice in the Third and Fourth Semesters shall focus upon the Area of Concentration chosen by the students. The students shall be placed in the field for twenty five days of consecutive field work. The field work settings shall be communities, NGOs, service organizations, hospitals, clinics and governmental agencies. Those students who are specializing in Community Development will either be placed in an urban or rural community setting that is identified by the Department. Students who are specializing in Medical and Psychiatric Social Work will be exposed to either a Medical or a Psychiatric setting.

The thrust in field placement will be to enable the students to become more proficient in the field and apply relevant skills and techniques in handling real situations. During the placement, the students are expected to implement the following activities and adhere to the guidelines specified below:

1. The students are expected to apply all the methods of social work such as casework, group work, community organization, research and administration, wherever applicable depending upon the organization and their services.
2. The students shall be involved in the activities of the institution and fulfill the responsibilities as requested by the Agency Supervisor.
3. The students shall prepare a daily report of the field work activities implemented and share them through e mail with the concerned Faculty Supervisor at the end of each day. The Supervisor shall provide the necessary feedback and guidance to the students by also making personal visits to the field where they are placed.
4. At the end of the continuous field work placement, the students shall submit a consolidated or summary report highlighting the main activities implemented and the major learning from the field placement. Every student shall also appear for a viva voce examination at the end of the semester.

SWFR6008: CONCURRENT FIELD WORK AND RURAL PRACTICUM (6 Credits)

CONCURRENT FIELD WORK I

The field work practice in the first semester consists of orientation visits, lab sessions for skills training and placement. In the first semester, the focus of field work is the community. The students are placed in communities and in NGOs, Service Organizations and Government Agencies working with communities, and in those settings where they can be exposed to the community and community issues. The students get a close feel of the community and community settings, understand the dynamics and issues in the community and become aware of the sensitivities of people while working with them. They also get a firsthand experience of the programmes and projects implemented in the communities by NGOs and government agencies and the impact that these have on the community. They also interact with the agency personnel and the community members to understand the tension between tradition and change that the communities in the region are likely to experience, and how it is handled. They, with the help of the agency and the field work supervisor, identify an issue and work on it following the principles of community organization. The students are expected to be creative and innovative in assisting the agency and community in whatever way possible.

Normally a student spends fifteen hours over two days per week in field work. However, keeping in mind the peculiar situation of transport and communications in the region and the expenses involved, the field work practice may be arranged in other convenient ways as the department deems fit.

After each session of field work the students write a report of their activities and submit to the concerned field work supervisor. The supervisor conducts individual and group field work conferences regularly.

At the end of the semester the student submits a summary report for the semester and an external viva voce examination is conducted.

RURAL CAMP

Students are required a rural camp at the end of the first or second semester. The duration of the rural camp shall generally be ten days excluding days of travel. At the end of the camp each student shall submit a written report to the department in a specified format. Performance at the Rural Camp shall be considered for evaluation of the Field Work during the second semester.

The objectives of the rural camp are:

- To apply the acquired skills of group work and community organisation in communities.

- To understand and assess the problems faced by the rural population.
- To involve positively in the communities to help to remove some of these problems.

SWFW6009: CONCURRENT FIELD WORK II

(6 Credits)

The field work practice in the second semester will consist of lab sessions for skills training and placement. The focus will be on the practice of Social Case Work and Group works. The students shall be placed in NGOs, Government Departments, Service Organizations and Communities working with individuals and families, and in those settings where they can be exposed to issues related to individuals and groups. Normally a student spends fifteen hours over two days per week in field work.

Objectives

The concurrent field work ensures that the student understands the way these institutions and agencies function and practice the skills of working with individuals and different groups.

Activities

The student is expected to complete 5 cases in casework and follow up one group with at least 5 sessions. Besides this, the student shall be involved in the activities of the institution and fulfill the responsibilities that are asked of him/her by the agency/ field supervisor. After each session of field work the students shall write a report of their activities and submit to the concerned field work supervisor. The supervisor shall conduct individual and group field work conferences regularly. At the end of the semester the student shall submit a summary report for the semester and an external viva voce examination is conducted.

SWRP6005: RESEARCH PROJECT PHASE I

(2 Credits)

Every student shall undertake a research project work which has bearing on his/her AoC under the supervision and guidance of a faculty member. The preliminary work may begin at the end of the second semester. The students are expected to complete the Literature Survey followed by a Synopsis presentation during the Phase I. The dates, the mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester.

SWRP6007: RESEARCH PROJECT PHASE II

(4 Credits)

Every student shall undertake a research project work which has bearing on his/her AoC and present a written thesis on the research work under the supervision and guidance of a faculty member. The preliminary work may begin at the end of the second semester. The students are expected to complete the data collection before the fourth semester. The thesis is to be submitted to the department before the date notified. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester. There shall be a viva voce examination on the research project.

SWCA6010: COMPUTER APPLICATIONS FOR SOCIAL SCIENCES (Lab)

(2 Credits)

Objectives:

The objectives of this course are

- *To learn the basic computer applications those are useful for a social worker.*
- *To learn and do data analysis for research using a Statistical Analysis Package*
- *The data analysis of modules IV and V may be carried out in any Statistical Analysis Package or using spreadsheets. If required the Statistical Analysis Package may be introduced in a separate workshop.*

Module I (6 hours)

Word Processing: Meaning, Features, advantages; Structure of a Word Processor window; Creating document, saving opening and printing, find and replace. Creating table; Mail merge - main document, data source and merging

Module II (8 hours)

Spreadsheet Package: Cell, rows and columns; Range, structure of a spreadsheet window; Creating, saving opening and printing a spreadsheet, creating tables, charts; data analysis using formulae in a spreadsheet.

Module III (5 hours)

- a) Presentation package: Creating presentations in a presentation package, text, tables, charts, Animation, running slide show, saving the slides, printing presentations
- b) Internet and browsing, E-Mail, blogging, use of Internet in Research

Module IV (10 hours)

Data analysis using statistical software packages.

Suggested Readings

1. Foster, J.J., Data Analysis Using SPSS for Windows, Sage Publications Ltd., London, 1998
2. Gaur, Ajai S., et al., Statistical Methods and Practice and Research, Response Books New Delhi, 2006
3. Kelle, V., Computer Aided Qualitative Data Analysis: Theory, Methods and Practice, Sage Publications Ltd., London, 1998
4. Lincoln, Y. S. and N. K. Denzin, Handbook of Qualitative Research, Sage Publications, California, 1994
5. Taxali, R.K., PC Software for Windows Made Simple, Tata McGraw-Hill Publishing Company Ltd New Delhi, 1998
6. User manual of the statistical package used
7. Miles, M.B. and E.A. Weitzman, Computer Literacy in Human Services, The Haworth Press, New York, 1995

DEPARTMENT OF PSYCHOLOGY AND COUNSELLING

PCLS0002: LIFE SPAN DEVELOPMENT

(4 Credits - 60 hours)

Objectives: *This course gives an overview about cognitive, emotional, psycho-sexual, social and moral development during tZAd discussed with a view to enable students to understand the clients in the context of life span perspective.*

Module I: Introduction to Life Span Development (10 hours)

Life Span Perspective: Importance of studying Life-Span Development, Characteristics of life span development, Nature of Development, Scope of Life span development. Theories of Development (Brief mention of all theories), Influence of Socialization and Development

Module II: Biological Bases to explain Human Development and Anatomy of the Nervous system (14 hours)

- The Evolutionary perspective and Heredity-Environment Correlations, genetic foundation, Conception, effect of Teratogens on Prenatal Development, Neonatal health- Low birth weight, Neonatal Assessment.
- Neuron: Structure, types and functions. Structure of the nervous system, physiological basis of the action potential (neural response).
- Structure and function of the brain: forebrain, midbrain, hindbrain, cerebral cortex, temporal, parietal and occipital lobes; prefrontal cortex. The effect of hormones on the nervous system.

Module III: Physical development across life span (12 hours)

Physical growth during childhood, adolescence and old-age, brain development across life span, Bio-Psycho-Social health model, aging, biological theories of aging and death.

Module IV: Cognition (14 hours)

Cognitive Development across during adolescence, growth beyond formal operational stage, Piaget's and Vygotsky's Theories of Cognitive Development, Development of the Self, Self Esteem and Self Concept, Self Regulation. Development of identity and Personality including Erickson's theory. Aging and cognitive skills. Intelligence, creativity, learning and memory across the lifespan. Stages in language development, language development across the lifespan.

Module V: Emotional Development (10 hours)

Development of Emotion, Temperament and Attachment and Love intimacy, Development of identity and Personality including Erickson's theory. Theories of moral development. Changes in moral reasoning(Kohlberg's Theory).

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Relate factors of evolution and hereditary in human behavior. (Remembering)
- CO2:** Show the neuro-anatomy of the human body. (Remembering)
- CO3:** Explain the impact of developmental errors in the later biology and psychology. (Understanding)
- CO4:** Identify markers in the developmental history as dispositions of psycho-pathology. (Applying)
- CO5:** Analyze the pros and cons of theories of human bio-psychological development. (Analysing)
- CO6:** Reinterpret attitudes related to behavioral changes in various life stages. (Evaluating)

- CO7:** Assess the role of morality as a contributor to cognitive development. (Evaluating)
- CO8:** Create awareness to reduce prenatal and childhood developmental barriers. (Creating)
- CO9:** Plan tentative models of preventive intervention to promote healthy youth and aging. (Creating)

Suggested Readings

1. Santrock, John W (2007), Life- Span Development, 3rd Edition, New Delhi: Tata McGraw-Hill
2. Hurlock, Elizabeth B. (1981), A Life-Span Approach, 5th Edition, New Delhi: Tata McGraw-Hill Publishing Company Limited
3. Berk, Laura E. (2007), Child Development, 7th Edition, New Delhi: Prentice Hall.
4. Bhaskar, R.(2008), Fundamentals of Child Psychology, Delhi: Swastik Publishers and Distributors
5. Chatterjee, Chopra Suhita, Patnaik, Priyadarshi, Charari, Vijayaraghavan M. (Eds), (2008), Discourses on Aging and Dying. Los Angeles: Sage.
6. Hurlock, Elizabeth B. (1997), Child Development, 6th Edition, New Delhi: Tata McGraw-Hill Publishing Company Limited.
7. Mallon, Brenda (2008), Dying, Death and Grief, Working with Adult Bereavement, Los Angeles: Sage
8. Mishra, A.K. (2007), Psychology of Aging, Jaipur: Sublime Publications.
9. Santrock, John W. (2007), Child Development, 11th Edition, New Delhi: Tata McGraw-Hill Edition.
10. Sharma, Ram Nath A. Sharma, Rachana (2002), Child Psychology, New Delhi: Atlantic
11. Carlson, N.R. (2004). Physiology of behaviour (8th.ed.). Boston:
12. Allyn and Bacon.Schneider M Alles (1990). An introduction to Physiological Psychology (3rd Edition) USA:Random House.
13. Leukel, F.(1985). Introduction to physiological psychology (3rd.ed.). New Delhi: CPS Publishers
14. Morgan, T.H. and Stellar, A. (1965). Physiological Psychology. New York: McGraw Hill.

PCMH0004: CONCEPTS OF MENTAL HEALTH AND ILLNESS

(4 Credits - 60 hours)

Objectives: *In this course students get an overview of the concepts of mental health and illness, forms of diagnosis and learn about the most common groups of disorders. Need for psychological counselling as important part of treatment is discussed but also the limitations counselling has in severe cases.*

Module I: Introduction (10 hours)

Definition, historical review. Changing attitudes and concepts of mental health and illness. Current views. Models for understanding psychopathology. Psychoanalytic, behavioural, interpersonal and humanistic. Need, cultural and social background for and types of classification of mental disorders. DSM and ICD systems of classification.

Module II: Anxiety, Somatoform and Dissociative Disorders (15 hours)

Diagnosis, types, clinical features, social context, medical treatment, possibilities and limits of counseling

Module III: Severe Mental Disorders: Bipolar and Schizophrenic Disorders (10 hours)

Diagnosis, types, clinical features, social context, medical treatment, possibilities and limits of counseling

Module IV: Mental Health Problems in Children and Adolescents (10 hours)

Autism, ADHD, eating disorders - Diagnosis, types, clinical features, social context, medical treatment, possibilities and limits of counselling (behavioural and development)

Module V: Personality Disorder and sexual Disorders (15 hours)

Clinical features , causes, treatment of personality and sexual disorders.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define mental illnesses. (Remembering)
- CO2:** List categories of mental illness as specified in DSM and ICD. (Remembering)
- CO3:** Classify and categorise anxiety disorders, mood disorders, schizophrenia, dissociative disorders and eating disorders. (Understanding)
- CO4:** Apply diagnostic criteria of mood disorders, schizophrenia, dissociative disorders and eating disorders to diagnose individual with mental illnesses. (Application)
- CO5:** Analyse the distinction between normality and abnormality. Distinguish clinical features of different mental illnesses. (Analysis)
- CO6:** Explain the importance of different model of mental health and illnesses. (Evaluate)
- CO7:** Select appropriate psychological intervention for different childhood, adolescent and adult mental health related issues. (Application)
- CO8:** Evaluate Bio Psycho Social model and other models of mental health and illness. (evaluation)
- CO9:** Create management plan for patients on the basis of clinical features, diagnosis criteria and therapist competence. (Creating)

Suggested Readings

1. Diagnostic and Statistical Manual of Mental Disorders (DSM- IV TR), 2000 American Psychiatric Association.
2. Robert C.Carson, James N. Butcher, Susan Mineka, Jill M. Hooley, Abnormal Psychology, 13th edition, Pearson
3. Sarason, Irwin G. a. Sarason Barbara R. (2009). Abnormal Psychology. The Problem of Maladaptive Behaviour. 11th Edition. New Delhi: PHI Learning Private Limited.
4. Ahuja, Niraj (2006), A Short Textbook of Psychiatry, 6th Edition, New Delhi: Jaypee.
5. Antony, John D. (2006), Mental disorders, Encountered in Counselling, A Textbook of clinical Psychology Based on DSM IV, Dindigul: Anugraha Publications.
6. Chaube, S.P (2007), Developmental Psychology, New Delhi: Neelkamal.
7. Gilbert, Paul (2007), Psychotherapy and Counselling for Depression, 3rd Edition. Los Angeles: Sage.
8. Humphrey, Geraldine M. A. Zimpfer David G. (2008). Counselling for Grief and bereavement. 2nd Edition. Los Angeles: Sage.
9. Korchin, Sheldon, J. (1986), Modern Clinical Psychology, Principles of Intervention in the Clinic and Community. New Delhi: CBS Publishers and Distributors.
10. Kumar Updesh and Mandal Manas K. (Eds). (2010), Suicidal Behaviour, Assessment of People-at-Risk. Los Angeles: Sage.
11. Patel, Vikram (2003). Where There is No Psychiatrist. A mental health care manual. Glasgow: Gaskell.
12. Patel, Vikram a. Thara. R. (Eds.) (2003). Meeting The Mental Health Needs of Developing Countries. NGO Innovations in India. New Delhi: Sage.

PCSP0006: INTRODUCTION TO SOCIAL PSYCHOLOGY

(3 Credits - 45 hours)

Objectives: *This course helps to understand the social behaviour of individuals in terms of both*

internal characteristics of the person and external influences. It aims to orient students towards the applications of the concept of social psychology to social problems.

Module I: Introduction (8 hours)

Social Psychology - Definition, Nature, Origin and Development; Social Psychology in Indian context.

Module II: Social Processes (8 hours)

Social perception or cognition, interpersonal attraction, social motives, social learning, socialisation and social roles, pro-social behaviour and aggressive behaviour.

Module III: Social Influences (8 hours)

Persuasion, attitude, prejudice and stereotypes - nature and differences among them. Factors in the formation of attitudes, measuring attitudes, factors in attitude change.

Module IV: Group Dynamics and Group Influence (13 hours)

Formation of groups, structure and functions, types, group communication, group norms, conformity behaviour, co-operation and competition, social facilitation, leadership, group effectiveness, decision making, problem solving, group conflict and resolution.

Module V: Social Problems and Social Psychology (8 hours)

Understanding social problems in the light of social psychology: concept and approaches, aggression and violence, poverty, discrimination - caste, class, religion, gender.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of social psychology. (Remembering)
- CO2:** Relate the social psychological concepts in Indian settings. (Remembering)
- CO3:** Explain different concepts of social processes, social influence, group dynamics and group influence.
- CO4:** Apply the theoretical concepts of social psychology into real life settings. (Applying)
- CO5:** Analyze the difference between social perception and social cognition as well as prejudice, stereotype, discrimination. (Analyzing)
- CO6:** Assess the influence of culture and other socio-demographic variables on social psychology in applied settings. (Evaluating)
- CO7:** Compare different types of groups and their functional systems. (Evaluating)
- CO8:** Plan short term projects in order to apply different concepts of social psychological processes in real life settings. (Creating)
- CO9:** Discuss various social problems in light of the theoretical concepts of social psychology. (Creating)

Suggested Readings

1. Baron, R., A., Byrne, D. (2006), Social Psychology, 10th Edition, New Delhi: Prentice Hall.
2. Mc David and Harai (1968), Social Psychology; Individuals, groups, societies, Harper and Row.
3. Moghaddam, F.M. (1997), Social Psychology: Exploring Universals Across Cultures, Freeman and Company
4. Dalal, Ajit K., A. Misra, Girishwar (Eds). (2001), New Directions in Indian Psychology, Social Psychology, New Delhi: Sage.
5. Eckes, Thomas and Trautner, Hanns M. (Eds.) (2000), The Developmental Social Psychology of Gender, Mahwah: Lawrence Erlbaum Associates, Publishers.
6. Hogg, Michael A. and Cooper, Joel (Eds), (2007), The Sage Handbook of Social Psychology, Concise Student Edition, Los Angeles: Sage.

7. Misra, Girishwar (Ed.) (1990), Applied Social Psychology in India, New Delhi: Sage.
8. Pandey, Janak (Ed.) (2001), Psychology in India Revisited – Developments in the Discipline, Vol. 3: Applied Social and Organisational Psychology, New Delhi: Sage
9. Sharan, A.K. (1999). Social Psychology, New Delhi: Commonwealth Publishers.
10. Linda steg, Abraham p. Buunk, Applied social psychology: Understanding and managing social problems

PCPD0007: PERSONALITY DEVELOPMENT

(3 Credits - 45 hours)

Objectives: *In this Course in Personality Development students will learn about personalities. It will go on to look at theories of personality development and the theories of the stages of development. The students will also delve into basic personality traits, including values and beliefs.*

Module I: Understanding Personality (10 hours)

Definition and concepts of personality; Basic Personality Traits and Types, Big Five Personality Dimensions.

Module II: Personality Development (15 hours)

Personality development; theories of personality development: Freudian stages of development, Erik Erickson's stages of development, Maslow's hierarchy of needs, Roger's self theory; applications.

Module III: Techniques of Personality Analysis and Change (20 hours)

Johari Window, SCOT Analysis; Stress Management; Positive attitude; Management of Emotions.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define personality. (Remembering)
- CO2:** Compare and contrast eastern and Western perspectives of personality. (Remembering)
- CO3:** Explain the theories of personality. (Understanding)
- CO4:** Identify the impact of environment in development of personality. (Applying)
- CO5:** Analyze modifications of self in perceiving environment. (Analysing)
- CO6:** Assess the validity of universal nature of personality theories. (Evaluating)
- CO7:** Assess cultural differences shaping personality in terms of preference. (Evaluating)
- CO8:** Develop insight into dysfunctional earlier behavioral practices. (Creating)
- CO9:** Improve areas of self for better adaptation. (Creating)

Suggested Readings

1. Atkinson, R. L., Atkinson, R. C., Smith, E. E., Bem, D. J. and Hilgard, E. R. (1990).
2. Introduction to Psychology. New York: H. B. J. Inc.
3. Sternberg, R. J. (2010). Cognitive Psychology. New York: Cengage Learning
4. Passer, M.W. and Smith, R.E. (2010). Psychology: The Science of Mind and Behaviour. New Delhi: Tata McGraw-Hill

PCCY0009: CHILD AND YOUTH COUNSELLING

(4 Credits - 60 hours)

Objective: *This course aims to introduce student to the need for and application of counselling techniques to the educational settings and to improve student mental health. Further, the course attempts to*

- *provide a firm foundation for Educational Counselling and Assessment*
- *develop counselling skills for dealing with behavioural problems of school Children*

- *provide an understanding on career issues*
- *Develop skills for different intervention strategies*

Module I: Introduction (12 hours)

Definitions and goals of counseling for children and youth; Children and Youth-counselor relationship, attributes of a counsellor, historical background and contemporary ideas about counselling

Module II: Academic Development (12 hours)

- a) Learning-styles - VAK Model, Kolb's Experiential Model, MBTI Pattern, Honey and Mumford Model, Hemispheric Dominance Model, Gregorc Model, Gardner's Multiple Intelligence Model.
- b) Study skills - reading, writing and note making skills, studying skills and study habits, time management
- c) Cognitive issues - causes and factors affecting attention, concentration, remembering, forgetting, experimental evidences and cognitive training

Module III: Major Theories in Counselling Children (14 hours)

Learning, Behavioural, Cognitive Behavioural Modification, Expressive therapy: play, art and drawing, drama, metaphors, story telling

Module IV: Counselling Children with specific problem (12 Hours)

- a) Children and trauma, child abuse- physical, sexual, emotional, HIV/ AIDS, specific issues in educational settings
- b) Techniques of assessment: Cumulative record, Anecdotal Record, Case Study, Sociometry

Module V: Career Counselling (10 hours)

Basic aspects: Nature, scope and importance of career counselling; role of counselor in career preparation; career decision making, career exploration techniques, career development theories- (Holland, Ginzberg super), career counselling with diverse population: children, adolescents, college students, women and adults

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts and goals of child counseling (Remembering)
- CO2:** Explain the various important learning styles like VAK Model, Kolb's Experiential Model and MBTI Pattern (Understanding)
- CO3:** Apply the skills about the significance of the child-counselor relationship (Applying)
- CO4:** Analyze the significance about the child-counselor relationship (Analyzing)
- CO5:** Conclude and combine the information on various cognitive issues in children with experimental evidences (Evaluating)
- CO6:** Compare and contrast among the major theories in counseling (Analyzing)
- CO7:** Determine the major theories in counseling children like Behavioral Therapy, Expressive Therapy and Cognitive theories. (Evaluating)
- CO8:** Build an understanding regarding the meaning and goals of Counseling and child-counselor relationship (Creating)
- CO9:** Build on the traditional views of learning styles models and build on the contemporary perspectives. (Creating)

Suggested Readings

1. Asch M (2000) Principles of guidance and counselling (I Ed) New Delhi: Sarup and Sons
2. Bove Frank G (2000). Birth to Five – early Childhood special education, New York, Delmar Publishers Inc.

3. Butler, G. and Hope, T. (1997). *Managing your mind: The mental fitness guide*. Oxford University Press.
4. Cohen, L.G., and Spenciner, L.J (2003). *Assessment of Children and Youth with Special Needs*. Boston: Allyn and Bacon.
5. Mangal S.K (2008) *Essentials of Educational Psychology*, New Delhi, Prentice Hall of India Pvt Ltd
6. Santrock, J.W. (2003). *Educational Psychology*. Boston: McGraw-Hill.
7. Woolfolk, A. (2007). *Educational psychology (10th ed.)*. Boston, MA: Allyn and Bacon.

PCRM0010: RESEARCH METHODOLOGY AND STATISTICS IN SOCIAL SCIENCE

(4 Credits - 60 hours)

Objectives:

- *To understand the significance of research and application of statistics in psychology*
- *To understand the research process and acquire the attitudes and skills essential for psychological research*
- *To develop skills for interpretation, documentation and presentation of results of the research.*
- *To familiarize with statistical methods and techniques needed for psychological research.*
- *To understand the process of report writing and publication.*

Module I: Introduction to Research (10 hours)

Philosophical Foundations of Research. Natural and social science research- characteristics and scientific attitude. Scope of social science research- basic and applied research; Ethical concerns in Counselling research.

Module II: Research designs, approaches and types (12 hours)

- a) Research designs: Descriptive, Exploratory and Experimental: meaning, scope, characteristics, application in social work setting.
- b) Research Approaches: Qualitative and Quantitative Research: meanings, scope, methods, steps, sampling, data collection, analysis, interpretation and reporting. Strengths and weaknesses.
- c) Evaluative research: Programme and projects evaluation: concept, types, steps, reports.
- d) Participatory research and action research: concepts, scope, application and steps.

Module III: Steps in Research Process (20 hours)

- a) Problem Formulation: Identifying research issue, formulating research topic and problem, review of literature (library work), theoretical framework, formulating objectives, clarifying concepts, variables- conceptual and operational, formulating hypothesis.
- b) Population and Sampling: Inclusion and exclusion criteria of population, the logic of sampling size and techniques: probability and non-probability sampling.
- c) Tools for data collection: Levels, Types of measurements, reliability and validity of tools. Constructing tools for data collection: questionnaire, interview schedule, scales. Quantification of qualitative data.
- d) Sources, Collection and Analysis of Data: Secondary and primary sources. Data collection data editing, coding, master sheet, analysis, report writing. Using computer for data analysis: coding, analysis- graphs and results.
- e) Professional report writing

Module IV: Introduction to Statistics (18 hours)

- a) Statistics: Definitions, Uses and Limitations. Classification and tabulation of data, univariate and bivariate, diagrammatic and graphic presentations. Measures of central tendencies,

Mean, Median and Mode and their uses. Measures of variability range, variance and standard deviation.

- b) Correlation: Meaning and computation of coefficient of correlation as product moment, Spearman's Rank Correlations, interpretation of correlations.
- c) Test of Hypotheses: Basics, Probability distribution, normal distribution. t-test, Chi-Square test and ANOVA.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

CO1: Define the basic concepts of research and recognize the philosophical foundations of research. (Remembering)

CO2: To name the different major research designs and state the steps in conducting a research. (Remembering)

CO3: Understand the philosophical foundations of research. (Understanding)

CO4: To analyze the scope of natural and social science research. (Analysing)

CO5: To analyze the collected data in research using different statistical measures. (Analysing)

CO6: Apply research designs and approaches to carry out research in social sciences. (Application)

CO7: To use computer for data analysis and Demonstrate professional report writing of research. (Application)

CO8: To evaluate the ethical considerations in statistical research (Evaluation)

CO9: To create a research proposal using indicating appropriate research design, method of data collection and statistical computation. (Creating)

Suggested Readings

1. Ahuja, Ram, Research Methods, Rawat, Jaipur, 2001
2. Alston, M. Bocoles, W., Research in Social Workers- An Introduction to the Methods, Rawat, Jaipur, Indian Edition 2003
3. Baker, T.L., Doing Social Research, McGraw Hill, Singapore, 1994
4. Goode, W.J. and Hatt, P.K., Methods in Social Research, McGraw Hill Singapore, 1981
5. Grinell, R. M., (Jr), Social Work Research and Evaluation, F.E. Peacock Pub. Inc., Illinois, 1988
6. Gupta, C.B., Introduction to Statistical Methods, Vikas Publishing House, 1995
7. Gupta, S.C., Fundamentals of Statistics, Himalaya Publishing House, Delhi, 1997
8. Gupta, S.P., Statistical Methods, Sultan Chand and Sons, New Delhi 1997
9. Jacob, K.K., Methods and Fields of Social Work in India, Asia Publishing, Bombay, 1996
10. Kothari, C.R., Research Methodology: Methods and Techniques, 2nd edition reprint, New Age International New Delhi, 2004
11. Krishnaswamy, O.R., Methodology for Research in Social Science, Himalaya, Bombay, 1993
12. Laldas, D.K., Practice of Social Research, Rawat, Jaipur, 2000
13. Mikkelsen, B., Methods for Development Work and Research-A New Guide for practitioners, Sage, New Delhi, 2005
14. Ramchandran, P., Social Work Research and Statistics, Allied Publishers, Bombay, 1968
15. Rubin, A. and Babbie, E., Research Methods for Social Work, 4th edition, Wadsworth, West, Brooks/Cole and Schirmer, 2001
16. Sarantakos, S., Social Research, Palgrave Macmillan, New York, 2005
17. Sharma, B.A.V, Prasad, R.D. and Satyanarayana, C., Research Methods in Social Sciences, Sterling, New Delhi, 2002

18. Sharma, K.R., Research Methodology, National Publishing House, Jaipur, 2002
19. Wilkinson, T.S. and Bhandarkar, P.L., Methodology and Techniques of Social Research, Himalaya, Bombay, 1984
20. Young, p., Scientific Social Surveys and Research, Asian Students edition, Asia Publishing House, Japan, 1960

PCMF0012: MARRIAGE AND FAMILY COUNSELLING

(4 Credits - 60 hours)

Objectives: *This course aims to make the students able to develop an understanding of basic theoretical models related to Family Therapy. They would be able to develop competency in conducting family therapy sessions as demonstrated through Role Play assignments. There would be an understanding of diverse issues amongst couples and the techniques to handle such issues. It would help in the rethinking of behavioural factors, disease prevention and health promotion in the context of holistic philosophy of health in the family.*

Module I: Introduction (10 Hours)

Historical evolution of Family and Marriage therapy; Goals of Family therapy; current trends in Family therapy; Fundamental concepts in Family therapy (Cybernetics and Systems theory, Social Constructivism) Stages of marriage, Divorce and remarriage, Marriage and Divorce: Role of Family Courts.

Module II: Family Across a Lifespan (16 hours)

The family life cycle, stages of family life cycle. Key developmental and emotional issues in different stages: Young adulthood. Newly married, Child bearing, Families with preschool children, Families with school age children. Families with teenage children, Launching stage, Middle aged adult, Retirement

Module III: Classical Schools (12 Hours)

Bowen's Intergenerational Approach; Structural Family Therapy; Strategic Family Therapy; Experiential and Humanistic Family Therapies; Psychoanalytic and Cognitive Behavioural Family therapy.

Module IV: Recent Developments (12 Hours)

Postmodernism, Feminist and contextual work, Solution focused therapy, Narrative therapy, Integrative models. Application and evaluation of Family therapy. Skill development: Genograms. The stages of Family therapy: Planning; Assessment; Disengaging or recontracting.

Module V: Counselling Couples with Special Issues (10 Hours)

Treating sexual abuse and physical abuse issues in family; Counselling of alcoholics and drug-addicts; Counselling the terminally ill and patients with HIV/AIDS.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of marriage and counselling. (Remembering)
- CO2:** Tell the role of family courts in marriage and divorce. (Remembering)
- CO3:** Classify different developmental and emotional issues in different family life stages. (Understanding)
- CO4:** Explain the concept of family life cycle. (Understanding)
- CO5:** Identify the classical schools of marriage and family counselling. (Applying)
- CO6:** Analyze the Bowen's intergenerational approach. (Analyzing)
- CO7:** Evaluate the historical evaluation of marriage and family therapy. (Evaluating)

CO8: Explain different therapeutic approaches of marriage and family counselling. (Evaluating)

CO9: Discuss the processes of counselling couples with special issues/problems. (Creating)

Suggested Readings

1. Nichols, P.M and Schwartz C.R (2006). Family Therapy – concepts and methods, 7th edition, Allyn and Bacon, Boston, Pearson education, Inc. Press, Inc
2. Gladding, S.T. Family Therapy: History, Theory, and Practice (4th Edition)
3. Essential Skills in Family Counselling. JoEllen Paterson, et al. New York, New York, Guilford Press. 2009.
4. Gehart, D.R. Mastering Competencies in Family Therapy: A Practical Approach to Theory and Clinical Case Documentation
5. Gottman, J.M. The Marriage Clinic: A Scientifically Based Marital Therapy
6. Satir, V. (2008) Satir Transformational Systemic Therapy. Publisher: Science and Behaviour Books
7. Steve de Shazer. (1982) Patterns of Brief Family Therapy: An Ecosystemic Approach, Guilford Publications
8. Satir, V. (2008) Satir Transformational Systemic Therapy. Publisher: Science and Behaviour Books
9. Napier, A.Y and Whitaker, C. (1988). The Family Crucible: The Intense Experience of Family Therapy
10. Bertrand Piccard, John Family Systems Therapy: Developments in the Milan Systematic Therapies, Ilsa Jones, Elsa Jones

PCEC0013: EASTERN APPROACHES TO PSYCHOLOGY AND COUNSELLING

(3 Credits - 45 hours)

Objectives: *The ideas of counselling are mainly connected with western concepts. But Asia and specially India has a rich heritage of skills and techniques to deal with individuals, families and groups in crisis. Concepts of psychology find their own definitions and ways of treatment. In this course traditional forms of Eastern Psychology and Counselling are learned and discussed in relation to western concepts.*

Module I: Introduction (7 hours)

Definitions, nature, differentiation of concepts - eastern, indigenous and Indian psychology; relationship between culture and psychology, emergence of non-western and indigenous perspectives to psychology.

Module II: Major Schools of Indian and Eastern Psychology (10 hours)

Indian approaches to Psychology - Upanishads, Sankhya, Dvaita and Advaita schools; current areas of research in Indian psychology. Chinese approaches to psychology - Taoism and Confucianism, Japanese approaches to Psychology - Morita and Naikan therapies.

Module III: Self and Consciousness (10 hours)

Viewpoints of Upanishads, Bhagavadgita, Buddhism and Jainism and other Eastern schools of thought.

Module IV: Indian and other Eastern Approaches to Health and Wellbeing (9 hours)

Yoga, Ayurveda, goals of life - concept of purusharthas, personality development - concept of Ashramas

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic terms related to the different eastern approaches of psychology. (Remembering)
- CO2:** Choose an appropriate method of Indian/Chinese/Japanese approaches to psychology in applied settings. (Remembering)
- CO3:** Classify among Indian/Chinese/Japanese approaches to psychology. (Understanding)
- CO4:** Make use of the appropriate Indian/Chinese/Japanese approaches to psychology in applied settings. (Applying)
- CO5:** Examine ancient and contemporary eastern approaches of psychology. (Analyzing)
- CO6:** Recommend the suitable approach in applied settings. (Evaluating)
- CO7:** Estimate the contribution of eastern approaches in the modern trends of psychology. (Evaluating)
- CO8:** Test the indigenous approaches to psychology in the various cultural settings. (Creating)
- CO9:** Develop a clear understanding of eastern and western approaches to psychology. (Creating)

Suggested Readings

1. Bankart, C. P. (1996). Talking cures: A History of Western and Eastern Psychotherapies. Pacific Grove, CA: Brooks/Cole.
2. Ajaya, S. (1983). Psychotherapy East and West. Honesdale (PA): Himalayan International Institute.
3. Berry, J. W., Poortinga, Ype H. and Pandey, J. (1997). Handbook of cross-cultural psychology, Tth Edition, Vol. 1 Theory and method. Boston: Allyn and Bacon. (Chapters 3, 4 and 8 by J.G. Miller, D. Sinha, P.M. Greenfield)
4. Jones-Smith, E. (2012). Theories of counselling and psychotherapy: An integrative approach. Thousand Oaks, CA: Sage.
5. Garg, Pulin K. K. and Parikh, I.J. (1995). Crossroads of culture: a study in the culture of transience, New Delhi: Sage.
6. Kakar. S. (1982). Shamans, mystics and doctors: A psychological enquiry into India and its healing traditions. Bombay: Oxford University Press.
7. Paranjpe, A.C. (1998). Self and identity in modern psychology and Indian thought. New York: Plenum.
8. Dunn, B.R., Hartigan, J.A., and Mikulas, W.L. (1999). Concentration and mindfulness meditations: Unique forms of consciousness? Applied Psychophysiology and Biofeedback, 24 (3), 147-165.
9. Kuyken, W., Byford, S., Taylor, R.S., Watkins, E., Holden, E., White, K., Barrett, B., Byng, R., Evans, A., Mullan, E., and Teasdale, J.D. (2008). Mindfulness-based cognitive therapy to prevent relapse in recurrent depression. Journal of Consulting and Clinical Psychology, 76(6), 966-978.
10. Segal, Z. (2008). Finding daylight: Mindful recovery from depression. Psychotherapy Networker, (Jan/Feb).

PCAT0014: ADDICTION AND TRAUMA COUNSELING

(3 Credits - 45 hours)

Objectives: *This course provides an understanding of the concept of addiction and trauma in the field of counselling. The first two sections of the course deal with forms of diagnosis and the classification, treatment of drug abuse and other related issues. The third and fourth sections deal with trauma, assessment and methods of intervention for trauma related issues.*

Module I: Addiction Counselling (8 hours)

Definition, DSM-V diagnostic category - classification of drugs of abuse, stages of addiction

Module II: Treatment Methodology (15 hours)

Psychodynamic approaches, cognitive-behavioural therapies, motivational enhancement therapy. Problem-oriented treatment, solution-focused treatment, group therapy, family therapy and community based interventions.

Module III (12 hours)

- a) Introduction to Trauma: Definition, types of trauma, historical context of trauma, theoretical contexts of trauma counselling.
- b) Issues of Loss and Grief: trauma experienced in early childhood, adolescence, elder abuse, sexual trauma, treating adult trauma survivors, Contextual issues of community based violence, school violence and trauma, workplace and campus violence, natural disasters

Module IV (10 hours)

- a) Assessment in psychological trauma: methods and intervention, models for trauma intervention, strategies and techniques for counselling survivor of trauma
- b) Ethical perspective on trauma work, trauma and supervision

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** What is addiction counseling. State about group therapies, family therapy and community based interventions for addiction. (Remembering)
- CO2:** Classify substance related disorders according to the classification of DSM 5. (Understanding)
- CO3:** Compare and contrast different psychological interventions for addiction related psychological disorders. (Understanding)
- CO4:** Categorize the sources of trauma and trauma intervention. (Analyse)
- CO5:** list various forms of trauma in childhood, adolescence and adulthood (Remembering)
- CO6:** To evaluate the effectiveness of Psychodynamic approach, CBT, MET, Group intervention in dealing with substance addiction. (Evaluating)
- CO7:** Decide method of assessment and intervention for trauma victims. (Evaluating)
- CO8:** Find out contextual issues in community based, school, workplace and campus violence; Apply psychological interventions and techniques on trauma victims. (Application)
- CO9:** Create need based and behavioural management plan for patients with addiction and trauma survivors. (Creating)

Suggested Readings

1. Rasmussen, S. (2000). Addiction treatment: Theory and Practice. London: Sage.
2. DSM-V (2013)
3. The New Guide to Crisis and Trauma Counselling- H.Norman Wright
4. Trauma counselling - Theories and Interventions, Lopez Levers, Lisa
5. Trauma: A Practitioner's Guide to Counselling, edited by Thom Spiers

PCDR0015: DISABILITY STUDIES AND REHABILITATION PSYCHOLOGY

(3 Credits - 45 hours)

Objectives:

- *To Provide an overview of various areas of disability and its rehabilitation*
- *To learn different approaches to rehabilitation.*

- *To understand the importance and application of psychological intervention in the field of rehabilitation*
- *To understand the legal issues in rehabilitation*

Module I: Introduction (10 hours)

Rehabilitation Psychology-meaning, definition, Historical roots, scope of rehabilitation psychology, significance, models of rehabilitation- Psychological and Social- cultural, medical, institutional, Functions of Rehabilitation psychology - General functions and special functions

Module II: Cognitive and Academic disability (15 hours)

- a) Intellectual Disability: definition, components of Intellectual Disability, medical, psychological, and educational classification, prevalence of Intellectual Disability in India, functional level of various categories of mentally retarded persons, Prevention and early intervention and rehabilitation.
- b) Learning disabilities: Types and causes, methods of assessment, intervention and rehabilitation, planning intervention.
- c) Autism spectrum Disorder: Definition, Characteristics, types and causes, intervention and rehabilitation

Module IV: Physical Disability (10 hours)

Nature, causes prevention and rehabilitation of hearing impaired; nature, causes, prevention and rehabilitation of visually impaired; nature, causes, prevention and rehabilitation of orthopedic impaired.

Module V: Legal issues (10 hours)

Rehabilitation policies and services: The Mental health Act, 1987, PWD Act, 1995, RCI Act, 1992, National Trust Act, programs and schemes of assistance, placement and community services; designing training programs for professionals in rehabilitation, implementation of training programs

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept of rehabilitation (Remembering)
- CO2:** List the methods of assessment and interventions for various disabilities (Remembering)
- CO3:** Illustrate the scope of rehabilitation psychology (Understanding)
- CO4:** Apply various models of rehabilitation in practice (Applying)
- CO5:** Plan assessments and interventions for various learning, intellectual and physical disabilities. (Applying)
- CO6:** Analyze the general functions of rehabilitation psychology (Analyzing)
- CO7:** Compare various psychological tools for assessment of cognitive and academic disability effectiveness (Analyzing)
- CO8:** Compare and conclude on the prevention and early intervention for various disability (Evaluating)
- CO9:** Modify the flaws in the successful implementation of various acts related to disability (Creating)

Suggested Readings

1. Tom Meehan Chris Lloyd, Robert King,(2007), Handbook of Psychological Rehabilitation, Blackwell Publisher
2. Sonnenmeier. R, Mirenda. P.(2008)Autism spectrum Disorder and AAC

3. The professional Practice of rehabilitation counselling, Springer Publication company, 2011
4. Jeanne. B. Patterson, (1997), Foundations Of Rehabilitation Counselling with Person who are blind or visually impaired, American foundation for the blind, U.S
5. James K. Luiselli, Dennis C. Russo, Walter P. Christian, (2008), Effective Practice for children with Autism: Educational and Behavioural support Intervention that work
6. Kim Etherington, (2002) rehabilitation counselling in physical and mental health, Jessica Kingsley publication
7. David. R. Cox, Speciality Competencies in Rehabilitation Psychology
8. T. F. Rigger, Handbook of Rehabilitation Psychology.
9. Jules M. Rothstein, Serge H. Roy, Steven L. Wolf, (2005), The rehabilitation specialist's Handbook.
10. Chaturvedi, T.N. (1981). Administration for the Disabled: Policy and Organisational Issues. New Delhi : I.I.P.A.
11. Mani, R.D. (1988). The Physically Handicapped in India Policy and Programme New Delhi: Ashish Publishing.

PCFC0016: FOUNDATIONS OF PROFESSIONAL COUNSELLING

(4 Credits - 60 hours)

Objective: *This course aims at introducing the theoretical basis of counselling, needs for counselling, training in Counselling skills, limitation of counselling, counselling in a multi-professional context, counsellors personal and professional issues and growth and ethical and legal issues from a multi-cultural perspective.*

Module I: Introduction (12 hours)

Meaning, Nature, Definition and Scope of Counselling; Historical perspectives; Counselling settings, Counselling psychology in India-development and current status; ethical and legal issues, Confidentiality, Research and Evaluation; Current trends.

Module II: Counselling relationship and Basic Counselling Skills (18 hours)

Qualities of helping relationship. Initial state of building a safe counselling relationship, relations during the counselling process, Microskills approach to Counselling Training, Basic Counselling Skills – Attending Behaviours; Questions; Observation Skills; Paraphrasing and Summarising; Encouraging; Empathy; Reflection of Content, and Reflection of Feelings.

Module III: Counselling process and Advanced Counselling Skills (18 hours)

Counselling Interview, assessment (standardized and non-standardized measures) setting goals, contracting, conceptualization, Advanced Counselling Skills - Confrontation Skills, Influencing skills, Skill Integration, Termination, and Referrals.

Module IV: Documentation (12 hours)

Case story, documentation of the first session, reports of ongoing sessions, conclusion of a counselling process, verbatim recording and analysis, interpretation, reporting of dangerous situations.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concepts in counseling, its theories and the role of a counsellor. (Remembering)
- CO2:** Recall, ethics in counseling and counseling settings. (Remembering)
- CO3:** Infer core issues of clients Illustrate current status of counselling in India. (Understanding)
- CO4:** Apply basic counseling skills to establish initial relationship with clients (Applying)
- CO5:** Examine danger and harmful behavior in a client. (Analysing)

- CO6:** Appraise the need of early referral of cases without violating ethics. (Evaluating)
CO7: Decide on termination and prepare client for termination of counseling session. (Evaluating)
CO8: Adapt to practice sessions as a counselor. (Creating)
CO9: Create awareness about pro mental health attitude among people. (Creating)

Suggested Readings

1. Gladding, S.T (2009), *Counselling : A Comprehensive Profession*, 6th Edition Pearson
2. Ivey, A.E. and Ivey, M.B. (2007), *Intentional Interviewing and Counselling*, Thomson: Brooks/Cole.
3. Nelson Jones, R. (2008), *Basic Counselling Skills: A Helper's Manual*, New Delhi: Sage Publications.
4. Evans, D.R., Hearn, M.T., Ulhemann, M.R. and Ivey, A.E.(2008), *Essential Interviewing: A Programmed Approach to Effective Communication*, Thomson:Brooks/Cole.
5. Kiruba, Charles and Jyothsna N.G. (2011), *Guidance and Counselling*, New Delhi: Neelkamal
6. Koshy, John S (2009/10), *Guidance and Counselling*, New Delhi: Dominant Publishers and Distributors.
7. McLeod, John (2003), *An Introduction to Counselling*, 3rd Edition, Berkshire: Open University Press.
8. McLeod, John (2007), *Counselling Skill*, Berkshire: Open University Press
9. Palmer, Stephen and Bor, Robert (Ed.) (2008), *The Practitioner's Handbook*, Los Angeles: Sage.
10. Russell, Janice and Dexter, Graham (2008), *Blank Minds and Sticky Moments in Counselling, Practical Strategies and Provocative Themes*, 2nd Edition, Los Angeles: Sage.

PCCP0017: THEORETICAL PERSPECTIVES FOR COUNSELLING PSYCHOLOGY

(4 Credits - 60 hours)

Objectives: *This course introduces the students of Psychological Counselling to a few of the contemporary theories of psychology with specific reference to learning, motivation, emotions and personality. The basic concepts and perspective of each theory are discussed and their applications to the field of counselling are highlighted. The empirical studies pertaining to different areas and the applications of the derived principles are examined.*

Module I: Introduction (12 hours)

Nature of a scientific theory, A historical perspective of psychological theories. Definition and Nature of perception, motivation, emotion and personality. Positive Psychology – Basic ideas and concepts.

Module II: Psychodynamic Approach to Counselling (16 hours)

Freudian and Post-Freudian approaches: conscious/unconscious, transference and counter transference, ego-psychology, defence mechanism, self theory. Therapeutic process, Application of Techniques and procedures. Therapy with diverse populations.

Module III: Cognitive-Behavioural Approaches (17 hours)

- a) Motivation - Drive and incentive theories (Hull)
- b) Emotions - Conditioning experiment (Watson and Rayner), Emotions and social interactions - imitation, empathy, communication and facial expressions, emotional control.
- c) Aron Beck's Cognitive Therapy, Albert Ellis Rational Emotive Behaviour Therapy.
- d) Donald Meichenbaum's approach to therapy.
- e) Behavioural therapeutic process, Application of Techniques and procedures. Therapy with diverse populations.

Module IV: Person-Centered Approaches (15 hours)

History, Basic Theory and Assumptions, View of Psychopathology, Goals and Skills, characteristics of counselling relationship. Existential Therapy. Logo therapy. Application of Techniques and procedures. Therapy with diverse populations.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of psychological phenomena on which theories were formulated. (Remembering)
- CO2:** Relate different ideas proposed by the theories to basic psychological processes. (Remembering)
- CO3:** Interpret psychopathology and goals in the light of systems of thought. (Understanding)
- CO4:** Make use of Fourier, Laplace and z-Transforms techniques in analysis of signals and systems. (Applying)
- CO5:** Build trials for practice of theoretical methods of facilitation for diverse populations. (Analysing)
- CO6:** Choose the use of an approach(es) to suit the needs of a client. (Evaluating)
- CO7:** Judge the shortcomings of theories and compensation of the same by another. (Evaluating)
- CO8:** Design unique community fit plans for preventive intervention. (Creating)
- CO9:** Condition growth enhancement behaviors of self and others. (Creating)

Suggested Readings

1. Corey, G.(2008), Theory and Practice of Counselling and Psychotherapy (8th ed), Canada: Brooks/Cole.
2. Seligman Linda, Lourie W. Reichenberg (2011), Theories of counselling and Psychotherapy (3rd ed), Prentice Hall.
3. Corey, G.(2008), Student Manual for Theory and Practice of Counselling and Psychotherapy (8th ed), Canada:Brooks/Cole.
4. Burl, E.G.and Richard, K.J.(1998), Theories and Strategies in Counselling and Psychotherapy, Singapore:Allyn and Bacon.
5. Borden, William (2009), Contemporary Psychodynamic, Theory and Practice, Chicago: Lyceum Books.
6. Koshy, John S (2009/10), Guidance and Counselling, New Delhi: Dominant Publishers and Distributors.
7. McLeod, John (2003), An Introduction to Counselling, 3rd Edition, Berkshire: Open University Press.
8. Omprakash B. Pal (2011), Encyclopaedia of Guidance and Counselling, Educational and Vocational Guidance and Counselling, Vol I and II, New Delhi: A P H Publishing Corporation.
9. Snyder, C., Lopez, Shane J. (2007), Positive Psychology, The Scientific and Practical Explorations of Human Strengths, New Delhi: Sage.
10. Westbrook, David; Kennerley, Helen and Kirk J. (2007), An Introduction to Cognitive Behaviour Therapy, Skills and Applications, Los Angeles: Sage.

PCPT0018: PSYCHOLOGICAL TESTING

(4 Credits - 60 hours)

Objectives:

- *To enhance the understanding of the concepts of psychological testing which is an integral part of psychological research.*

- *To acquaint the students about the techniques of test construction*
- *To familiarise with various assessment techniques – cognitive, personality, achievement and aptitude.*

Module I: Introduction to Psychological Testing (9 hours)

History of Psychological Testing; Definition and Purpose and relevance of Psychological testing, Types of tests, Principles, Applications and Issues, Ethical and Social Considerations in Testing

Module II: Test Construction (15 hours)

Steps in test construction, Item Writing: types of items, General guidelines for item writing, Characteristics of a good psychological test: Objectivity, Standardization, Reliability: Meaning, Types of Reliability and Factor influencing Reliability.

Validity: Meaning, Type of validity and Factors influencing validity. Norms: Norm referenced and criterion referenced tests, Types of Norms and Test Scales.

Module III: Assessment of Cognitive Abilities (13 hours)

Measurement of Intelligence: Types of Intelligence tests, Individual intelligence tests, Other broad range intelligence tests, Group intelligence tests, Psychological issues in intelligence testing
Longitudinal studies, Problems in cross cultural testing

Module IV: Assessment of Personality (13 hours)

Measurement of Personality: Meaning and Purpose, Tools of Personality Assessment, Measurement of Interests, Values and Attitudes, Projective Techniques: Meaning and Types of Projective Techniques, Classification and Evaluation of Projective Techniques

Module V: Assessment of Aptitude and Achievement (10 hours)

Aptitude and Achievement: Distinction between Aptitude and Achievement Tests, Types of Aptitude tests, Types and selection of standardized Achievement Tests, Achievement test batteries.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of psychological testing. (Remembering)
- CO2:** Choose a suitable method of data analysis. (Remembering)
- CO3:** Classify the group and individual techniques of psychological testing. (Understanding)
- CO4:** Make use of different statistical concepts in data analysis. (Applying)
- CO5:** Examine the results of the statistical data analysis. (Analyzing)
- CO6:** Recommend the suitable technique (qualitative/quantitative) of data collection/ interview in applied settings. (Evaluating)
- CO7:** Estimate the reliability/validity of a test. (Evaluating)
- CO8:** Test the assumptions of normality in a data set. (Creating)
- CO9:** Develop a psychological tool using appropriate norms of tool construction. (Creating)

Suggested Readings

1. Anastasi, A. and Urbina, S. (1997). Psychological testing. N.D.: Pearson Education.
2. Kaplan, R.M. and Saccuzzo, D.P. (2007). Psychological Testing: Principles, Applications, and Issues. Australia: Thomson Wadsworth.
3. Gregory, R.J. (2005). Psychological testing: History, principles and applications. New Delhi: Pearson Education.
4. Singh, A.K. (2006). Tests, Measurements and Research Methods in Behavioural Sciences. Patna: Bharati Aiken, L.R., and Groth Marnat, G. (2006). Psychological Testing and Assessment (12th ed.). Boston, MA: Pearson.

PCIG0019: PROCESS AND SKILLS OF INDIVIDUAL AND GROUP COUNSELLING

(4 Credits - 60 hours)

Objectives: *This course will introduce to the students the basic theoretical aspects of the counselling process and different skills of counselling, along with their evaluation. In the first part fundamentals of individual counselling are highlighted. Second part of this paper is introducing the basic concepts of group counselling, stages of group development, skills, techniques and strategies to group process.*

Module I: Fundamentals of Individual counselling (15 hours)

Introduction: Definition, Characteristics, advantages of individual counselling, counselling setup indications and contraindications, value of supervision as part of professional counseling; settings in counseling: educational and community; : Training programs for counselors in Educational and Community settings, Counselling with diverse population; historical background of multicultural counselling

Module II: Eclectic and integrative approaches (15 hours)

Concepts, approaches, historical background, skills and techniques, cognitive analytic theory, brief Counselling approaches - solution focused approach and narrative approach.

Module III: Basics of group counselling (15 hours)

Goals, Functions and Definitions of Group guidance, Ethical guidelines for group counselors; Rights of group participants. Uses and misuses of group techniques, psychological risks in group; Group work in multicultural settings and Integrative eclectic perspectives: professional issues and current trends.

Module IV: Stages of group development (15 hours)

Pre –group issues: Formation of the group: Initial stage: Orientation and exploration; Transition stage: dealing with resistance; Working stage: Cohesion and productivity; Final stage: Consolidation and termination; Post group issues: Follow-up and evaluation

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of individual and group counselling and understand the different settings of the practice of counselling and psychotherapy (Remembering)
- CO2:** Tell the role and value of supervision in professional counselling and its practice (Remembering)
- CO3:** Classify different stages of the practice of individual and group counselling and the use of counselling skills in each of the stages(Understanding)
- CO4:** Explain the ethical guidelines given by ACA in the practice of counseling (Understanding)
- CO5:** Identify counselling techniques as per the current trends and be vigilant about the uses and misuses of group techniques in group counseling (Applying)
- CO6:** Analyze the differences between individual and group therapy and the effectiveness of different theoretical approaches in counseling (Analyzing)
- CO7:** Evaluate the practical applicability of ethical perspectives in individual and group counseling (Evaluating)
- CO8:** Explain the strengths and weaknesses of Individual and group counseling taking into consideration the current trends and practice (Evaluating)
- CO9:** Discuss the processes of counselling to deal with individuals from diverse population applying an integrative and integrative approach(Creating)

Suggested Readings

1. Kiruba, Charles and Jyothsna N.G. (2011). Guidance and Counselling. New Delhi: Neelkamal
2. Gladding, S.T (2009), Counselling : A Comprehensive Profession, 6th Edition Pearson
3. Reynolds Welfel, Elizabeth and Patterson, Lewis E. (2005), The Counselling Process, A Multitheoretical Integrative Approach, 6th Edition, New Delhi: Cengage Learning.
4. Koshy, John S (2009/10). Guidance and Counselling. New Delhi: Dominant Publishers and Distributors.
5. Kottler, Jeffrey A. and Shepard, David S. (2008) Counselling, Theories and Practices. New Delhi: Cengage Learning.
6. McLeod, John (2003), An Introduction to Counselling, 3rd Edition, Berkshire: Open University Press.
7. McLead, John (2007), Counselling Skill, Berkshire: Open University Press
8. Nelson-Jones, Richard (1988), Practical Counselling and Helping Skills, Bombay: Better Yourself Books
9. Nelson-Jones, Richard (2008), Basic Counselling Skills, A Helper's Manual, 2nd Edition Los Angeles: Sage.
10. Westbrook, David; Kennerley, Helen A., Kirk J. (2007), An Introduction to Cognitive Behaviour Therapy, Skills and Applications, Los Angeles: Sage.

PCBP0101: BASIC PSYCHOLOGICAL PROCESSES

(4 Credits - 60 hours)

Objectives: *To introduce and initiate the student into the world of Psychology with a brief historical sketch of the science of psychology and a glimpse into the methods used in the study of human behavior; To understand the fundamental processes underlying human behavior such as biological foundations of behaviour, processes underlying sensation, perception, cognition, memory, learning, motivation, emotion, individual differences, intelligence, personality and states of consciousness.*

Module I: The Science of Psychology (14 hours)

Definition and goals of psychology; modern perspectives and Indian perspective of psychology; fields of psychology; types of psychological research: descriptive research (observation, survey and interviews, standardized tests, case studies); correlational research (positive and negative); experimental research (independent and dependent variables, experimental and control groups, doubleblind experiments).

Module II: Intelligence (14 hours)

Definition; measuring intelligence; criteria of good intelligence tests, types of intelligence tests (Binet tests, Wechsler scales, Group Tests of Intelligence); theories of intelligence - multiple intelligences, Gardners Eight Intelligences, Sternbergs Triarchic intelligence; influences on intelligence - genetic and environmental only; extremes in intelligence - mental retardation, giftedness; emotional intelligence.

Module III: Learning (12 hours)

Definition, types of learning; biological factors in learning, classical conditioning: (Pavlovs studies, acquisition, generalization and discrimination, extinction and spontaneous recovery); applications of classical conditioning; operant conditioning: Thorndikes Law of Effect; Skinners approach to operant conditioning, shaping, principles of reinforcement (positive and negative reinforcement, primary and secondary reinforcement); observational learning, insight learning.

Module IV: Memory (12 hours)

Nature of memory (Encoding, storage and retrieval): Memory encoding - attention, levels of processing, elaboration, imagery; Memory storage sensory memory, short-term memory, chunking

and rehearsal, working memory, long-term memory, explicit memory, implicit memory; Memory retrieval cues and retrieval tasks; Forgetting encoding failure; retrieval failure; memory and study strategies in encoding, storage and retrieval.

Module V: Motivation (8 hours)

Nature; Approaches instinct approaches, drive reduction approaches, arousal approaches, incentive approaches, humanistic approaches, self-determination theory.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define psychology and define the various concepts. (Remembering)
- CO2:** Explain the nature and characteristics of psychological research and perspectives. (Understanding)
- CO3:** Analyse the basic principles and theories of intelligence, learning and memory and motivation. (Analysis)
- CO4:** Distinguish between various psychological researches (Understanding and analysis)
- CO5:** Explain the causes of forgetting and stages of memory (Remembering)
- CO6:** Apply research designs and approaches appropriately. (Application)
- CO7:** Evaluate modern and Indian perspectives of psychology (Evaluation)
- CO8:** Determine the strengths and weaknesses of theories of learning and memory, intelligence and motivation. (Evaluation)
- CO9:** Design research studies for psychological phenomena. (Creating)

Suggested Readings

1. John W Santrock, Psychology Essentials 2, II Edition (Updated) 2006, Tata McGraw Hill Publication.
2. Feldman RS Understanding Psychology, IV Edition, 2006, Tata McGraw Hill Publication.
3. Robert A Baron, Psychology, III Edition, Prentice Hall Publications.
4. Srivasthava, Indian Psychology
5. Anand Paranjpay, Indian Psychology

PCDP0102: DEVELOPMENTAL PSYCHOLOGY

(4 Credits - 60 hours)

Objectives: *This course in Developmental Psychology will enable students to*

- *Understand basic concepts, issues and debates in the field of developmental psychology. Appreciate principal theories of life-span development. Comprehend human development as progressing through different stages. Discuss development from the perspective of different domains such as physical, motor, cognitive, and psychosocial.*

Module I: Introduction to Developmental Psychology (12 hours)

Life span perspective: importance of lifespan development; principles lifespan approach, theoretical approaches to human development; domains of human development - physical, cognitive, psychosocial development; influences on human development - heredity, environment, maturation, family, socioeconomic status and neighbors, culture.

Module II: Biological Beginnings (16 hours)

Birth process - stages of child birth; evolutionary perspective and heredity - genetic code, sex determination, patterns of genetic transmission -dominant and recessive inheritance: genotypes, phenotypes, multifactorial transmission, effects of teratogens on prenatal, perinatal and postnatal development.

Module III: Stages of Life Span (16 hours)

Infancy, childhood, puberty, adolescence, adulthood and old age- characteristics, developmental tasks, adjustment process personal and social hazards across lifespan

Module IV: Cognition and Emotional Development (16 hours)

Cognitive development throughout life span, theories of cognitive development; development of emotional, temperament and attachment and love intimacy, theories of moral development.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept of lifespan perspective. (Remembering)
- CO2:** Illustrate the different theoretical perspectives of human development. (Understanding)
- CO3:** Explain the birth process, stages of childbirth and evolutionary perspective. (Understanding)
- CO3:** Utilize the knowledge of different theoretical perspectives, developmental tasks, adjustment process and hazards across the lifespan (Applying)
- CO4:** Build on emotional, moral and cognitive development theories. (Applying)
- CO4:** Analyze the concept of lifespan perspective and principles (Analysing)
- CO5:** Examine the different theories and domains of human development. (Analysing)
- CO6:** Evaluate the lifespan perspective (Evaluating)
- CO7:** Determine the influences of heredity, environment, maturation, family, socioeconomic status (Evaluating)
- CO8:** Assess the birth process and determine the patterns of genetic transmission (Evaluating)
- CO9:** Adapt to the new principles of human development (Creating)

Suggested Readings

1. Santrock, John W (2007), Life- Span Development, 3rd Edition, New Delhi: Tata McGraw-Hill
2. Hurlock, Elizabeth B. (1981), A Life-Span Approach, 5th Edition, New Delhi: Tata McGraw-Hill Publishing Company Limited
3. Berk, Laura E. (2007), Child Development, 7th Edition, New Delhi: Prentice Hall.
4. Diane E. Papalia, Sally Wendkos Old, Ruth Duskin Feldman, Human Development, 9th edition, Tata McGraw Hill Publication

PCCP0103: COUNSELLING PSYCHOLOGY**(4 Credits - 60 hours)**

Objective: This course introduces a few of the contemporary theories of counselling, the need for counselling, training in counselling skills, motivations, emotions and personality.

Module I: Introduction (13 hours)

Definition of counselling, goals of counselling, scope of counselling, difference between counselling, guidance and psychotherapy; historical background of counselling; current trends.

Module II: Theoretical Approaches to Counselling (20 hours)

Nature of a scientific theory, psychoanalytic, behavioural, cognitive, humanistic and Gestalt therapy.

Module III: Process of Counselling (13 hours)

Client-counsellor relationship establishment, stages of counselling, working in a counselling relationship, types of counselling - individual and group, micro and macro skills of counselling

Module IV: Personal Aspects Of Counselling Skills (14 hours)

Counselling skills: communication skills: nonverbal and verbal communication skills; variables affecting the counselling processes: counsellor variables - age, experience, sex, interest, perceptual sensitivity, personal adjustment, personal security, genuineness, counsellors attitude and beliefs, rapport, empathy; portrait of an effective counsellor; counsellee factors.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define counselling and state the goals of counselling. (Remembering)
- CO2:** Explain the nature and characteristics of scientific theory. (Understanding)
- CO3:** Analyse the basic principles and techniques of Psychoanalytic, behavioural, cognitive, humanistic and gestalt therapy. (Analysis)
- CO4:** Distinguish between micro and macro skills and demonstrate the skills through role plays in classroom settings. (Understanding and analysis)
- CO5:** How different counsellor and counsellee factors affect the effectiveness of the counselling process. (Rembering)
- CO6:** Apply individual and group counselling skills in different stages of counselling in role plays. (Application)
- CO7:** Evaluate the applicability of guidance, counseling and psychotherapy and evaluate the effectiveness of different theoretical approaches in dealing with mental health related issues. (Evaluation)
- CO8:** Determine in the effectiveness of verbal and nonverbal communication skills; micro and macro skills in professional counselling relationships. (Evaluation)
- CO9:** Design counselling sessions setting the goals and determining the techniques to be used in each stage depending on the psychological concerns of the client. (Creating)

Suggested Readings

1. Samuel T. Glading,(6th Edition), Counselling, A Comprehensive Profession. Dorling Kindersley India Limited, Pearson.
2. Robert.LGibson,Marianne H, Mitchell, Introduction to Counselling and Guidance. 7thEdition, Prentice Hall India Private Limited.
3. S Narayana Rao, Counselling and Guidance.Tata McGraw Hill Publication Co. Ltd. New Delhi.
4. E.R. Welfel, LevisE. Patterson. The Counselling Process A multi-theoretical Integrative Approach

PCEX0105: EXPERIMENTAL PSYCHOLOGY

(3 Credits - 45 hours)

Objectives: *This course aims to acquaint students with the basic concepts of experimental psychology provide students a perspective of experimental psychology equip the students with the basic information and knowledge about test-administration and scoring, and interpretation of the obtained results.*

Module I: Introduction (10 hours)

Meaning, nature, scope and value; types of experiment, steps involved in conducting an experiment, meaning and types of variable, forms of behaviour, advantages and limitations of experimental method. Pioneers of experimental method - Wilhelm Wundt, Herman Von Helmholtz, J. McKeen Cattell

Module II: Psychophysics and Psychophysical experiments (13 hours)

Psychophysics: Introduction to psychophysics, threshold and absolute threshold, differential threshold, point of subjective equality, point of error and movement error. Webers law, Fechners

Law Psychophysical Method and Experiments: Method of limits, method of constant stimuli, method of average error.

Module III: Learning Memory (12 hours)

Meaning and types of learning (verbal learning, motor learning and thinking and problem solving), transfer of training, types of measurement of learning and experiments in learning. (serial learning: non-sense syllables, meaningful words; free learning; Bolt Head Maze, Tapping test) Introduction to memory, basic distinctions about memory, short term memory, long term memory, Models of memory - The Atkinson and Shiffrin Model; Tulvings Model: Episodic, Semantic and Procedural; The levels of Processing Approach; The Parallel Distributed Processing Approach Retention: Retention as a function of level of learning, test of retention. Experiments in memory. The effect of mnemonic strategies on memory

Module IV: Thinking and Problem Solving (10 hours)

Thinking: nature, definition and kinds; theories of thinking: Central Theory and Peripheral-central Theory; problem solving: nature of problem, types of problems, understanding the problem, approaches in problem solving, factors influencing problem solving; Reasoning: Formal logic and Limitations; Decision Making: Stages and heuristics; experiments of thinking/ problem solving.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concepts in experimental psychology. (Remembering)
- CO2:** Show the play of variables in experiments. (Remembering)
- CO3:** Explain various sensation and perception processes involved in psychological experiments. (Understanding)
- CO4:** Make use of instruments of experimental psychology. (Applying)
- CO5:** Examine nuances in experimental results due to individual differences. (Analysing)
- CO6:** Perceive perceptual biases in cognitive processes. (Evaluating)
- CO7:** Prove differences in perception due to environmental cues. (Evaluating)
- CO8:** Predict the variables in play in a cause and effect relationship. (Creating)
- CO9:** Plan experiments of sensation, perception and cognition. (Creating)

Suggested Readings

1. Hussain Akbar. (2014): Experiments in Psychology, PHI Learning Private Limited. New Delhi
2. M.Rajamanickam. (1925) Experimental Psychology with Advanced Experiment (Vol.2) Concept Publishing Company
3. Borton Andrews. Experimental Psychology Wiley Eastern Pvt. Ltd., New Delhi.
4. Morgan and King. Introduction to Psychology (4th ed.) McGraw Hill Book Co. New York.
5. DAmato, M.R. (2009). Experimental psychology: Methodology, psychophysics and learning. N.D.: Tata McGraw-Hill.
6. Myers, A. and Hansen, C. (2002). Experimental Psychology. U.S.: Thomson Wadsworth.
7. Postman, L. & Egan, J.P. (1949), reprint 2009. Experimental psychology: An introduction. ND: Kalyani Publication.
8. Solso, R.L., MacLin, M.K. (2008). Experimental psychology: A case approach. N.D.: Dorling Kindersley Pvt. Ltd.
9. Woodworth, R.S. & Schlosberg, H. (reprint 2008, 6th ed.), Experimental Psychology. ND: Oxford & IBH Publishing Co. Pvt. Ltd.

PCBP0106: BASIC PSYCHOLOGICAL THEORIES

(3 Credits - 45 hours)

Objectives: *To familiarize students with the different perspectives prevalent in the discipline of Psychology; To understand the basic theories in Psychology to be able to describe and explain human thought and behaviour in a systematic way.*

Module I: Introduction (10 hours)

Theories and hypotheses, functions of psychological theories; mind-body problem, determinism, free will, empiricism, rationality, introspection and phenomenology; physiological influences in the development of psychology

Module II: Psychodynamic theories (15 hours)

Historical background and fundamental ideas of psychoanalysis, neo Freudians: C. G. Jung, A. Adler, K. Horney, and E. Erikson; therapeutic processes; critics of psychoanalytic theories.

Module III: Behavioural and Cognitive theories (10 hours)

Historical background and fundamental ideas: I. Pavlov, B. F. Skinner, J. B. Watson, A. Beck, A. Ellis; therapeutic processes; critics of behavioural and cognitive theories.

Module IV: Humanistic and Existential theories (10 hours)

Historical background and fundamental ideas: C. Rogers, A. Maslow, V. Frankl, R. May; therapeutic processes; critics of humanistic theories.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of different psychological theories. (Remembering)
- CO2:** Tell the different methodologies adopted in the development of various scientific psychological theories. (Remembering)
- CO3:** Classify different historical backgrounds of the theories in psychology and understand the differences between their techniques (Understanding)
- CO4:** Explain the formulation of a scientific theory, summarize strengths and weaknesses of the empirical techniques in psychology (Understanding)
- CO5:** Identify the classical schools of psychology and its role in the development of psychological as an empirical discipline (Applying)
- CO6:** Analyze the issues involved in the mind-point debate and the psychological stance involved therein. (Analyzing)
- CO7:** Evaluate the steps and techniques involved in the development of a scientific psychological theory and the effectiveness of various psychological theories (Evaluating)
- CO8:** Explain different the different steps involved in the development of a scientific hypothesis. (Evaluating)
- CO9:** Formulate Hypothesis following the steps of a scientific method and demonstrate the use of psychological theories in counseling (Create)

Suggested Readings

1. Hall, G. C., Lindzey, G., & Campbell, J. C. (1998). *Theories of Personality*. NY: Wiley.
2. Leahey, T.H. (2005). *A History of Psychology: Main currents in psychological thought*. Singapore: Pearson Education.
3. Paranjpe, A.C. (1984). *Theoretical Psychology: The Meeting of East and West*. New York: Plenum Press.
4. Viney, W. & King, D.B. (2003). *A History of Psychology: Ideas and Context*. Boston: Allyn & Bacon.

5. Wolman, B.B. (1979). Contemporary Theories and Systems in Psychology. Delhi: Freeman Book Company.
6. Higdon, J. (2011). Psychodynamic Theory for Therapeutic Practice. NY: Palgrave Macmillan.
7. Frankl, V. E. (1985). Man's Search for Meaning: An Introduction to Logotherapy. NY: Simon and Schuster.
8. Todd, J. T., & Morris, E. K. (1995). Modern Perspectives on BF Skinner and Contemporary Behaviorism. London: Greenwood Press.
9. Ellis, A. (2004). Rational Emotive Behavior Therapy: It works for me-it can work for you. NY: Prometheus Books.
10. Maslow, A. H. (1943). A theory of human motivation. Psychological Review, 50(4), 370-396.

PCPG0107: PERSONAL GROWTH

(3 Credits - 45 hours)

Objectives: *To focus on the discovery of self and the authentic search for meaning in ones own life; To familiarize students with aspects related to interpersonal relationships, socio-cultural challenges encountered, human development and effective coping mechanisms; To advance in a multi-faceted approach to personal development combining theory, personal experience, and self-reflection.*

Module I: Understanding the self (10 hours)

Self esteem, self concept, self efficacy, self-reflection, self in a social world; Enhancing individuals potential: Self-determination theory; Self-regulation and self enhancement; Fostering creativity; Facilitating self-awareness through reflective exercises, self-awareness questionnaires/inventories.

Module II: Stress, Health and Coping (18 hours)

Nature and sources of stress; effects of stress on physical and mental health; the mind-body connection; wellness and life choices , coping with stress, depression, anger and anxiety ; managing stress: methods - yoga, meditation, relaxation techniques, problem focused and emotion focused approaches.

Module III: The Challenge of Human Relationships (12 hours)

Effective interpersonal communication, interpersonal conflicts: causes and management; Perceiving others and Interpersonal attraction; self-disclosure in close relationships; loneliness and social support

Module IV: Emotional Competence (5 hours)

Recognizing emotions in oneself; the universality of emotional expression; perceiving emotions accurately in others; managing difficult emotions; applying emotional intelligence

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of self and understand its components in the real world. (Remembering)
- CO2:** Tell the role of self awareness in overall personality development. (Remembering)
- CO3:** Classify different developmental and emotional issues in different stages of life leading to self growth and alleviation of stress(Understanding)
- CO4:** Explain the concept of stress, emotional competence and the basic concepts of self enhancement. (Understanding)
- CO5:** Identify the practical means of improving self regulation and self enhancement in one's daily lives (Applying)

- CO6:** Analyze the various components of the concept of self awareness with the help of different questionnaires and inventories (Analyzing)
- CO7:** Evaluate the theoretical background of different approaches to deal with stress and anger management . (Evaluating)
- CO8:** Explain different strategies in the overall personal growth of an individual with an emphasis on their theoretical backgrounds. (Evaluating)
- CO9:** Discuss the processes of counselling to deal with stress, improving self awareness and dealing with difficult emotions. (Creating)

Suggested Readings

1. Baron, R.A., Byrne, D. & Bhardwaj, G. Social Psychology . New Delhi: Pearson.
2. Carr, A. Positive Psychology: The science of happiness and human strength. UK: Routledge.
3. Neiten, W. & Lloyd, M.A . Psychology applied to Modern life. Thomson Detmar Learning.
4. Schraw, G. Promoting general metacognitive awareness. Instructional Science, 26,113-125.
5. Robbins, S.P. & Hunsaker, P. L. Training in interpersonal skills: Tips for managing people at work. New Delhi: PHI Learning

PCPA0108: PSYCHOLOGY OF PERSONAL ADJUSTMENT

(3 Credits 45 hours)

Objective: *The objective of this course is to provide insights into the area of personal adjustment so as to ease the process of adjustment in various life contexts. It also aims to increase self-knowledge considering the role of personality, environment and social factors.*

Module I: Introduction (10 hours)

The process of adjustment. Adjustment to college work: motivation for study, improving basic study habits.

Module II: Personal factors in adjustment (15 hours)

Understanding oneself: goals, conflicts, conflict management. Personal efficiency: managing time, money and creating an efficient environment. Development of personal strengths: Concentration, learning, thinking, self-confidence, attitude and attitude change.

Module III: Personality development (10 hours)

Personality development across the lifespan: childhood, adolescence, and adulthood. The adjusted personality. Career planning and vocational choice.

Module IV: Social adjustment (10 hours)

Friendships, familial roles, interpersonal attraction, social influence (conformity, compliance, obedience), social groups, intergroup relations, social proficiency, leadership.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** State the concept of adjustment. Recognize one's own self and techniques to develop personal strengths. (Remembering)
- CO2:** Explain the process of adjustment and challenges in adjustment to college work. (Understanding)
- CO3:** Explain personality and different theoretical approaches to personality. (understanding)
- CO4:** Apply techniques to improve their motivation, basic study habits, learning and confidence. (application)
- CO5:** Apply concepts of social influences and leadership in one's own life. (Application)

- CO6:** Analyze theories of attitude and examine factors influencing attitude change. (Analysis)
CO7: Determine ways to overcome to challenges in adjustment to college work. (Evaluating)
CO8: Evaluate the importance of adequate vocational training and career planning. (Evaluating)
CO9: Assess the leadership qualities in oneself and determine ways to inculcate leadership qualities within self. (Analysis and evaluation)

Suggested Readings

1. Wade, C. and Tavris, C. (2007). Psychology. Pearson Education.
2. Sternberg, R.J. (2007). Cognitive Psychology. Australia: Thomson Wadsworth.
3. Isaacson, L.E. and Brown, D. (1993). Career information, career counselling and career development. New York: Allyn & Bacon.
4. Wolman, B.B. (1979). Contemporary Theories and Systems in Psychology. Delhi: Freeman Book Company.
5. Baron, R. A., & Branscombe, N. R. (2016). Social Psychology. Boston, MA: Pearson/Allyn and Bacon
6. Crawford, L. A., & Novak, K. B. (2013). Individual and Society: Sociological Social Psychology. New York: Routledge
7. Frankl, V. E. (1985). Man's Search for Meaning: An Introduction to Logotherapy. NY: Simon and Schuster.
8. Williamson, E. G. (1942). Psychology of personal adjustment. Psychological Bulletin, 39(3), 187- 188.
9. Claes, M. E. (1992). Friendship and personal adjustment during adolescence. Journal of adolescence, 15(1), 39-55.

PCBP0110: BIO- PSYCHOLOGY

(3 Credits - 45 Hours)

Objectives: *To understand the key concepts in biology and their evolutions; To be able to make a connection between the psychological aspects of humans and their behavioral basis; To understand the biological aspects of psychological disorders*

Module I: Introduction (10 hours)

Bio-Psychology: Meaning, evolution and scope, major characteristics and principles, and critical evaluation.

Major theoretical perspectives: Rene Descarte, Phinaes Gage, Charles Darwin. Nature versus Nurture controversy

Module II: Nervous System (14 Hours)

Neuron: Structure and Function, Communication within a neuron, Types of Neurons, Synapse and Synaptic Transmission, Neurotransmitters: types and functions.

The Brain: Basic Features of Nervous System, Central Nervous System, Peripheral Nervous System, Role of Nervous System in Controlling Behaviour, Spinal Cord: Structure and Functions.

Module III: Genetic Bases of Behaviour (12 Hours)

Genes: Structure of a gene, DNA and Chromosomes, Types and Functions of Genes, Genotype and Phenotype.

Mendelian genetics, Chromosomal abnormalities: Down Syndrome, Klinefelter Syndrome, Turner Syndrome.

Module IV: Behavioral Basis of the endocrine system (9 hours)

Endocrine System: Structure and Functions, Major endocrine glands, Hormones: Types and Functions, Influence of hormones on human behavior

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of bio-psychology. (Remembering)
- CO2:** Name different biological systems involved in psychological disorders. (Remembering)
- CO3:** Explain the biological basis of human behavior. (Understanding)
- CO4:** Identify the difference among genetic, neurological and endocrine systems. (Applying)
- CO5:** Classify the sub-systems of the central nervous system. (Analyzing)
- CO6:** Compare different biological systems causing psychological pathology. (Evaluating)
- CO7:** Explain the importance of biological basis of behavior as well as psychological disorders. (Evaluating)
- CO8:** Develop the awareness of the biological basis of behavior. (Creating)
- CO9:** Discuss the major theoretical perspective of bio-psychology. (Creating)

Suggested Readings

1. Bateson, W. (1902). Mendels principles of heredity. Cambridge, UK: Cambridge, University Press.
2. Carlson N.R. (1998) Physiology of Behaviour, 6th edition, Allyn & Bacon: Boston
3. Glimcher, P. W. (2005). Indeterminacy in brain and behavior. Annual Review of Psychology, 56,25-56.
4. Kandel E.R., Schwartz J.H. and Jessell T.M. (2000) Principles of Neural Science, 4th edition, McGraw-Hill Inc.
5. Pinel, J., Biopsychology (2009), Pearson Education Limited.
6. Wickens. A., Introduction to BioPsychology (2009), Pearson Education Limited.

PCPP0111: PEACE PSYCHOLOGY

(3Credits-45 hours)

Objectives: *Understand the psychological connections between violence and peace; To comprehend the meaning and relevance of Peace Psychology and dynamics of violence; Apply current theories in peace psychology to personal, interpersonal, community, national, and international contexts; Discuss peace psychologies contributions to peacemaking and peace building* Module 1: Introduction to Peace Psychology

Module I: Introduction to Peace Psychology (10 Hours)

Peace - Meaning and definition, Paradigms of peace (Negative Peace, Positive Peace and Sustainable Peace), Peace Psychology and its notions.

Module II: Understanding Violence and its Psychological effects (13 Hours)

Understanding Violence: Typologies of Violence: Direct Violence, Indirect Violence, Structural Violence, Cultural Violence and Psychological Violence and other dimension of Violence, Mental health consequences of Violence: PTSD, Depression, Suicide etc.

Module III: Psychological Violence and its dynamics (11 Hours)

The Psychology behind Violence: Gender Discrimination, Harassment and its types, Rape, Abuse and its types, Psychological violence in Children, Elder abuse, Racial Abuse, Domestic Violence etc.

Module IV: Peace Building and Prevention of violence (11 Hours)

Conflict Resolution, Peace Building, Intrapersonal Peace Resolution, Interpersonal Peace Resolution, Cross- Cultural Peace Building etc.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the key concepts of peace, violence and conflict resolution. (Remembering)

- CO2:** Recall various paradigms and typologies involved. (Remembering)
- CO3:** Interpret significant patterns of cross cultural methods of conflict resolution. (Understanding)
- CO4:** Apply various intra-personal conflict resolution techniques (Applying)
- CO5:** Examine barriers to attain sustainable peace. (Analysing)
- CO6:** Determine the factors behind modern violence and slavery. (Evaluating)
- CO7:** Interpret gaps in current society towards attainment of justice and empowerment. (Evaluating)
- CO8:** Compose new ideas to integrate cross cultural approaches to peace. (Creating)
- CO9:** Create awareness among people of the nature of violence and its resolution. (Creating)

Suggested Readings

1. Christie, D. J., Wagner, R. V., & Winter, D. (2001). Introduction to peace psychology.
2. Sanson, A., & Bretherton, D. (2001). Conflict resolution: Theoretical and practical concerns.
3. Wessells, M. Schwebel, M., & Anderson, A. (2001). Psychologists making a difference in the public arena: Building cultures of peace.
4. Steger, M. B. (2001). Peacebuilding and nonviolence: Gandhi's perspective on power.

PCBA0112: BASIC ABNORMAL PSYCHOLOGY

(4 Credits - 60 hours)

Objectives: To have knowledge of different aspects of abnormal behavior; To know the historical development of the study of abnormal behaviour, criteria and perspectives in abnormal behaviour, common classification systems, and range of disorders including anxiety disorders, mood disorders, schizophrenia, disorders generally observed at childhood and adolescence, and personality disorders; Understand various behavioural dysfunctions and use the same in day-to-day life.

Module I: Introduction to Abnormal Psychology (10 hours)

Definition of abnormal behaviour, historical and contemporary views of abnormal behaviour; history of psychiatry in India; myths and misconceptions of abnormal behaviour; classification of abnormal behaviour,

Module II: Understanding causes of Abnormal Behaviour (15 hours)

Necessary, sufficient, contributory causes and diathesis- stress model, psychodynamic, behavioural, cognitive- behavioural, humanistic theory, socio- cultural factors.

Module III: Psychological Disorders (25 hours)

Anxiety disorders, somatoform disorders, dissociative disorder, mood disorder, schizophrenia, personality disorder, disorders of childhood

Module IV: Psychological Treatment (10 hours)

Psychodynamic treatment, behavioural therapies, cognitive treatment, client-centred therapy, experiential therapies, family therapy

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define abnormal psychology. (Remembering)
- CO2:** Relate to the historical and contemporary views of abnormal behavior. (Remembering)
- CO3:** Explain different theoretical perspective of abnormal behaviour. (Understanding)
- CO4:** Identify some of the abnormal behaviours and its symptoms. (Applying)
- CO5:** Classify the neurotic and psychotic disorders. (Analyzing)

- CO6:** Distinguish different psychological disorders on the basis of its symptoms. (Evaluating)
- CO7:** Explain different theoretical perspective of abnormal psychology. (Evaluating)
- CO8:** Develop awareness about the myths and misconceptions of abnormal behavior. (Creating)
- CO9:** Discuss different types of therapeutic techniques applied in various clinical settings. (Creating)

Suggested Readings

1. American Psychiatric Association (2013). Diagnostic and Statistical Manual of Mental Disorders, DSM -5th, Fifth Edition.
2. Ahuja N. (2011). A Short Textbook of Psychiatry (7th Ed). New Delhi: Jaypee
3. Barlow D.H. and Durand V.M. (2005). Abnormal Psychology: An Integrated Approach (4th Ed.).Wadsworth: New York.
4. Carson R.C., Butcher J.N., Mineka, S., & Hooley J.M. (2007). Abnormal Psychology (13th Ed.).ND: Pearson Education.
5. Davison, G. C., Neal, J. M.,& Kring. A. M. (2004) Abnormal Psychology. (9th Ed) New York; Wiley.
6. Lauren B Alloy, John.H.Riskind, Margaret J Manah, Abnormal Psychology Current perspective- 9th edition.
7. Kring,A.M.,Johnson,S.L., Davison G.C. & Neale J.M. (2010). Abnormal Psychology (11th Ed.).NY: John Wiley.

PCCA0113: CHILD AND ADOLESCENT DEVELOPMENTAL PSYCHOLOGY

(3 Credits- 45 Hours)

Objectives: *To equip the learner with an understanding of the concept and process of child and adolescent growth and development across the lifespan. To gives an overview about physical, cognitive and language development, personality and social development. Various theories of child and adolescent development are discussed with a view to enable the students to understand child and adolescent clients in the context of their developmental milestones.*

Module I: Introduction (10 hours)

Definition of human development, principles of development, periods of development, developmental task; purpose, hazards of developmental task. Different theories of development, influences of factors on human development, nature vs. nurture issue.

Module II: Physical development (12 hours)

Physical growth during childhood, Milestones: Gross motor development in early and middle childhood. Puberty: Physical transition to adulthood, growth spurt, puberty and adolescents health, Bio-psycho-social health model.

Module III: Cognitive and language development (13 hours)

Cognitive development across childhood and adolescence, information-processing perspective, Piagets and Vygotskys theories of cognitive development, language development across childhood and adolescence, theories of language development.

Module IV: Personality and Social development (10 hours)

Psychosexual and psychosocial theories of personality development; Emotional development: Functions of emotion, development of emotional expressions, temperament, development of attachment, understanding of self. Moral development: theories of moral development

Suggested Readings

1. Berk E. Laura,(7th ed). Child Development. Prentice-Hall of India Private Limited

2. P. E. Diane, O. W. Sally & F. D. Ruth. Human Development. Tata Mc Graw Hill.
3. Hurlock, B. E. Developmental Psychology, Tata McGraw Hill.
4. Hurlock, B. E. Child Development. Tata McGraw Hill.

PCCM0114: COMMUNITY PSYCHOLOGY

(3 Credits-45 Hours)

Objectives: *To learn the link between individuals and communities; Deal with social issues more effectively with peoples participation; Understand the importance of community mental health and to deal with the different issues prevailing in the communities.*

Module I: Introduction (12 hours)

Definition of community psychology; social and historical contexts of community psychology; principles of community psychology; the ecological model in psychology; types of communities; models

Module II: Core values (10 hours)

Individual and family wellness; sense of community; respect for human diversity; social justice; empowerment and citizen participation; collaboration and community strengths.

Module III: Community mental health (10 hours)

Evolution and nature of community mental health; process of community organization for health promotion, importance. Community program for: child and maternal health, Mental Health as a complex Community Function

Module IV: Interventions (13 hours)

Community development and empowerment; Mental Health Education; Necessary conditions, techniques and status of crisis intervention. Community Intervention in India-Present Status and Future Scope; case studies in Indian context.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the key concepts of the course. (Remembering)
- CO2:** Recall typologies and models in community work. (Remembering)
- CO3:** Interpret mental health phenomena at the community level. (Understanding)
- CO4:** Apply preventive interventions techniques in class demonstrations. (Applying)
- CO5:** Examine barriers to the decentralized operation of mental health services. (Analysing)
- CO6:** Determine the factors involved in compromised progress in PHCs . (Evaluating)
- CO7:** Prioritize areas of concern in communities. (Evaluating)
- CO8:** Compose new ideas to integrate community resources in rehabilitation. (Creating)
- CO9:** Test the efficacy of current functioning of Community Mental Health Services at District Level. (Creating)

Suggested Readings

1. Shanmugham, T.E. (1987) Community Psychology. Madras: Utsav Shanmugham.
2. Korchin, S.J., (2004) Modern Clinical Psychology: Principles of Intervention in the Clinic and Community. New Delhi: CBS Publishers
3. Rappaport, J & Seidman, E (2000) Handbook of Community Psychology. New York: Plenum Publishers
4. Kloos B. Hill, J Thomas, Wandersman A, Elias M.J. & Dalton J.H. (2012). Community Psychology: Linking Individuals and Communities, Wadsworth Cengage Learning.
5. McKenzie, J. F. Pinger, R. R. & Kotecki, J. E. (2005). An introduction to community health. United States: Jones and Bartlett Publishers.

PCSP0115: SOCIAL PSYCHOLOGY

(4 Credits- 60 Hours)

Objectives:

- *Understand the historical and scientific origin and development of the field in the western and Indian context.*
- *Describe the development of the self and the dynamics of interpersonal attraction, prosocial behaviour, aggression, prejudice, group processes and attitude formation and change in a social context.*
- *Comprehend the nature of scientific methods employed to study behaviour in the social context.*

Module I: Introduction (10 hours)

Nature and scope of social psychology; Overview of the history of social psychology (including development in India), Theories of social psychology

Module II: Understanding self and others (20 Hours)

Self: Learning about the self; Person Perception: Forming impressions of others, Social Cognitions, Attribution theories and biases, Attitude, Attitude-Behaviour link

Module III: Social relations and influences (20 Hours)

Interpersonal attraction and affiliation; Personal relations: Self disclosure, commitment, responses to dissatisfaction, conflict, Pro-social behaviour: Helping influences; Social influences: Conformity, compliance and obedience, Aggression

Module IV: Group Dynamics and Inter-group relations (10 Hours)

Nature of groups, Consequences of belonging (performance, decision making, cooperation and competition), Nature of intergroup relations (prejudice, intergroup conflict, intervention techniques)

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- C01:** Define the basic terms related social psychology like Impression formations, social cognitions, social influence and aggression. (Remembering)
- C02:** Choose different theoretical approaches to explain human behaviour. (Remembering)
- C03:** Understand the evolution of the study of human behaviour in the context of society. (Understanding)
- C04:** Analysing the factors that influences social behaviour, impression formation and formation of the attitudes. (Analyse)
- C05:** Examine the determinants of interpersonal attraction and affiliation, Pro social behaviour and aggression. (Analyse)
- C06 :** Make use of theoretical understanding of these social factors in analysing human behaviour in the real life contexts. (Application)
- C07:** Evaluate the attribution theories and biases and understand attitude-behaviour link. (Evaluation)
- C08:** Evaluate the effectiveness of different approaches to social psychology in predicting human behaviour in their social contexts. (Evaluation)
- C09:** Develop explanations for human behaviour in more accurate ways and thereby maintaining healthy interpersonal relationships. (Creating)

Suggested Readings

1. Crisp, R.J. and Turner, R.N. (2007), Essential Social Psychology. New Delhi: Sage Publications India Pvt Ltd.
2. Misra, G. and Dalal, A.K. (2001). Social Psychology in India: Evolution and Emerging trends. Edited by Ajit.K. Dalal and Girishwar Misra. New Directions in Indian Psychology, Volume I: Social Psychology. New Delhi: Sage Publications India Pvt. Ltd.
3. Myers, D.G (2002) Social Psychology, 7th international edition. New York: McGraw Hill Companies.
4. Taylor, S. E, Peplau, L.A and Sears, D.O. (2006) Social Psychology, 12th edition. New Delhi: Pearson Prentice-Hall of India Pvt Ltd.

PCHP0116: HEALTH PSYCHOLOGY**(3 Credits-45 Hours)****Objective**

This course aims to acquaint the students with a broad overview of the nature and significance of the emerging area of health psychology. The course includes concepts, theory and research to highlight the importance of psycho-social processes and behavioral risk factors in terms of health promotion and disease prevention.

Module I: Introduction to Health Psychology (7 Hours)

Definition, nature and scope of health psychology, emergence of health psychology, goals of health psychology, traditional Indian healing system and health care networks in India.

Module II: Biological Basis of Health and Illness (13 Hours)

The nervous system, endocrine system, cardiovascular system, digestive system, respiratory system, reproductive system, genetic process, immune system, and related disorders.

Module III: Theories of Health Behavior (15 Hours)

Motivational models, behavioral enhancement models, efficacy theories, Socio-cultural factors in health behavior.

Module IV: Health Promotion and Illness Prevention (10 Hours)

Definition of stress, psycho-physiological consequences of stress, chronic diseases, health promotion, health compromising behavior.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic terms related to the field of health psychology. (Remembering)
- CO2:** Choose suitable health promotion methods (Remembering)
- CO3:** Learn the nature of stress response and the subsequent etiology and cause of health related problems. (Understanding)
- CO4:** Make use of psychological research methods, theories, and principles to enhance bio-medical approaches for health promotion and illness prevention. (Applying)
- CO5:** Examine the stress response and its impact on the etiology and course of many health related problems. (Analyzing)
- CO6:** Recommend the health promotion methods. (Evaluating)
- CO7:** Estimate the approximate health hazards related to health compromising behaviors. (Evaluating)
- CO8:** Test an individual's different health promoting and health compromising lifestyle habits. (Creating)
- CO9:** Develop awareness about the stressful impact of disabling/life-threatening illness on the patient and their family members. (Creating)

Suggested Readings

1. Taylor, S. E. (2012). *Health Psychology* (8th Edition). New York: McGraw Hill.
2. Ghosh, M. (2015). *Health Psychology-Concepts in Health and Well-being*. New Delhi: Dorling Kindersley (India) Pvt. Ltd.
3. Khatoon, N. (2012). *Health Psychology*. New Delhi: Dorling Kindersley (India) Pvt. Ltd.
4. Taylor, S. E., & Sirois, F. M. (2012). *Health psychology*. Toronto: McGraw-Hill Ryerson.
5. Baum, A., Revenson, T. A., & Singer, J. E. (Eds.). (2001). *Handbook of health psychology*. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

PCEP0117: ENVIRONMENTAL PSYCHOLOGY

(3 Credits – 45 hours)

Objectives: *The objective of the course is to create understanding between the bio-psycho-social interconnectedness of sustainable existence. The course also aims to develop pro environmental attitudes and behaviors for optimal psychological benefits .*

Module I: Introduction (12)

Definition purpose and history of environmental psychology; Theories of environmental Psychology; Research studies in environmental psychology

Module II: Interacting Factors (10)

Human factors: Cognition, Attitude, Judgement, Personality and Spatial Behavior.

Environmental factors: Natural Environment (Climate and landscape, destructive and restorative properties), Built environment (Design/Architecture as server of consumer needs, technology and environment)

Module III: Adversities (10)

Social and collective dilemmas; Stressors; Environmental Disasters and their psychological consequences

Module IV: Applied perspective (13)

Pro-environmental behavior; Utilisation of resources; Sustainable development; Principles of problem focused counseling and psychotherapy.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the key concepts of Environmental Psychology. (Remembering)
- CO2:** Recall theoretical perspectives, various factors on interaction, adversities and application for sustenance. (Remembering)
- CO3:** Explain population specific perspectives of nurture of nature.(Understanding)
- CO4:** Apply knowledge about adversities to minimize their maladaptive consequences. (Applying)
- CO5:** List current areas in need of pro-environmental behavior. (Analyzing)
- CO6:** Assess psychological impact of pro-environmental movements . (Evaluating)
- CO7:** Examine existing barriers to adaptability due to normalized anti-environment acts. (Evaluating)
- CO8:** Operate awareness amongst public about restorative nature of environment. (Creating)
- CO9:** Plan alternatives to existing work and residential designs for enhancement of quality of life. (Creating)

Suggested Readings

1. Gifford , R. (2007a). *Environmental psychology: Principles and practice* (4th ed.). Colville, WA : Optimal Books .
2. Berleant , A. , & Carlson , A. (Eds.). (2004) *The aesthetics of natural environments* . Peterborough, Ontario : Broadview Press .
3. Bechtel , R. B. , & Churchman , A. (Eds.). (2002). *Handbook of environmental psychology* . New York : Wiley .
4. Gardner , G. T. , & Stern , P. C. (2002). *Environmental problems and human behavior* (2nd edition). Boston, MA : Pearson Custom Publishing .
5. Hall , E. T. (1976) *Beyond culture* . Garden City, NY : Doubleday & Company .
6. Norman , K. L. (2008) *Cyberpsychology: An introduction to human - computer interaction* . New York : Cambridge University Press .

PCPT0118: PSYCHOLOGICAL TESTING**(4 Credits-60 Hours)****Objectives:**

- *To develop an understanding of the basic concepts of the psychological testing.*
- *To develop the elementary knowledge and competency in the basic principles of psychological assessment.*

Module I: Introduction (14 Hours)

Definition, Historical Perspective, Basic Principles, Types of Psychological Tests: intelligence, Aptitude, Achievement, Personality, Neuropsychological tests, Interest Inventories, Behavioural Procedures, Application, Ethical and Social concerns of Psychological Testing.

Module II: Test Construction (15 Hours)

Steps in test construction, Different techniques of psychological assessment, Classification of psychological tests: Group vs. Individual Tests, Speed vs. Power tests, Subjective vs. Objective tests, Characteristics of a good psychological test.

Module III: Reliability (10 Hours)

Definition, Types, Factors affecting reliability of a test, Reliability Coefficient, Standard error of measurement.

Module IV: Validity (8 Hours)

Definition, Types, Factors influencing validity, Relationship between reliability and validity.

Module V: Norms and Test Scales (13 Hours)

Definition, Types, difference between criterion-referenced and norm-referenced tests, Steps in developing test norms, different types of norms, Test scales: Nominal, Ordinal, Interval, Ratio, Importance of measurement scales.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic concepts of psychological testing. (Remembering)
- CO2:** Name the characteristics of a good psychological test. (Remembering)
- CO3:** Classify different psychological tests. (Understanding)
- CO4:** Compare different types of psychological tests. (Understanding)
- CO5:** Develop an understanding of the ethical and social issues of psychological testing. (Applying)
- CO6:** Categorize different types of psychological tests. (Analyze)

CO7: Explain the concepts of reliability and validity of a test. (Evaluating)

CO8: Evaluate different types of test scales. (Evaluating)

CO9: Discuss the steps of test construction. (Creating)

Suggested Readings

1. Singh, A. K. (1986). Tests, measurements and research methods in behavioural sciences. Tata McGraw-Hill.
2. Gregory, R. J. (2004). Psychological testing: History, principles, and applications. Allyn & Bacon.
3. Anastasi, A., & Urbina, S. (1997). Psychological testing. Prentice Hall/Pearson Education.
4. Urbina, S. (2014). Essentials of psychological testing. John Wiley & Sons.
5. Miller, L. A., & Lovler, R. L. (2019). Foundations of psychological testing: A practical approach. Sage publications.
6. Kline, T. (2005). Psychological testing: A practical approach to design and evaluation. Sage Publication.

PCPY0119: POSITIVE PSYCHOLOGY

(3 Credits – 45 Hours)

Objectives:

- *To help students to understand the rationale behind positive psychology.*
- *To make them understand the importance of the realisation and application of positive emotions and its role in the enhancement of well being*
- *To make students understand and apply strength - based approach to mental health issues*

Module I: Introduction (10 hours)

Introduction to Positive Psychology ,Goals and assumptions, Historical background, Perspectives on Positive Psychology: Western and Eastern, Character Strengths and virtues.

Module II: Positive emotions, Well-being and Happiness (15 hours)

Positive emotions, positive subjective experience, Components of flow, Conditions and mechanisms of flow, Positive and negative consequences of flow experience, Meaning and nature of happiness, Psychology of well-being

Module III: Positive Cognitive States and Processes (10 hours)

Resilience: meaning and types; Sources of resilience in children; Sources of resilience in adulthood and later life; Optimism

Module IV: Applications of Positive Psychology (10 hours)

Increasing optimism, Discovering strength, Mindfulness, Positive coping strategies; Positive psychology in building relationship

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

CO1: Define positive psychology and its basic concepts. (Remembering)

CO2: Realize the existence of positive emotions in day to day life (Remembering)

CO3: Grasp basic cognitive states and processes in positive psychology (Understanding)

CO4: Identify individual strengths and sources of resilience. (Applying)

CO5: Classify the sources of resilience in different life stages (Analyzing)

CO6: Distinguish different mechanisms in flow and happiness (Evaluating)

CO7: Explain different psychological assessment to measure strengths in individuals. (Evaluation)

- CO8:** Develop an awareness of applications and implications of positive psychology concepts and theories. (Creating)
- CO9:** Equip himself/herself with the skill and competence to apply positive psychology principles in a range of environments to increase individual and collective wellbeing (Creating)

Suggested Readings

1. Baumgardner, S.R. Crothers M.K. (2010). Positive psychology. Upper Saddle River, N.J.: Prentice Hall.
2. Carr, A. (2004). Positive Psychology: The science of happiness and human strength.UK: Routledge.
3. Peterson, C. (2006). A Primer in Positive Psychology. New York: Oxford University Press.
4. Seligman, M.E.P. (2002). Authentic Happiness: Using the New Positive Psychology to Realize Your Potential for Lasting Fulfillment. New York: Free Press/Simon and Schuster.
5. Snyder, C.R., & Lopez, S.J.(2007). Positive psychology: The scientific and practical explorations of human strengths. Thousand Oaks, CA: Sage.
6. Snyder, C. R., & Lopez, S. (Eds.). (2002). Handbook of positive psychology. New York: Oxford University Press.

PCOB0120: ORGANISATIONAL BEHAVIOUR

(3 Credits – 45 hours)

Objectives: The objective of the course is to equip students with an understanding of organizational behavior, components and endurance of humans as resources and skill requirement and training.

Module I: Foundation (15 hours)

History of organizational psychology; Principles; Theoretical frameworks: cognitive framework, behavioral framework and social learning; Challenges and opportunities of organizational behavior.

Module II: Individual and Social Aspects (15 hours)

Individual: Cognition, Attitude, Personality and Life Skills.

Social factors: Culture and its dimensions; integration of individuals into organizations; Challenges of cultural change.

Module III: The psychology of Management (15 hours)

Environmental analysis in organization; Principles and techniques of selection; Training and development; Organizational change.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the key concepts of Organisational Psychology. (Remembering)
- CO2:** Recall theoretical perspectives, diversities, adversities and techniques of management. (Remembering)
- CO3:** Explain various organizational contexts in the globalised world.(Understanding)
- CO4:** Apply knowledge of selection and training in consulting sectors. (Applying)
- CO5:** List current areas in need of up gradation. (Analyzing)
- CO6:** Assess psychological impact on organization and vice-versa . (Evaluating)
- CO7:** Examine modern day challenges to success in organization. (Evaluating)
- CO8:** Plan novel strategies for organizational change. (Creating)
- CO9:** Plan alternatives to a homogenous human resource. (Creating)

Suggested Readings

1. Levy Paul. (2009). Industrial/Organizational Psychology: Understanding the Workplace. Worth Publishers,
2. Furnham Adrian.(1997). The Psychology of Behaviour at Work: The Individual in the Organization. Psychology Press.
3. Rothman Ian, Cooper L. C. (2015)Work and Organizational Psychology. Routledge
4. Wayne F.C., Herman A. (2013). Applied Psychology in Human Resource Management: Pearson New International Edition. Pearson Education Limited.

PCAA0121: ADVANCED ABNORMAL PSYCHOLOGY

(3 Credits-45 Hours)

Module I: Understanding abnormality (7 hours)

Understanding mental health and mental illness; Definition and criteria of abnormality; Classification system in mental illnesses: DSM 5 and ICD 10, Clinical assessment

Module II: Developmental Disorders (12 hours)

Intellectual Disability, Autism Spectrum Disorders, ADHD, Learning Disabilities: Subtypes, Clinical features and Psychological Management

Module III: Major Psychological Disorders (18 hours)

- a) Schizophrenia Spectrum and other psychotic disorders: Subtypes, clinical features, etiology, psychological management.
- b) Mood Disorders: Subtypes, clinical features, etiology, psychological management.
- c) Obsessive Compulsive and Related Disorders: Subtypes, clinical features, etiology, psychological management.

Module IV: Substance related Disorders and Eating Disorders (8 hours)

- a) Substance related Disorders: Subtypes, clinical features, etiology, psychological management.
- b) Eating Disorders: Subtypes, clinical features, etiology, psychological management.

COURSE/ LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define mental health and mental illness. (Remembering)
- CO2:** Relate to classification in Psychiatry (DSM 5 and ICD 10). (Remembering)
- CO3:** Explain different clinical assessment of abnormal behaviour. (Understanding)
- CO4:** Identify clinical features of Schizophrenia, Mood disorder, OCD and Developmental Disorders. (Applying)
- CO5:** Classify the neurotic and psychotic disorders. (Analyzing)
- CO6:** Distinguish different psychological disorders on the basis of its symptoms. (Evaluating)
- CO7:** Explain and evaluate psychological interventions for different mental disorders. (Evaluation)
- CO8:** Develop awareness about the myths and misconceptions of abnormal behavior. (Creating)
- CO9:** Create case study and diagnose patients based on the clinical features and develop Psychological interventions. (Creating)

PCIG6001: INDIVIDUAL AND GROUP COUNSELLING PRACTICUM**(2 Credits)**

Objectives: *This practicum course is meant to be a first practical experience for the students of Psychological Counselling in the area of individual and group counselling skills.*

Students are expected to explore the following skills:

Individual Counselling Skills

- Social perception
- Observation
- Intake assessment skills
- Documentation of case history
- Mental status examination
- Establishing Counselling goals

Group Counselling Skills

- Group effectiveness: verbal, non-verbal cum non-verbal
- Communication: Verbal and Non-verbal
- Leadership
- Decision making process
- Group Problem solving
- Conflict management

PCPG6002: PERSONAL GROWTH I**(P/NP)****PCPG6005: PERSONAL GROWTH II****(P/NP)**

Objectives: *Counselling uses the personality of the counsellor as the main instrument. It is a basic need in a training program for the students to learn to understand their own perceptions, emotions, motivations. Therefore this session is a guided form to bring the students close to their own strengths and weaknesses. They learn to be aware about their own perceptions and feelings, understand basics of transference and counter transference as part of their own social life, and experience how to deal with it in personal and professional life. This part of the training is based on personal experience and exploration of students. During the sessions of personal growth workshops which spread across two semesters the future counsellor explores the following areas of his/her person:*

Self-Awareness

- Johari Window
- SCOT Analysis
- Transactional Analysis

Emotional Development

- E.Q. Assessment
- Self Management
- Positive Emotion

Suggested Reading

Goud Nelson H. (2009). Psychology and Personal Growth. 8th Edition. Boston: Pearson.

PCCY6003: CHILD AND YOUTH COUNSELLING PRACTICUM

(2 Credits)

In this course which is meant to be the second practical experience, students will develop their skills in the areas of individual and group counselling skills further:

Individual Counselling Skills

- Perception during the counselling process
- Interviewing skills
- Documentation of case history, process documentation
- Establishing Counselling goals and follow up
- Problem solving
- Skills of listening

Group Counselling Skills

- Understanding Group processes
- Roles inside a group
- Psycho-dynamic background of a group situation
- Systemic approach
- Using group skills like psychodrama, systemic approach
- Conflict management

PCFW6004: FIELD WORK

(2 Credits)

Field work is an essential part of the preparation to become a counsellor. It is designed to give opportunity to integrate academic knowledge into real life situations. The field work practice in the second semester shall focus upon the area of concentration chosen by the students. The students will be placed in the field for a minimum of eight days. The fieldwork setting shall be NGO's, hospitals, clinics, schools. During the placement the students are expected to implement the follow activities and adhere to the guideline specified below:

1. The students are expected to apply all the skills and techniques of counselling whenever applicable depending upon the organization and their services
2. The students should be involved in the activities of the institution and fulfill the responsibilities as requested by the agency supervisor.
3. Students shall prepare a daily report of the fieldwork activities and submit it to the concerned faculty supervisor. The faculty supervisor shall provide the necessary feedback and guidance to the students.
4. At the end of the semester the students shall submit a summary report of the cases taken and activities done during their placement. The students shall also appear for the viva voce examination at the end of the semester.

PCMC6006: MARRIAGE AND FAMILY COUNSELLING PRACTICUM**(2 Credits)**

The practicum for this course will deal with counselling in the areas of

1. Family environment
2. Anxiety, stress and depression in the family
3. Emotional adjustment and its management in the family

PCCS6007: CASE STUDY AND DOCUMENTATION**(4 Credits)**

Objectives: *Students should be able now to make good documentation about individual and group counselling. Hence this course in case study and documentation.*

One detailed case study to be conducted and documented. Documentation will consist of the following: beginning, first evaluation, definition of counselling goal, reason for counselling, protocols of counselling sessions, conclusion and further suggestions. Findings from the case study are to be presented to the staff and students of the department. The presentation will be followed by a viva voce examination. Details of the components of evaluation and weightages attached to them are to be determined by the department and informed to the students at the beginning of the semester.

PCRP6008: RESEARCH PROJECT PHASE I**(2 Credits)****PCRP6011: RESEARCH PROJECT PHASE II****(8 Credits)**

Every student shall undertake a research project work under the supervision and guidance of a faculty member. The student may choose the topic of research and start the preliminary work by the end of the second semester. The students are expected to complete the Literature Review followed by a Literature Review presentation and the Proposal presentation during the Phase I. Students are expected to complete the data collection before the fourth semester. Phase II of the research project should ideally be undertaken in the organisation where the student is placed for internship. The thesis is to be submitted to the department before the date notified. The mode and components of evaluation of Phase I and Phase II of the research project and the weightages attached to them shall be published by the Department at the beginning of the semester. There shall be a viva voce examination on the research project.

PCSI6009: SUMMER INTERNSHIP (P/NP)

Students are required to undergo a summer internship of two weeks' during the semester break between the second and third semesters. It is a P/NP course and shall be recorded in the third semester. The Summer Internship gives students an opportunity to apply the theories and principles that they have learnt in class room courses to the "real world" of social service agencies, medical institutions, the criminal justice system, business, and industry. During the internship, students can explore career interests, develop professional skills, learn how community organizations work and expand their clinical and interpersonal skills. The summer internship enriches the students' academic experience while making a valuable contribution to the community and utilizing the vacation optimally.

PCSI6010: SUPERVISED INTERNSHIP

(8 Credits)

Objectives: *On basis of the theory, skills and practical experience acquired by the students so far, they will now be able to start counselling work at an individual, family and group level. It is expected that this be done in the form of an Internship in an organisation which offers counselling help to clients. Supervision has to be provided for by the university in collaboration with the organisation where the student performs the internship. The process has to be documented, reflected and the insights of supervisor have to be recorded. Students should feel competent to do their own counselling using supervision as part of the counselling setting.*

1. Introduction

Analysing the situation: need of counselling, space for counselling, information to clients, documentation, organizing supervision.

2. Internship

Taking in clients: first interview, documentation of the case, definition of counselling goals, building the counselling relationship, process of counselling, using skills of counselling, concluding counselling, documentation of the whole counselling process, evaluation; working in a team – role of counselling, resources and challenges, role in the team, case management: discussion, supervision. Evaluation of the internship will be based on the documentation, reports from the organisation, report of the supervisor and the presentation and the viva voce examination of the student at the end of the period of Internship.

Every student is required to undertake a research project work and present a written thesis on the research work under the supervision and guidance of a faculty member. The research project should ideally be undertaken in the organisation where the student is placed for internship.

The thesis is to be submitted to the department before the date notified. The mode and components of evaluation and the weightages attached to them shall be published by the Department/Institute at the beginning of the semester. There shall be a viva voce examination on the research project.

PCST6012: STUDY TOUR

P/NP

During the programme the students shall undertake a study tour, along with the faculty members, to a place approved by the department. The places are to be so chosen as to be of educational benefit to students. During the tour, the focus shall be to visit and interact with NGOs, hospitals, state/national/ international organisations involved in psychological counselling. A report of the learning outcomes shall be submitted to the department at the end of the tour. The Study Tour shall be a Pass/No Pass course.

PCPP6102: PSYCHOLOGY PRACTICUM I

(4 Credits – 60 hours)

Objective: The objective of the course is to acquaint the students with the various types of Psychological Tests and Clinical Rating Scales related to Intelligence, Personality, Memory and Learning and Projective Techniques. The course also is intended to provide the theoretical background necessary to understand the basic concepts behind these assessments and imparts training in classic as well as contemporary tests in the field of Psychology.

Module I: Introduction to Clinical Rating Scales (15 hours)

Introduction to Clinical Rating Scales; Purpose of various rating scales; Beck Depression Inventory (BDI): basic concepts, administration, scoring, results and interpretation; Indian Scale for Assessment of Autism (ISAA): basic concepts, administration, scoring, results and interpretation.

Module II: Projective Tests: Thematic Apperception Tests (12 hours)

Introduction to Projective tests; importance and purpose; various types of projective tests; Thematic Apperception Test (TAT): Introduction, basic concepts, themes, administration, scoring, results and interpretation.

Module III: Assessment of Cognitive Functioning (20 hours)

Definition of Intelligence and IQ measures, Types of Intelligence tests used; Definition and types of Learning and Memory; Vineland Social Maturity Scale (VSMS): basic concepts, administration, scoring and interpretation; Binet-Kamat Test of Intelligence (BKT): basic concepts, administration, scoring, results and interpretation; Mazes experiment: basic concepts, administration, scoring, results and interpretation.

Module IV: Introduction to Personality Tests (13 hours)

Definition of Personality; Measurement of Personality; Various types of Personality tests (MMPI, NEO-FFI); Eysenck Personality Questionnaire: basic concepts, administration, scoring, results and interpretation.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic terms related to cognitive functioning, personality, projective techniques and clinical rating scales.
- CO2:** Choose a suitable method of psychological test to administer on a subject. (Remembering)
- CO3:** Classify the various types of psychological tests on the basis of their use. (Understanding)
- CO4:** Make interpretations and draw conclusions based on the norms given in the manual (Applying)
- CO5:** Examine the details of the rating scale/ test, the aim, applications, procedure of administration and subject results. (Analysing)
- CO6:** Recommend the use of a suitable psychological assessment for a particular disorder. (Evaluating)
- CO7:** Estimate the purpose and importance of each of these tests. (Evaluating)
- CO8:** Test the administrator's decision making process to select a particular test for assessment of a given psychological disorder. (Creating)
- CO9:** Develop techniques for carrying out group based small quantitative research projects (Creating)

Suggested Readings

1. Baron, R.A. Psychology. (1995). 3rd edition. Delhi: Prentice Hall.
2. Morgan, C.T, King, R.A., Weisz, J.R., and Schopler, J. (2004). Introduction to Psychology, 7th edition, 24th reprint. New Delhi: Tata McGraw-Hill.
3. Gregory, R.J. (2006). Psychological Testing: History, Principles, and Applications (4th Ed.). New Delhi: Pearson Education.
4. Baron, Robert A. and Byrne, D. (2001). Social Psychology 8th Edition (Reprint). New Delhi: Prentice-Hall of India Pvt Ltd.
5. Carson, R.C., Butcher, J.N and Mineka, S. (2004). Abnormal psychology. 13th Edition. New Delhi: Pearson Education

PCPP6103:PSYCHOLOGY PRACTICUM II

(4 Credits – 60 hours)

Objective: The objective of the course is to acquaint the students with the various types of Psychological Tests and Clinical Rating Scales related to Intelligence, Personality, Memory and Learning and Projective Techniques. The course also is intended to provide the theoretical background necessary to understand the basic concepts behind these assessments and imparts training in classic as well as contemporary tests in the field of Psychology.

Module I: Introduction to Clinical Rating Scales (20 hours)

ADHD Symptoms Checklist-4: basic concepts, administration, scoring, results and interpretation; Hamilton's Anxiety Rating Scale-II (HAM-A II): basic concepts, administration, scoring, results and interpretation.

Module II: Projective Tests: Rorschach Psychodiagnostic Test (15 hours)

Rorschach Inkblot Test: Introduction, basic concepts, themes, administration, scoring, results and interpretation.

Module III: Assessment of Cognitive Functioning (15 hours)

Developmental Screening Test (DST): basic concepts, administration, scoring and interpretation; Malin's Intelligence Scale for Indian Children (MISIC): basic concepts, administration, scoring, results and interpretation; Seguin's Form Board Test (SFBT): basic concepts, administration, scoring, results and interpretation.

Module IV: Introduction to Personality Tests (10 hours)

Cattell's 16 Personality Factors Questionnaire (16PF): basic concepts, administration, scoring, results and interpretation.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic terms related to cognitive functioning, personality, projective techniques and clinical rating scales.
- CO2:** Choose a suitable method of psychological test to administer on a subject. (Remembering)
- CO3:** Classify the various types of psychological tests on the basis of their use. (Understanding)
- CO4:** Make interpretations and draw conclusions based on the norms given in the manual (Applying)
- CO5:** Examine the details of the rating scale/ test, the aim, applications, procedure of administration and subject results. (Analysing)
- CO6:** Recommend the use of a suitable psychological assessment for a particular disorder. (Evaluating)
- CO7:** Estimate the purpose and importance of each of these tests. (Evaluating)
- CO8:** Test the administrator's decision making process to select a particular test for assessment of a given psychological disorder. (Creating)
- CO9:** Develop techniques for carrying out group based small quantitative research projects (Creating)

Suggested Readings

1. Baron,R.A. Psychology.(1995). 3rd edition.Delhi:Prentice Hall.
2. Morgan,C.T, King,R.A., Weisz,J.R., and Schopler,J. (2004). Introduction to Psychology, 7th edition,24th reprint.New Delhi:TataMcGraw-Hill.

- 3 Gregory, R.J. (2006). Psychological Testing: History, Principles, and Applications (4 th Ed.).New Delhi: Pearson Education.
4. Baron, Robert A. and Byrne, D. (2001) .Social Psychology 8 th Edition (Reprint).New Delhi : Prentice-Hall of India Pvt Ltd.
5. Carson,R.C., Butcher,J.N and Mineka,S.(2004). Abnormal psychology. 13th Edition. New Delhi: Pearson Education

DEPARTMENT OF EDUCATION

EDLR0007: LEADERSHIP AND SOCIAL RESPONSIBILITY

(3 Credits – 45 hours)

Objective: *This course in Leadership and Social Responsibility, offers the students a landscape to reconnoitre and construct a foundation of leadership through fundamental theories of leadership by understanding the dynamic nature of human behaviour, advancement in Information and Communication Technology, change in values, cultures and relationships, and blurring of international borders. Students will be challenged to develop skills required to build immediate, extended and virtual communities that support a sustainable equitable world. A special emphasis is given to leadership as relationships between and among people and systems.*

Module I: Leadership and Management (13 hours)

Understanding Leadership, its need and function, Styles and Theories of Leadership, changing roles of Leadership; Concept of Management, functions of Management, Leadership and Management issues, The Daily Disciplines of Leadership, Leadership-A bridge to improved practice, How to improve Staff Achievement; Staff motivation, Performance and Personal Organization

Module II: Social Responsibility (10 hours)

Concept of Social Responsibility, Types of Social Responsibility, Its need, Changing role; Social Engagement; Individual Social Responsibility and Corporate Social Responsibility, Social Responsibility of the Educators.

Module III: Leadership and Decision Making (12 hours)

Decision Making process; Types of Decision Making, Key steps in Decision Making, techniques of effective Decision Making; What inhibits and misleads Decision Makers Tactics for improving Managerial Decision Making; Importance of Decision Making in Educational Institution, Organisational Behaviour, Leadership and Decision Making.

Module IV: Leadership Implementation and Implantation (10 hours)

Leadership and implantation; Formulating policy; Complexity of joint actions; Economic theory and program implementation; Implantation as exploration; Volunteerism; social entrepreneurship

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the meaning of leadership (R); Understand the qualities of a true leader (U); State the meaning of social responsibility (R); Write the characteristics of leadership (R); Identify a true leader (Ap); Analyze the role of a leader in the present context (An); Understand the different leadership styles existing (U); Explain the theories of leadership (U); Understand the historical background of leadership theories (U); Find out the implications of the theories of leadership on education system (Ap); Define the term management (R); Describe the nature of management (U); Explain the functions of management (U); Define the term individual social responsibility (R); Understand the implications of leadership in the field of individual social responsibility (U); Analyze the role of individual social responsibility in our day to day life (An); State the meaning of corporate social responsibility (R); Describe the historical background of CSR (U); Understand the relationship of leadership and CSR (U); Illustrate the CSR activities taking place in our country (U).

Module II

Identify the issues related to management and leadership (Ap); Analyze the role of leaders in improving practice in an institution (An); Understand the changing roles played by leaders in a society (U); State the meaning of social engagement (R); Describe the role of leader in social engagement (U); Understand the daily disciplines of a true leader (U); Find out the impact of leadership in motivating staff and achieving performance (Ap); Give a brief overview of the role of leaders in personal organizations process (U).

Module III

Write about the concept of decision making (R). Identify the role of leadership in the decision making process (Ap). State the meaning of organizational behavior (R). Explain the decision making process (U). Find out the tactics for improving the decision making process (Ap); Identify the problems of the decision making process (U); Understand the key steps in decision making process (U); Find out the Techniques that improves decision making process (Ap).

Module IV

Understand the relationship between leadership and policy implementation (U); Find out the effect of leadership in formulating policy (Ap); Analyze the complexity of joint actions (An); Understand how leadership influences economic theory and program implementation.(Ap); Define volunteerism (R); Explain the role of leadership in the field of volunteerism (U); State the meaning of social entrepreneurship (R); Understand the meaning of social entrepreneurship (U); Find out the effect of leadership in social entrepreneurship (Ap).

Suggested Readings

1. Bass, B. M. (1998). Transformational leadership: Industry, military, and educational impact, Mahwah, NJ: Erlbaum.
2. David, B. (2009). Leadership in Organizations There Is a Difference between Leaders and Managers. New York: University Press Of America
3. Friedman, A. A. (2004). Beyond mediocrity: transformational leadership within a transactional framework. International Journal of Leadership in Education, 7(3), 203-224. doi:10.1080/1360312042000213877
4. Fullan, M. (2005). Leadership and sustainability. New Delhi: Sage publication Ltd.
5. Kouzes, J.M., & Posner, B.Z. (2002). The leadership challenge. San Francisco, CA: Jossey- Bass.
6. Lee G. & Bolman,T. (2008). Deal Reframing Organizations Artistry, Choice, and Leadership. San Francisco: Jossey- Bass.
7. Rogers, C. (2012). Transition, self-regulation, independent learning and goal theory. Psychology Of Education Review, 36(2), 26-31.
8. Starratt, R. (2004). Ethical Leadership. San Francisco: Jossey- Bass
9. Williams, M. (2006) Leadership for leaders. New Delhi: Vinod Vasishta

EDFE0011: PHILOSOPHICAL FOUNDATIONS OF EDUCATION**(4 Credits - 60 Hours)**

Objective: In this course on Philosophy of Education, students will explore Eastern and Western philosophies of human flourishing, dilemmas in contemporary education, and certain specific Indian philosophical thoughts. Students will encounter the philosophical underpinnings that help educators navigate through the truly difficult historical situation of 21st century education.

Module I: Nature and Scope of Education

Education as a science and Education as a social process; Nature of Knowledge and theories of knowledge; Role of Philosophy in Education; Aims of education – individual, social, vocational

and democratic; Formal, informal, and non-formal agencies of education; Relation between school and society.

Module II: Indian Schools of Thought

Astika and Nastika; Sankhya, yoga, Nyaya, Visheshika, Mimamsa, and Vedanta; Buddhism, Jainism, Carvaka – with special reference to theories of knowledge.

Module III: Western Philosophical Thought

Some major schools; Naturalism, Idealism, Rationalism, Pragmatism, Realism, Logical positivism, Empiricism, Existentialism, Marxism and Post modernism - Their educational implications with special reference to epistemology, axiology and the process of education.

Module IV: Modern Indian Thinkers

Vivekananda, Tagore, Gandhi, Aurobindo, J. Krishnamurty, Radhakrishnan; Nature of Knowledge and theories of knowledge; Social Philosophy of Education – Freedom, Equality, Democracy and Responsibility; Indigenous philosophy with special reference to northeast India

Module V: Functions of education

Individual development; Transmission of cultural heritage; Acquisition of skills; Acquisition and generation of human values; Social cohesion; A practical approach to philosophy of education.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the term 'education' (R); Explain education as a science (U); Explain education as a process (U); Define 'knowledge' (K); State the methods of obtaining knowledge (R); State the theories of knowledge (R); Explain the theories of knowledge (U); Analyse the theories of knowledge (An); Demonstrate the use of the theories of knowledge (Ap); Explain the concept of philosophy (U); Use the philosophical basis for determining the educational aims and objectives (Ap); Define and state the individual, social, vocational and democratic aims of education (R); Differentiate between the informal and non-formal agencies of education (U); Explain the relationship between school and society (U).

Module II

State the basic concept of Indian philosophy (R); Explain the Indian philosophical concepts- Astika and Nastika (U); Differentiate between the Astik person and Nastik person (U); Hypothesise the actions of Astik and Nastik persons (Ap); Define the concepts Sankhya, Yoga (R); Define the concepts Sankhya, Yoga, Visheshika, Mimamsa and Vedanta (R); Explain the concepts like – Sankhya, Yoga, Visheshika, Mimamsa and Vedanta (U); Explain the philosophies of Buddhism, Jainism and Carvaka (U); Apply these ideals of different philosophies in life (Ap); Establish the relationship of philosophies and education (Ap); Determine the quality of life with the concepts of different philosophies (Ap)

Module III

State the major Western philosophies of education (R); Explain the concept of Naturalism in relation to aims and objectives of education, curriculum, method of teaching, role of teacher, discipline (U); Use the philosophy of Naturalism in making and teaching the curriculum (Ap); State the functions of Idealism, Pragmatism, Empiricism, Existentialism, Marxism and Post modernism (R); Distinguish among the different philosophies of education (U); Prepare the curriculum for taking the ideas of different philosophies (An); Analyze the different philosophies of education (AN); Evaluate the different philosophies of education from their implications point of view (E).

Module IV

State the life sketches of Tagore, M.K.Gandhi, Aurobindo, J.Krishnamurthy and Radhakrishnan (R); Analyze and find out the contributions of modern Indian thinkers in the field of education (AP); State the nature of knowledge and theories of knowledge advocated by modern Indian thinkers (R); Explain the concept of social philosophy of education in relation to freedom, equality, democracy and responsibility (U); Find out the indigenous knowledge of different ethnic groups of NE India (Ap); Find out the relevance of Indian and western philosophies of education in NE India (Ap); Find out the difference in educational philosophies of NE India and India as a whole (Ap).

Module V

State the functions of education (R); Define the functions of education towards an individual (R); Explain the integral growth of an individual (U); Illustrate education as a preparation for adult life (U); Define the function of education towards society (R); State the role of education in maintaining continuity of life (K); Find out the process of continuity of life and education in society (Ap); Use the process of education in conservation of culture (Ap); Find out the impact of education on the culture and civilization (Ap); Explain the process of education and transmission of culture (U); Define function of education towards nation (R); Explain the different aspects of nation which need to be cured through education (U); Explain the concepts of emotional integration and national integration (U); Inculcate life skills through education (Ap); State human values (R); Acquire and practice human values (Ap); Find out the impact of different philosophies on human life (Ap).

Suggested Readings

1. Bailin, S., and Siegel, H. (2003). Critical thinking. The Blackwell guide to the philosophy of education, 181-193.
2. Barrow, Robin. (1988). Chapter 1: the concept of education. Ch 2: knowledge and curriculum. An introduction to Philosophy of Education, London: Routledge. 5812.2008.00422.x
3. Biesta, G. (2010). 'This is My Truth, Tell Me Yours'. Deconstructive pragmatism as a philosophy for education. Educational Philosophy and Theory, 42(7), 710-727. doi:10.1111/j.1469-
4. Bredo, E. (2010). Mead's Philosophy of Education. Curriculum Inquiry, 40(2), 317-334. doi:10.1111/j.1467-873X.2010.00484.x
5. Brown, L.M. (1970). Aims of Education, New York: Teachers College Press.
6. Brubacher, John. (1970). Modern Philosophies of Education, New Delhi: TATA McGraw-Hill publishing company Ltd.
7. Carr, Brian and Mahalingam, Indira. (1998). Part II and III, Companion Encyclopedia of Asian Philosophy. London and New York: Routledge.
8. Cohen, B. (1983). Means and Ends in Education, London: George Allen and Unwin.
9. Dewey, J. (1966). Democracy and Education and Introduction into Philosophy of Education, New York: The Free Press
10. Freire, P. (1971). Pedagogy of the oppressed. New York: Herder And Herder.
11. Hamm C. M. (1989). Chapter 3, An Analysis of the Concept of Education. 31-40. RoutledgeFalmer London and New York.
12. Hamm, C.M. (1989). Philosophical issues in education: An introduction, Chapter 1, The nature of philosophical inquiry into educational discourse. 1-14.
13. Kamii, Constance. (1984). Autonomy: the aim of education as envisioned by Piaget. The Phi Delta Kappan, Vol. 65, No. 6, 410-415
14. Kazepides, T. (1979). Human nature in its educational dimensions. Journal of philosophy of Education, Vol.13, 55-63.
15. Lal. B.K. (1973). Contemporary Indian Philosophy. Delhi: Motilal Banarasidass
16. Lipman, M. (2003). Thinking in education. Cambridge University Press
17. Morris, V. (1966). Existentialism in Education, New York: Harper and Row.

18. Peters, R. S. (Ed.). (2010). The concept of education (international library of the philosophy of education volume 17). Routledge.
19. Radhakrishnan. S. (2008). Indian Philosophy. Vol. 1. 2nd edn. USA: Oxford University Press.
20. Radhakrishnan. S. (2008). Indian Philosophy. Vol. 2. 2nd edn. USA: Oxford University Press.
21. Saksena. Kishore. (1970). Essays in Indian Philosophy. Honolulu: Universities of Hawaii Press.
22. Sidorkin, A. M. (2011). On the Essence of Education. Studies In Philosophy and Education, 30(5), 521-527. doi:10.1007/s11217-011-9258-3
23. Smith, Philip. (1965). Philosophy of Education, New York: Haper and Row.
24. White, J. (2010). Elusive rivalry? Conceptions of the philosophy of education. Ethics and Education, 5(2), 135-145. doi:10.1080/17449642.2010.516134
25. Winch, C., and Gingell, J. (1999). Key concepts in the philosophy of education. Psychology Press.

EDEP0012: FUNDAMENTALS OF EDUCATIONAL PSYCHOLOGY

(4 Credits - 60 Hours)

Objective: *This course provides an overview of contemporary theories of learning, cognitive development, and memory. Besides these the study will include significant aspects of human development from conception through adolescence, emotional growth, personality, intellectual capacity and the acquisition, and development of language.*

Module I : Foundations of Psychology (12 hours)

Definitions of psychology, Historical antecedents of psychology and trends in 21st Century; Psychology:

Its meaning, nature, methods and scope; Educational Psychology: concept concerns and scope, and functions of educational psychology

Module II: Human growth and Development (14 hours)

Human Development and growth: Concept, principle; factors influencing development and their relative role; general characteristics and problems of each stage. Stages of human development; stage specific characteristics and developmental tasks; Adolescence in Indian context – characteristics and problems of adolescents; their needs; Theories of growth and development; Piaget, and Bruner, Erickson and Kohlberg –and their educational implications.

Module III: Learning and Memory (12 hours)

Learning: Concept, kinds, levels of learning, laws of learning and various view points on learning; Theories of Learning;; trial and error, classical conditioning, operant conditioning Gagne’s theory of learning, Carl Roger’s theory of learning and field theory of learning; cognitive view point and information processing; Educational implications of the view points on learning; Memory: Encoding and remembering, different forms of memory, theories of forgetting.

Module IV: Thinking and Problem Solving

Definitions of thinking and problem solving; Piaget’s theory of cognitive; Group Dynamics: Group process, Interpersonal relations, Sociometric grouping; Social emotional climate of the classroom and its influence of teacher characteristics; Adolescence – Psychological characteristics and problem of adolescents; role of education in solving their problems.

Module V: Motivation and Personality

Individual Difference: Concept of intra and inter differences: Intelligence and cognitive abilities, identification fostering; Creativity – Nature, Process, Identification, fostering and Guiding creative children; Motivation Cycles; Interests, attitude and values; Adjustment of teaching – learning process to suit individual differences – learning styles and teaching strategies; Atkinson’s Theory of

Achievement Motivation; Maslow's Self-actualization Theory; Tolman's Sign Gestalt Theory; Gagne's Hierarchical Theory of Learning

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define psychology (R); Recount the historical antecedents of psychology (R); Explain the importance and significance of educational psychology in the teaching learning process (U); List down the stages of human development (R); Apply the knowledge of the stages of human development in understanding their own growth and development pattern (Ap); Point out their current stage of growth and development (U); Differentiate the specific stage developmental tasks that human beings undergoes during their life time (U); Assess the unique contributions of psychology in the field of education (E).

Module II

Differentiate between growth and development (U); Apply the concepts of growth and development in the context of human being and nature (Ap); List down the principles of human growth and development (R); Identify factors affecting human growth and development (An); Recall the different theories of growth and development (R); Explain the Cognitive development theory of Piaget (U); Identify the different stages of cognitive theory of Piaget (An); Critique on the cognitive development theory of Piaget (E); Explain Moral Development theory of Kohlberg (U); List down the different stages of moral development (R); Find out the current stage of their moral development (Ap); Compare the moral development during childhood stage and that of Adolescent (An); Generalize the moral development pattern of human beings (Cr); Compare the different theories of personality (An); Assess their own personality based on the theory of Carl Jung (E).

Module III

List down the different theories of learning (R); Identify the different laws of learning (An); Apply the laws of learning in their own learning (Ap); Write down the different levels of learning (R); Illustrate the different levels of learning (U); Analyse the different levels of learning (An); Apply the knowledge of theory of classical conditioning in their own learning (Ap); Evaluate their own learning style (E); Generalize the different factors that enhance remembering/memory (Cr); Identify different factors associated with forgetting (An); Point out the different forms of memory (U); Illustrate the cognitive view point and information processing in learning (U); Explain the Gagne theory of learning (U); Contrast Social learning theory with operant conditioning (E).

Module IV

State the meaning of thinking (R); Classify the different tools of thinking (U); Analyze the types of thinking (An); Define adolescence (R); Identify the three main stages of adolescence (An); Assess the growth and development of an adolescent (E); Summarize the different needs and problems of adolescence (S); Assess their own problems they faced as an adolescents (E); Evaluate the significance of group dynamic in group works (E); Point out the different features of group dynamic (U); Identify the different type of formation (Ap); Generalize the principles of group dynamic (S); State the concept of social emotional climate of the classroom (R); Illustrate the significance of socio-emotional climate of the classroom in the teaching-learning process (U); Analyze the roles of the teacher in promoting a conducive socio- emotional climate in the teaching-learning process (An); Explain the concept of sociometric grouping (K); Identify the individual and group phenomena influencing formation of group in the society (An); Assess the various factors influencing group formation in the classroom environment (E).

Module V

Define the concept of adjustment (R); Identify the factors influencing adjustment (An); Compare the individual and situational factors influencing adjustment (An); Explain the adjustment mechanism of people (U); Decide about the type of adjustment mechanism that individuals use in their daily life (E); Identify the symptoms of maladjustment (An); Define intelligence (R); Evaluate the concept of intelligence as given by different thinkers (E); Explain the nature of intelligence (U); State the different functions of intelligence (R); Explain Spearman's two factor theory of intelligence (U); Determine the significance of g factor in the intellectual activity of the organism (E); Compare the Guilford's structure of intellect and Spear's two factor theory as theoretical perspectives of intelligence (E); Explain the mental process or intelligence as a composition of operations, contents and products (U); Assess their own intellectual activities in terms of operations, contents and products (E); Define motivation (K); Identify the different types of motivations (An); Explain Maslow's Human Needs theory as a theory of motivation (U); State Maslow's hierarchy of needs (R); Understand Henry Murray's theory of motivation (U); Identify the psychogenic needs as the factors of motivation (An); Compare the similarity of Maslow's Theory of motivation with Henry Murray's theory of motivation (E).

Suggested Readings

1. Atkinson, J.W. and Feather, N.T. (1960). *A Theory of Achievement Motivation*, New York: Wiley Publishers.
2. Bhatnagar, S. (2002). *Advanced Educational Psychology*, Agra: Bhargava Book House.
3. Chand, T. (2002). *Educational Psychology*, Agra: Bhargava Book House.
4. Crow, R.B. and Crow, A. (1964). *Educational Psychology*, New Delhi: Eurasia Publishing House.
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18. Reynolds, W. M and Miller, G. E. (2003). Current perspectives in Educational Psychology. In *Handbook of Psychology Vol. VII* (ed.) Irving B. Weiner. Canada: John Wiley and Sons, Inc.
19. Rogers, C. (2012). Transition, self-regulation, independent learning and goal theory. *Psychology Of Education Review*, 36(2), 26-31.

20. Sahoo, F.M. (2002). Psychology in Indian Context, Agra: Bhargava Book House.
21. Sharma, R.N. (2002). Educational Psychology, Guwahati: DVS Publication.
22. Sternberg, R.J (2003). Contemporary Theories of Intelligence. In Handbook of Psychology Vol. VII (ed.) Irving B. Weiner. Canada: John Wiley and Sons, Inc.
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EDTE0013: EMERGING TRENDS IN EDUCATION

(3 Credits - 45 Hours)

Objectives:

- *To impart in students the knowledge of the contemporary issues in education.*
- *To acquaint students with the information related to recent techniques in Education.*
- *To make students aware of the various challenges and hurdles faced by the Educational Institutions.*

Module I: Recent Pedagogical and Delivery Techniques (10 Hours)

Distance Education – Purposes, functions, organization and management of Distance Education Programme; e-learning – Nature, Characteristics Styles, Arrangement for e-learning in an educational institution; Virtual Classrooms – Modus operandi, Advantages and Limitations. Teleconferencing and Videoconferencing – Meaning, types, Educational Advantages.

Module II: Recent Techniques in Education (10 Hours)

Language laboratory - Need, Types, Functioning, Uses and Applications. Team Teaching-Meaning, Definition, Objectives, Principles, Types, Organization, Procedure and steps, Advantages and Limitations. Co-operative learning and collaborative learning-Key elements-Implementing the elements

Module III: Autonomy, Accountability and Accreditation (8 Hours)

Autonomy-Meaning, Need, Academic, Administrative and Financial Autonomy, Objectives, Salient Features, Advantages of Autonomous colleges. Accountability and Accreditation; Accreditation process, Assessment and Accreditation –NAAC, NBA-ISO, Accreditation and Certification

Module IV: Challenges in School Education (10 Hours)

Current student related Challenges: Parental Involvement, Drugs and Violence, School safety. Current Teacher related challenges: Diverse learning needs, Quality and expectations, Pupil-Teacher ratio. Teacher mentee /mentor programs. Current School related challenges- Technology issues, Bullying, harassment and ragging.

Module V: Learning Environment in Educational Institutions (7 Hours)

The concept of Institutional environment, The classroom learning environment- Disciplinary problems, The effects of the Institutional environment on Academic performance, Punishment and its effects. Creating Trustworthy school environments. Guidance and Counselling.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the concept, purpose and functions of distance education (R); Explain the functions and management of distance education (U); Establish the distance education center and

running it effectively (Ap); Write the meaning, features, models ,styles and arrangement for e-learning (R); Explain the concept and features of e-learning (U); Use e-learning for the purpose of performance in any field of learning (Ap); Define virtual classroom (R); Explain the concept of virtual classroom (U); Use virtual classroom for effective learning (Ap); State the merits and demerits of virtual classroom (R); Explain the concepts of teleconferencing and video conferencing as the modes of learning (U); Define teaching (R); Distinguish between teaching and instruction (U); Explain the levels and phases of teaching (U); Define a model of teaching (R); Explain the elements of the model of teaching (U); Prepare the instructional materials and using a model of teaching in the classroom (Ap); Apply micro teaching for the inculcation of teaching skills among the pupil teachers (Ap); Explain the concept of FIACS (U); Use the FIACS for observing the behavior of a teacher in the classroom (Ap).

Module II

Write about language laboratory, its need, types and functions (R); Explain the utility of language laboratory for effective teaching (U); Define team teaching (K); Explain the steps of team teaching (U); Apply team teaching in the classroom (Ap.); Evaluate the effect of team teaching in terms of learning of students (E); State the objectives and principles of team teaching (R); Define collaborative learning (R); Explain the steps of collaborative learning (U); Analyze the elements of collaborative learning (An); Use the collaborative learning for creating maximum learning among the students (Ap); Evaluate the process of collaborative learning in terms of the performance of students (E); Analyze the features of micro teaching, team teaching and collaborative learning (An).

Module III

Write the meaning, need and objectives of autonomy (R); Explain the academic, administrative and financial autonomy (U); Use the concept of autonomy in educational institution (Ap); Analyze administrative, financial and academic autonomy of an educational institution (An); Define accountability (R); Explain the features by educational accountability (U); Explain the implication of accountability (U); State the meaning of accreditation (R); Explain the parameters of assessment and accreditation of an educational institution (U); Assess and accredit the educational institution (E); Explain the functions of NAAC,NBA and ISO in the context of accreditation and certification (U)

Module IV

State the challenges relating to students (R); Analyze the challenges relating to the students of an educational institution (An); Solve the problems of students (Ap); Explain the role of parents in solving the problems of students (U); Use the involvement of parents in making the smooth and effective functioning of the school (Ap); Identify and analyze the teacher related problems (Ap); Find out the diversified needs of the learnings (Ap); Meet up the needs of the learners by adopting some effective measures (Ap).

Module V

Define the term environment (R); Write the meaning of institutional environment (R); State the elements of institutional environment (R); Explain the institutions and classroom learning environment (U); Find out the effects of institutional environment on the academic performance of students (AP); Define the concept of trustworthy environment (K); Create trust worth environment in the institution (Cr); Identify the causes of indiscipline in institutions and solving the problems of indiscipline (AP); Organize the guidance and counselling services (AP).

Suggested Readings

1. Associates, A. F. (2000). Leading Academic Change: Essential Roles for Departmental Chairs. San Francisco: Jossey -Bass Publishers.

2. Associates, H. D. (2000). Higher Education in the Era of Digital Competition – Choice and Challenges. Modison: WI Atwood Publishing.
3. Association of Indian Universities. Privatization of Higher Education. 2003
4. Association of Indian Universities: Accountability and Autonomy in Higher Education. 1998
5. Association of Indian Universities: Excellence in Achieving Social Relevance in Higher Education. 1993
6. Chauhan, S.S (2004) Innovations in Teaching Learning Process. New Delhi, Vikas Publication
7. Gandhi, M.M (2013). Autonomy and Accountability in Higher Education- An Indian Perspective. IOSR Journal of Research and Method in Education. Vol. 3, Issue 5 (Nov-December) pp. 33-37. Retrieved from <http://www.iosrjournals.org/iosr-jrme/papers/Vol-3%20Issue-5/F0353337.pdf?id=7370>
8. Govindasamy, T. (2001). Successful implementation of e-learning: Pedagogical considerations. The internet and higher education, 4(3), 287-299.
9. Haynes, N. M. (1996). Creating safe and caring school communities: Comer school development program schools. Journal of Negro Education, 308-314.
10. Hernes, G and Martin, M. (eds) (2008). Accreditation and the global Higher education market. UNESCO: International Institute for Educational Planning. Retrieved from <http://unesdoc.unesco.org/images/0016/001635/163514e.pdf>. Accessed on 19 July, 2016.
11. Holmberg, B. (2005). Theory and Practice of Distance Education. 2nd Edition. Routledge.
12. Mangal, S.K (2005) Essentials of Educational Technology. Ludhiana, Tandon Publications.
13. Mclsaac, M. S. and Gunawardena, C. N. (2005). Distance Education. Retrieved from <http://www.aect.org/edtech/ed1/pdf/13.pdf>. Accessed on 19 July, 2016.
14. Mehta, R. (2004). Crisis in Higher Education. Delhi : Kalpaz Publications.
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16. Narkhede, S. (2001). Challenges of higher Education in India. New Delhi: Sarup and Sons.
17. Pollack, I., and Sundermann, C. (2001). Creating safe schools: A comprehensive approach. Juvenile Justice, 8(1), 13-20.
18. Purushotham, H.R (2009). Team Teaching: An Alternative to Lecture Fatigue. Edutracks, 9(1), 5-7
19. Singh, A. and G.D.Sharma. (1989). Higher Education in India: The Institutional Context (ed.), New Delhi: Konarch

EDDE0014: HISTORY AND DEVELOPMENT OF EDUCATION IN INDIA

(3 Credits - 45 Hours)

Objectives:

- To develop in the students an understanding of the progress of education in ancient India- Vedic and Buddhist Education
- To develop in the students an understanding of the progress of education in medieval India-Islamic education
- To impart knowledge about the various committees and commissions formed for the progress of education during the pre- and post-Independent India.
- To impart knowledge about the various Government policies related to Education

Module I: Ancient Indian Education (8 Hours)

Fundamentals of Ancient Indian Education, Salient features, purpose of studying Vedas, Relevance of Ancient Indian education in the 21st Century. Chief Characteristics of Vedic Educational System; Education in post Vedic (Buddhist) period – features. Female education; *Swardhyaya* (Self-Learning), Duties of teachers and students in Vedic and post Vedic period, Introduction to Islamic

Education, State patronage and Growth of education, Primary Education (*Maktabs*), Higher Education (*Madarsas*), Female Education, Student and Teacher relationship.

Module II: Education during Pre Independent India (13 Hours)

Anglicization of Education 1836-1855- Exponents of Oriental Education, The Anglicists, Macaulay's Minutes and its effect, Wood's Despatch – 1854, India Education Commission regarding Primary, Secondary and University Education, The University Commission (1902), The Hartog Committee (1928-29), The Filtration Theory of Education. Important Development in Education during 1921-1931- Inter University Board, Establishment of new Universities, Teachers Training, Technical Education.

Module III: Education during Post Independent India (14 Hours)

Various Commission and policies in Education - Secondary Education Commission 1953, Education Commission 1964-66, National Policy on Education 1986, Ramamurthy Review Committee 1990, National Commission on Teacher 1999, National house Committee 2004; problems of Indian Education- Wastage and Stagnation, Examination Reform, Inclusive Education and Education of the Marginalized.

Module IV: Current Government Policies (10 Hours)

Unni Krishnan commission, DPEP, National policy on ICT, National Commission Report, Panchayat Raj Act, Rashtriya Madhyamik Shiksha Abhiyan, Rashtriya Uchchar Shiksha Abhiyan, SSA, RTE, Right to Information Act, Total Literacy Campaign, NAEP, National Knowledge Commission, Education for all, NAS, SPQEM etc.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the fundamentals of Ancient Indian Education (R); Explain the fundamentals of Ancient Indian Education (U); Illustrate the feature and purposes of studying Vedas (U); Find out the relevance of Ancient Indian Education in 21st century (Ap); Write the basic features of Vedic education system (R); Analyze the Vedic education in post Vedic period in terms of duties of teachers and students (An); State the Islamic education (K); Analyze the different aspects of Islamic education (An); Find out the implications of Islamic education on the quality of life (Ap); Explain the growth of Islamic education (U); Explain the female education and relationship between students and teachers in Islamic Education (U).

Module II

State the educational development from 1836 to 1855 in India (R); Analyze the educational development in India before independence (U); Explain the exponents of oriental education (U); State Macaulay minute and its effects (R); Write about Wood's Despatch-1854 (R); Find out the effect of Wood's Despatch on the learning of students (Ap); Explain the university education (1902), Hartog committee (1928-29) (AP); Explain the filtration theory of education. (Ap); Find out the effect of filtration theory of education (Ap); State the educational development during 1921-1931 in India (R).

Module III

State policies and programmes of education in India after independence (R); Explain the features of Secondary Education Commission (1953), and Education Commission (1964-1966) (U); Identify the impact of different commissions and committees on the quality of education in India (Ap); State the basic features of NPE 1986 (R); Analyze the different components of NPE 1986 (An); Find out the effects of NPE -1986 on the qualitative improvement in education (Ap); Explain the features and changes inducted in POA-1992 (U); Explain the concept of

teachers education and basic features of Teacher Education Commission-1999 (U); Identify the problems of Indian Education and suggest some solutions of these problems (Ap); Make your own action research on some problems and giving the solutions of those problems (Cr).

Module IV

State the features of Unni Krishnan Commission (R); Explain the objectives and structure of DPEP (U); Find out the effect of DPEP (Ap); Analyze the problems of DPEP (An); Solve the identified problems of DPEP (Ap); State the National Policy on ICT (R); Explain the role of Panchayat in educational development (U); Explain the features of SSA and RMSA (U); Find out the effects of SSA and RMSA on the quality of Education (Ap); Explain the features of RTE Act 2009 (U); Evaluate the TLC,NAEP and find out the effectiveness of these programmes (Ap); Explain the structure of NKC, EFA, NAS, SPQEM (U).

Suggested Readings

1. Acharya, P. (1978). Indigenous vernacular education in pre-British era: Traditions and problems. Economic and political weekly, 1981-1988.
2. Dash, M. (2000), Education in India: Problems and Perspectives, Eastern Book Corporation
3. Ghosh, S. C. (2007), History of Education in India, Eastern Book Corporation.
4. Govt. of India, report of the University Education Commission,(1949) Vol -I, Simla.
5. Jain, M. (2003), History in the New NCERT Textbooks Fallacies in the IIC Report, Delhi NCERT.
6. Lall, M. (2005), The Challenges for India's Education System, Chatham House: London
7. M.H.R.D, Report of the University Education Commission (1948), Ministry of Education, New Delhi, Govt. of India.
8. M.H.R.D. Challenges of Education (1985). A policy perspective, Ministry of Education, New Delhi, Govt. of India.
9. M.H.R.D. Report of the Secondary Education Commission (1952). Ministry of Education, New Delhi, Govt. of India.
10. Mookerji, R. K. (1990), Ancient Indian Education: Brahmanical and Buddhist, Delhi, Motilal Banasidass Publishers.
11. Niak J.P (1963) The role of govt. of India, Ministry of Education.
12. Nurullah S., Naik J.P and Oad L.K. (1970). A student history of education in India, Mumbai: McMillan and Co.
13. Ramchandra, P and Ramkumar V. (2005), Education in India. Eastern Book Corporation.
14. Rawat, P. L. (1956), History of Indian Education: Ancient to Modern, Delhi Bharat Publication.
15. http://mhrd.gov.in/sites/upload_files/mhrd/files/document-reports/NPE86-mod92.pdf
16. http://www.teindia.nic.in/Files/Reports/CCR/Yash%20Pal_committe_report_lwb.pdf
17. http://ncte-india.org/ncte_new/pdf/NCFTE_2010.pdf
18. <http://www.ncert.nic.in/rightside/links/pdf/framework/english/nf2005.pdf>

EDET0015: EDUCATIONAL TECHNOLOGY

(3 Credits - 45 Hours)

Objectives: *The aims of this course on Educational Technology are*

- *To impart to the students an understanding of the Concept, Scope and Significance of Educational Technology in the Education System.*
- *To describe the Teaching Models and explain the concept of instructional design*
- *To describe the application of programmed instruction in the teaching-learning process.*
- *To impart the knowledge and understanding of the methods of ICT integration and other advanced techniques of instruction in education.*
- *To develop an insight into the multimedia applications in teaching learning.*

Module I: Educational and Behavioural Technology (13 Hours)

Meaning, nature and scope; Historical perspective of Educational Technology; approaches- Software, hardware and system; Utility and problems of Educational technology in Formal and non-formal education; Behavioural Technology: teacher behaviour and teaching behaviour, teaching skills, Micro Teaching SSST and FIACS

Module II: Designing Instructional System (12 Hours)

Teaching learning process, variables, levels, functions taxonomies of instructional objective, instructional strategies, PI, PSI, MI, CAI, BMLS

Module III: Process of Communication and ICT (10 Hours)

Concept and process of communication, Barriers to communication, principles of communication, Mass Media and multi media; concept and need of ICT

Module IV: Emerging trends in Educational Technology (10 Hours)

Distance Education; Open learning system; New technologies- Videotapes, Radio, Teleconferencing, CCTV, INSAT, EDUSAT, Internet, Broadband; Resource centres for Educational Technology: CIET, UGC, IGNOU, NIOS; 3D printing, mobile learning, Gamification, Flipped, blended learning/classrooms, Cloud computing, Massive open online course (MOOCs), Flashnotes, Virtual Reality, Wearables, etc

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the term 'educational technology' (R); Analyze the different definitions of educational technology (An); Explain the nature of educational technology (U); Write the historical background of educational technology (R); State the approaches of educational technology (R); Explain the hardware ,software and systems approach (U); Use the hardware and software approaches in the classroom for effective teaching (Ap); Apply systems approach for the improvement of learning outcomes (Ap); Explain the concept of ICT (U); Write process of communication (R); Analyze the process of communication (An); Analyse the basic features of educational technology (An); Write the principles involved in the process of communication (R); Evaluate the process of communication (E); State the scope of educational technology (K); Define instructional technology (K); Explain the concept of instructional technology (U); Use the new approaches of teaching in the class room for effective teaching (Ap); Explain the verbal and non- verbal interaction in the classroom which the teacher and students process (U); Define mass media (R); Explain the concept of multimedia approach in the process of mass communication (U).

Module II

Define instructional objectives (R); Formulate instructional objectives (Ap); Analyze the task of teaching (An); State the different instructional strategies (R); Explain the methods like-lecture, team teaching,discussion,seminar,tutorial etc (U); Differentiate between a method and approach of teaching (U); Apply the different methods of teaching in a classroom (Ap); Write the meaning of programmed instruction (R); State the origin and types of programme instructional styles (R); Develop the programmes instructional material (Ap); Explain the concepts of CAI and multimedia presentation (U); Apply CAI or multimedia presentation in classroom (Ap); Evaluate the plus points of programmed instruction and CAI in the context of classroom teaching(E); Analyze the features of PI and CAI (An).

Module III

State the meaning of distance education (R); Explain the significance and features of distance education (U); Explain the concept of open learning system (U); Differentiate between distance education and open learning system (U); Use new technologies in the teaching-learning process (Ap); Analyze the roles of resource centers of Educational technology (An); Prepare the software's for various hardware's and using in the classroom (An); State the roles of CIET,UGC,IGNOU and NIOS in the field of educational technology (R).

Module IV

State the meaning of 3D printing (R); Illustrate the concept of 3D printing (U); Write about the concept of mobile learning (R); Explain the merits of 3D printing and mobile learning (U); State the meaning of gamification (R); Analyze the components of gamification (An); Use 3D,mobile and gamification in the process of learning (Ap); Describe the nature of flipped and blended learning (R); Illustrate the utility of flipped and blended learning (U); Define cloud computing, MOOCs, flashnotes, virtual and wearability etc.(R); Apply cloud computing in the management of library (Ap); Use flashnotes, virtual classrooms for teaching and learning (Ap); Explain the nature and scope of MOOCs in the present context (U).

Suggested Readings

1. Ahalt, S. (2015). Ten Emerging Educational Technology. *Renci White paper Series*, Vol. 3, No. 1 pp. 1-18.
2. Barle David (1960), *The Process of Communication*, Holt and Rinehart New York.
3. Bhatia, R.L. and Ahuja, B.N. *Educational Technology*. New Delhi: Surjeet Publications.
4. Bhatta B.D. and Sharma, S.R. (1992). *Educational Technology- Concept and Techniques*, Kanishka Pub. House New Delhi.
5. Dale Edgar (1961) *Audio Visual Methods in Teaching*, Holt Rinehart and Einston, New York.
6. Das R.C. (1993) *Educational Technology-A basic Text*, Sterling, New Delhi.
7. Dhand,H., *Techniques of Teaching*, APH Publishing Corporation.
8. Hooft, M. V. (2008). Mobile, Wireless, connected information clouds and learning. *Emerging technologies for learning*. Vol. 3.pp. 30-46.
9. Jangira N.K. and Ajit Singh (1982), *Core Teaching Skills: The Micro Teaching Approach*, NCERT, New Delhi.
10. Joyce, and B Weil, *Models of Teaching*, Prentice Hall, New Jersey.
11. Mangal S.K. *Foundations of Educational Technology*, Prakash Brothers Ludhiana.
12. Mclsaac, M. S. and Gunawardena, C. N. (2005). *Distance Education*. Retrieved from <http://www.aect.org/edtech/ed1/pdf/13.pdf>. Accessed on 19 July, 2016.
13. Nayak, A.K. *Classroom Teaching Methods and Practices*: APH, Publishing Corporation.
14. Passi, B.K (1976) *Becoming Better Teacher*, Micro Teaching Approach, Sahita Mudranalya, Ahmedabad.
15. Sechdeva, M.S. *A New Approach to Educational Technology*, Vinod Publications.
16. Sharma R.A. *Technological Foundations of Educational Publications* Meerut.
17. Sharma, R.A. (1983) *Technology of Teaching*: International Publishing House.
18. Venkataiah: *Educational Technology*, APH Publishing Corporation New Delhi.
19. Walia. J.S. *Essentials of Instructional Technology*; Paul Publishers Punjab.

EDPC0016: PEACE EDUCATION AND CONFLICT MANAGEMENT**(3 Credits - 45 Hours)****Objectives:** *To enable students*

- *To understand the importance and relevance of peace education*

- *To comprehend the concept of peace as held by different thinkers and other religious beliefs*
- *To bring awareness of the modes and methods for conflict management*
- *To familiarize with global issues and peace movements*

Module I: Understanding peace as a dynamic social reality (10 hours)

Peace – meaning, nature; theories of peace – democratic peace and active peace; religious beliefs and peace – Buddhism, Islam, Hinduism and Christianity

Module II: Philosophy of peace and peace education (10 hours)

Montessori, Freire, the Dalai Lama, Gandhi, Krishna murthy, Aurobindo and Tagore; Concept and scope of peace education; peace teacher, peace method and other enabling practices for a culture of peace in an educational setting

Module III: Conflict management and its methods and modes (9 hours)

Meaning, types, levels and reasons for conflict; approaches to the study of conflict; methods and modes of conflict resolution - mediation, negotiation, diplomacy, coercive methods; creative peace building, cross cultural methods

Module IV: Global issues and peace movements (8 hours)

Human rights, preservation of ecology, population control, economic exploitation, deprivation, equitable economic world order; non-alignment movement, campaign for nuclear disarmament and role of world organizations in promoting peace

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the term 'peace' (R); Explain the nature and theories of peace (U); Use the theory of peace in an educational institution (Ap); Analyze the theories of peace (An); Evaluate the theories of peace (E); Explain the roles of different religions in creating peace (U); Find out the effectiveness of religions in generating peace in the society (Ap)

Module II

Discuss the contributions of Montessori, Friere and Dalai Lama in creating peace in the world (Cr); Explain the contributions of Gandhi, Krishnamurty, Aurobindo and Tagore in creating peace (E); Compare the roles of Montessori, Friere, Gandhi, Aurobindo and Tagore (Ap); Apply the philosophies of great personalities of the world in classroom teaching (Ap); Explain the role of teachers in generating peace in the society (U); State the practices for a culture of peace (R); Apply different practices in life for enhancing peace in society (Ap)

Module III

State the concepts of conflict and conflict management (R); Explain the process conflict management (E); Analyze the factors affecting conflict management (An); Use the process of conflict management in practice (Ap); Name the approaches /methods to resolve conflicts (R); Explain the approaches to conflict resolution (U); Explain the meaning of mediation, negotiation, coercive method and cross cultural methods (U); Use diplomacy in resolving the conflict (Ap)

Module IV

State the human rights (R); What are Human Rights (R); Explain the significance of human rights (E); Define the term 'ecology' (R); Explain the practices of preservation of ecology (U); Write the meaning of population control (R); Name the methods and approaches of population control (R); Explain the approaches of population control (U); Explain the concept

of economic exploitation (U); Identify the causes of economic exploitation and eliminate the exploitation (Ap); Explain the non- alignment movement (U); Explain the nuclear disarmament and the role of UNO in promoting peace in the world. (E)

Suggested Readings

1. Dalai Lama (1998). The joy of living and dying in peace. (ed.) Donald S. Lopez. Jr. Dharamsala: Tibetan and Archives.
2. Diwaha, R. R., and Agarwal, M. (Ed). (1984). Peace education. New Delhi: Gandhi Marg.
3. Doyle, M. W. (2012). Liberal peace: Selected essays. London and New York: Routledge.
4. Duckworth, C. (2006). Teaching peace: a dialogue on the Montessori method. Journal of Peace Education, 3(1), 39-53.
5. Fountain, S. (1999). Peace education in UNICEF. New York: UNICEF.
6. Gat, A. (2005). The Democratic peace theory reframed: The impact of modernity. World Politics, 58, pp. 73-100.
7. Girard, K. (1995). Preparing teachers for conflict resolution in the schools. Washington, DC: ERIC Clearinghouse on Teaching and Teacher Education
8. Heopper, B (2002). Peace education and years 1 to 10 studies of society and environment key learning Area. Queensland: Queensland School Curriculum Council.
9. Johan, G. (1996). Peace by peaceful means. New Delhi: Sage Publication.
10. Krishnamurti, J. (n.y). Education and Significance of life. Retrieved from <http://www.jkrishnamurti.org/krishnamurti-teachings/view-text.php?tid=51&chid=66876>.
11. Layne, C. (1994). Kant or Cant: The Myth of the Democratic Peace. International Security, Vol. 19. Issue 2, pp. 5-49.
12. Montessori, M. (1943). Peace and Education. India: The Theosophical Publishing House.
13. Morrison, M. L. (2003). Peace Education. Australia: McFarland
14. Nair, G. (1997). Peace education and conflict Resolution in school. Health Administrator Vol. XVII, Number 1:38-42.
15. Pant, D. and Gulati, S (2014). Ways to peace: a resource book for teachers. New Delhi: National Council of Educational Research and Training.
16. Salomon, G., & Nevo, B. (2002). Peace Education: The Concept, Principles, and Practices around the World. London: Lawrence Erlbaum Associates
17. Sheean, V. (1955). Mahatma Gandhi, a great life in brief. New Delhi: Random House.
18. UNESCO. (2005). Peace Education: Framework for Teacher Education. New Delhi: UNESCO

EDSF0017: SOCIOLOGICAL FOUNDATIONS OF EDUCATION

(4 Credits - 60 hours)

Objective: This course in sociological foundation of education probes into educational systems of past and present, to comprehend the relationship between education and social change. Education is inseparable from society. Emerging theories, methodologies and policies of society play a vital role in forming an understanding of contemporary education and determining its future. Besides teaching and learning, educational institutions are crucial for shaping the broader society. To understand this it is important to consider the relationships within and outside the educational institutions and between various stakeholders. The sociological perspective will enable students to have a better grasp of the larger social reality that affect educational institutions and their mission.

Module I: Concept and Approaches (10 Hours)

Education from a sociological point of view – functionalism, structuralism, system approaches to education and a critical evaluation of these approaches; transition from pre-capitalist to capitalist social formations and its impact on educational structure and function; education and social groups, education in a multi-cultural context.

Module II: Theoretical Perspective of Educational Sociology (15 Hours)

Theoretical approaches to educational sociology and their relevance in present day scenario - standpoint theory, theory of social learning by Bandura, social realism, critical theory, rational choice theory, human capital theory, conflict theory.

Module III: School as a Social Institution (15 Hours)

School as a social institution, school as an organization; hierarchy of authority and their functions in school, unpacking schools' social contexts - contexts and factors shaping differences in schooling and schooling outcomes, schools as sites for social development, school choice, social mobility by means of education; organisational climate types, classroom climate and its impact.

Module IV: Cross-National Perspectives on the Sociology of Education (10 Hours)

- a) Culture - conceptual understanding of culture, developing intercultural competency through education, culture and personality, education for cross-national understanding;
- b) Education beyond geographical barriers - distance education, online certification courses, student and faculty exchange programmes, curriculum goals for creating globally competent students.

Module V: Schooling in the Context of Globalization and National Policies (10 Hours)

Central policies of education, privatization of education, sanskritisation and westernization of society and role of education, conceptualizing modernization from educational point of view, present education system and sociological issues - primary level, secondary level, higher educational level.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the meaning of sociology (R); Explain the relationship between sociology and education (U); State the meaning of sociology of education (R); Explain the scope of sociology of education (U); Differentiate educational sociology from sociology of education (An); Summarize the function of education from a sociological point of view (Cr); Conclude the need of studying sociology of education (E); Understand the different theoretical approaches to Sociology of Education (U); Identify the major theories that have contributed towards the field of sociology of education (An); Explain the concept of society from the functionalism view points (U); List down the functions of Functionalism (An); Critique the viewpoints of functionalism on society (E)

Module II

Explain the perspective of conflict theorists on society (U); Contrast the perspective of conflict theorist on society from that of functionalists (E); Summarize the contributions of different perspectives on better understanding of society (U); Elaborate the basic principles and tenets of symbolic interactionism in understanding society (Cr); State and explain the different theories associated with Symbolic interactionism (K); Interpret and apply symbolic Interactionists perspectives in school (U); Relate the rational choice theory in explaining the actions of individual in society (Ap); Critique rational choice theory in explain the complex social phenomena (E); Give a historical account of the evolution of feminism (U); List down the specific foci of feminist standpoint theory (R); Explain social realism in the understanding of social life (U); Explain the social theory in understanding and critiquing the changing society (U)

Module III

Explain the concept of classroom climate (U); Assess the impact of classroom climate on students' learning (E); Identify the factors that influence climate classroom (An); Define classroom climate (K); Summarise the dimensions of classroom climate (S); Illustrate the factors promoting positive classroom climate (U); Explain school as a center of community service (U); Justify the concept of school as community center (An); Demonstrate the connection between school and home (Ap); List down the educational function of the family (R); Analyse the need of parent-teacher cooperation in the teaching- learning process (An); Pinpoint the difficulties in securing home-school cooperation in the teaching- learning process (An); Propose method for securing healthy cooperation between the home and the school in the teaching-learning process (Ap); Explain the relationship between school and society (U); Predict the impact of society on education and vice-versa (Ap); Generalize the duties of school towards education (Cr)

Module IV

List down the agencies of education (R); Explain the concept of community (U); Infer the importance of community in the education of the child (An); List down the educational functions of the community on child (R); Suggest ways and means to make community an effective agency of education (Ap); Illustrate the role of family as an agency of education (U); Explain the meaning of socialization (U); Explain socialization as a process of acculturation (U); List down function of educational institution in socialization (K); Differentiate between state management and state control of education (U); Summarise the educational functions of state (Cr); Identify the merits and demerits of state control on education (An)

Module V

Define and explain the meaning of culture (R); List down different types of culture (K); Differentiate between material and non-material culture (U); Explain the concept cultural lag (U); Summarise the role of education in promoting and conserving culture (cr); Identify the influence of culture on education (An); Explain the broad concept of Democracy (U); Apply the ideas of democracy in the context of education (Ap); Incorporate democratic ideas in formulation of curriculum (Ap); Explain the meaning of International understanding (U); Justify the need of international understanding in the present scenario (E); Propose the various principles of international understanding (Ap); Explain the concept of nationalism (U); Differentiate between nationalism and patriotism (U); Summarize the role of education in promoting the spirit of nationalism (S); Explain the meaning of national integration (U); List down the obstacle of national integration (R); Suggest educational programme for national integration (Cr); State the demerit of education for national integration (K); State the meaning of Sanskritization (K); Differentiate between Sanskritization and Brahmainisation (U); Analyse the process of Sanskritization (An); Explain the concept social mobility (U); Differentiate between horizontal and vertical mobility (U); Apply the concept of vertical mobility in society (Ap); State the different dimensions of social mobility (R); List down causes of social mobility (R); Summarise the factors affecting social mobility (S); Apply the concept of social mobility in the classroom context (Ap); Explain the concept of social stratification (U); Summarize the process of stratification (S); Explain the concept of equality of educational opportunity (U); Explain the concept of westernization (E); State the concept of modernization (R); Differentiate westernization from modernization (An)

Suggested Readings

1. Below, S. V., Powell, J. J., & Roberts, L. W. (2013). Educational Systems and Rising Inequality: Eastern Germany after Unification. *Sociology of Education*, 86(4), 362-375.
2. Bills (2013). 2013. Sociology of Education reviewer awards. *Sociology of Education*, 86(4).

3. Binder, A. J. (2013). Sociology of Education's Cultural, Organizational, and Societal Turn. *Sociology of Education*, 86(4), 282-283.
4. Bose, S. (2012). A Contextual Analysis of Gender Disparity in Education in India: Women's Status and Community. *Sociological Perspectives*, 55(1), 67-91.
5. Brown, F.J. *Educational Sociology*, Prentice Hall of India, New Delhi.
6. Clinard, M. B., & Elder, J. W. (1965). Sociology in India: A Study in the Sociology of Knowledge. *American Sociological Review*, 30(4), 581-587.
7. Damle, Y. B. (1974). Sociology in India: its teaching and status. *International Social Science Journal*, 26(2), 343-348.
8. Goel, S. K. (1990). Education, Training, and Rehabilitation of the Handicapped in India. *Retrospect and Prospect. Education & Society*, 8(1), 21-29.
9. Harding, O. J. (2011). Rethinking the Cultural Context of Schooling Decisionism Disadvantaged Neighborhoods: From Deviant Subculture to Cultural Heterogeneity. *Sociology of Education*, 84(4), 322-339.
10. Hodkinson, A., & Devarakonda, C. (2009). Conceptions of inclusion and inclusive education: A critical examination of the perspectives and practices of teachers in India, *Research in Education*, (82), 85-99.
11. Maclver and Page- *Society: An Introductory Analysis*, Macmillan.
12. Nakamura, T. (2013). Sociologization, Pedagogization, and Resociologization: Has the Post-war Japanese Sociology of Education Suffered from the Galapagos Syndrome? *International Journal of Japanese Sociology*, 22(1), 64-79.
13. Sharma, C. L. (1990). Crisis of Character in India: The Need for Moral Education. *Education & Society*, 8(1), 64-73.
14. Smith R. Eliot et al, (2000). *Social Psychology*. U.S.A.: Taylor and Francis.
15. Von Below, Powell, J. W., & Roberts, L. W. (2013). Educational Systems and Rising Inequality: Eastern Germany after Unification. *Sociology of Education*, 86(4), 362-375.
16. Wright, R. (2014). The Fourth Sociology and Music Education: Towards Sociology of Integration. *Action, Criticism, and Theory for Music Education*, 13(1), 12-39.

EDTK0018: THEORY OF KNOWLEDGE

(3 Credits - 45 Hours)

Objective: *The course aims at developing educational practitioners who can facilitate the process of knowledge construction, organisation of the curriculum and make a significant contribution in learner's experiences towards 'learning to learn'. The modules highlight not only the concepts to be discussed but also the abilities to be nurtured. Learners will be able to*

- *Appreciate the different 'forms of understanding'*
- *Derive key principles for teaching-learning experiences in each of the discipline.*
- *Analyse the classroom interactions through the lens of 'critical pedagogy'.*
- *Critically review the textbooks with the lens of 'knowledge' and 'power'.*

Throughout the course dialogic method of teaching will be used so that students can experience constructivist way of teaching and learning. Students will be required to present and initiate dialogue.

Module I: Introduction to knowledge and Forms of Understanding (12 Hours)

Difference in Belief, assumptions, information, and Knowledge. Knowledge as true justified belief. Sources of knowledge, types of knowledge, forms of understanding/ different kinds of knowledge and their validation processes, role of learner (knower) in knowledge construction.

Reviewing how students learnt subjects in school and college and critically analyse the processes through the lens of 'knowledge'.

Module II: Facilitating knowledge construction (12 Hours)

Nature, process of construction, pedagogy (andragogy) and assessment of: Mathematical knowledge, Knowledge of science; Knowledge of humanities and social sciences; Aesthetics

Dialogue on 'knowledge claims' and 'validation' of the claims in each of the disciplines.

Module III: Understanding Curriculum (10 Hours)

Curriculum framework, curriculum and syllabus. Process of/approaches to curriculum organisation and development; principles for selection of content and processes.

With reference to school, college and university curricula - Study of NCF 2005, NCERT syllabi for school education, curricular documents of degree courses.

Module IV: Knowledge and power (11 Hours)

Knowledge and power-Dominance, inclusion and exclusion of knowledge in curriculum and text books. Academic knowledge and everyday knowledge; Knowledge of the marginalised, indigenous knowledge.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Write the conceptual framework of knowledge (R); Differentiate the concept of knowledge and belief, assumptions, information's (U); Define 'knowledge' (R); Explain the sources of knowledge (U); Name the types of knowledge (R); Categorize the knowledge (Ap); Explain the process of validation of knowledge (U); Validate the knowledge (Ap); Construct the knowledge (Cr); Analyze the knowledge (An); Summarize and come out with theory of principal (Cr)

Module II

Write the nature of construction of knowledge (R); State the process of knowledge construction (K); Analyze the process of construction (An); Synthesize the elements of the process of knowledge construction (S); Construct the knowledge (Ap); Explain the term pedagogy (U); Classify the knowledge of Mathematics, Science, Humanities and Social sciences (Ap); Use the constructed knowledge. (Ap)

Module III

Define curriculum (R); Analyze the elements of curriculum (An); Explain the concept of curriculum (U); Execute the curriculum (Ap); Design the curriculum (Ap); Evaluate the curriculum (E); Name the co-curricular and extra-curricular activities (R); Explain the approaches to organize curriculum (U); Write principles and bases of curriculum (R)

Module IV

State knowledge as power (R); Classify knowledge (Ap); State the criteria for inclusion and exclusion of knowledge in curriculum (R); Explain the process of inclusion and exclusion of knowledge in curriculum (U); Update the curriculum (Ap); Analyze the knowledge (An); Synthesize the knowledge (S); Define text-book (K); Explain the different parameters of a good text-book (U); Design and develop a good text-book (Ap); Differentiate between the academic (specific) knowledge and general knowledge (U); Define indigenous knowledge (R); Explain the knowledge marginalized communities (U); Explain the utility of indigenous knowledge (U); Identify the indigenous knowledge and to classify it (Ap); Analyze the text-book (An); Evaluate the text-book (E) Critical study of text books – NCERT, state board text books, text books for colleges.

Suggested Readings

1. Dhankar, Rohit. Aims of Education to classroom – mapping the field of curriculum.
2. Hirst, P.H., Realms of meaning and forms of knowledge in 'Knowledge and Curriculum' A collection of philosophical papers, Routledge and Kegan Paul, 1974
3. Kumar, Krishna. (1992). What is worth teaching? Orient Blackswan.
4. Nambissan, Geetha. B. (2000). 'Identity, Exclusion and the Education of Tribal Communities'. In Rekha Wazir (Ed.) The Gender Gap in Basic Education: NGOs as Change Agents. New Delhi: Sage
5. NCERT (2006). Position papers on Science, Language, Social Science, Mathematics, Assessment. NCERT, New Delhi
6. Noah, Lemos. (2007). An Introduction to the Theory of Knowledge. Cambridge.
7. Sarangpani, Padma. Constructing school knowledge.
8. Saxena, Sadhana (2007). 'Education of the Masses in India: A Critical Enquiry'. In Krishna Kumar and Joachim Oesterheld (Eds.) Education and Social Change in South Asia. New Delhi: Orient Longman.
9. Batra, P. (2010). The Contested Terrain of School Social Science. Learning Curve. Bangalore: Azim Premji Foundation.
10. Carr, D. 'Knowledge and curriculum: four dogmas of child-centred education', Journal of Philosophy of Education, vol. 22, 1988, pp. 151–62.
11. Carr, D., 'The logic of knowing how and ability', Mind, vol. 88, 1979, pp. 394–409.
12. Gettier, E.L. (1967). Is justified true belief knowledge? in A. Phillips-Griffiths (ed.), Knowledge and Belief, Oxford, Oxford University Press.
13. Lawton, D. (1975). Class, Culture and the Curriculum, London, Routledge.
14. Mehlinger, H. D. (ed). (1981). UNESCO Handbook of Social Studies. France: UNESCO Publications
15. Mukherjee, A. (2010). The Nature of mathematics and its relation to school education. Learning Curve XIV, pp. 16-22.
16. Mukherjee, A. (2005). Methods of enquiry in science, Proceedings of the International Seminar on Science Education. VidyaBhawan Education Resource Centre, Udaipur.
17. Winch, P., The Idea of a Social Science and Its Relation to Philosophy, London, Routledge and Kegan Paul, 1958.
18. Young, M.F.D. (ed.), Knowledge and Control, London, Collier-MacMillan, 1971.

EDEL0019: DEVELOPING EDUCATIONAL LEADERSHIP

(3 Credits - 45 Hours)

Objectives: *This course aims at developing the concepts and skills required to understand, appreciate and make informed choices required for leading educational endeavours. The modules highlight not only the concepts to be discussed but also the abilities to be nurtured. The objectives of the course are to enable students to:*

- *Understand specific nature and attributes of educational processes, institutions and system.*
- *craft the vision, goals and strategy for the educational institution in the light of democratic values, larger societal aims and context.*
- *analyse the various roles and responsibilities of an educational leader.*
- *It is recommended that dialogic pedagogy be used and students are required to bring in their personal experiences, initiate dialogue and build theories. Teachers would problematize, provide space for dialogue, provide resources and help the students understand finer nuances.*

Module I: Education system and institutions (15 Hours)

- a) Education as an ideal (What is education? Aims of education). Education as a system. School as a social institution.
- b) Decentralisation of Education: Education- a concurrent subject in the Constitution. Structure of the educational system in India. Study of the structure at the state level. Linkages within the system.
- c) Roles and responsibilities of the personnel involved: Teacher as an academic leader, Head teacher as a school leader, CRC, BEO, DEO, DIET Principal, SCERT Director, NCERT Director, Panchayati Raj Institutions.

Reflecting on one's own experiences of schooling to understand school as a social institution, nature of relationships among the various stakeholders in the school and overarching values as stated by the school.

Module II: Stakeholder collaboration (10 Hours)

- a) Parent, learners, community, teachers as stakeholders: their expectations and roles. Ensuring their participation.

Analysis of research on impact of stakeholder participation, challenges and principles for successful collaboration.

Module III: Leadership for Inclusion (10 Hours)

- a) School Culture: Meaning and components. Hidden curriculum.
- b) Zones of exclusion. Analysing curriculum-content and pedagogy - to critically examine school processes. Identifying school processes that cause exclusion.

Synthesizing principles of inclusive institutional culture.

Module IV: Constructing 'Educational Leadership' (15 Hours)

- a) Leadership for quality education, equity and inclusion, continuous professional development of teachers, creation of learning communities, ensuring autonomy of learners, teachers and other staff, contextualisation of the curriculum.
- b) Crafting vision and mission for an educational institution. Critical review of the vision based on the parameters of educational aims, ideals of administration and values of democratic society. Assess an educational issue to arrive at a strategic principles, action plans, resource management to address the issue.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the term education (R); Understand the concept of education (U); Explain the importance of Education (U); Illustrate the aims of education (U); Find out the relevance of aims of education in the present context (Ap); Write the basic types of aims of education (K); Analyze education as a system (An); Understand school as an social institution (U); State the meaning of decentralization of Education (R); Explain the decentralization system in India with regard to education (U); State the meaning of concurrent list (K); Understand education as a concurrent list subject (U); Analyze the structure of education system in India (An); Find out the structure of education at the state level (Ap); Find out the role of a teacher as a academic leader (Ap); Find out the role of the Head teacher as a school leader (Ap); Understand the role and responsibilities of CRC, BEO, DIET Principal, SCERT Director and NCERT Director (U); Describe the *Panchayati Raj* Institution in India (U); Formulate the roles and responsibilities of *Panchayati Raj* Institutions in India (Cr)

Module II

Write about the meaning of stakeholder's (R); Explain the role of leadership played by a teacher, parent and community (U); Understand the role of parent, learner, community, teachers as a stakeholder (U); Find out the expectations of parents, learners, community and teachers as stakeholders (Ap)

Module III

Understand the concept of inclusion (U); State the meaning of school culture (R); State the basic of school (R); Explain the meaning of hidden curriculum (U); State the meaning of exclusion----; Critically analyze the curriculum content and pedagogy existing in schools (An); Examine the school processes existing in schools (Ap); Identify the school processes causing exclusion (Ap); Illustrate the role of a leader for bringing inclusive institutional culture (U)

Module IV

Understand the need of quality education (U); Explain the importance of leadership for quality education (U); State the meaning of equity (R); Explain the problems related to equity, quality and inclusion (U); Explain the role of leadership in bringing equity and inclusion (U); Understand the continuous professional development of teachers (U); Find out the importance of creating learning communities (Ap); Understand the nature of learners, teachers and other staff (U); Analyze the factors responsible for ensuring autonomy to teachers, learners and staff (An); Understand the role of leader in crafting a vision and mission for educational institutions (U); Critically analyze the vision and mission of any educational institution based on the parameters of educational aim, ideals and values of our society (E)

Suggested Readings

1. Apple, M. W., & Beane, J. A. (1995). *Democratic schools*. Association for Supervision and Curriculum Development, 1250 North Pitt Street, Alexandria, VA 22314 (Stock No. 1-95052; \$14.95)..
2. Batra, S. (2003). *From School Inspection to School Support*. In Sood, N. (ed). *Management of School Education in India*. NIEPA: New Delhi. 2. Early, P, and Weindling, D. (2004).
3. Cheney, G. R., Ruzzi, B. B., & Muralidharan, K. (2005). *A profile of the Indian education system*. Prepared for the New Commission on the Skills of the American Workforce.
4. Dewey, J. (1916). *Democracy and Education*. New York: Macmillan.
5. Fullan, M. (1993). *Why Teachers Must Become Change Agents*. In *Educational Leadership*, 50 (6).
6. Govinda, R. (2001). *Capacity Building for Educational Governance at Local Levels*. Paper presented at the International Consultation on Educational Governance at Local Levels. Held at UNESCO, Paris 27-28 February 2001.
7. NCERT,(2006). *position paper on aims of education*. New Delhi: NCERT Preamble to the Constitution of India concerning values for teachers
8. *School as a social institution*, Andre Baitelle.
9. Sheshagiri K.M. *Decentralisation of Education in India: Reflections from Kerala and Rajasthan*.
10. Wren, D. J. (1999). *School culture: Exploring the hidden curriculum*. *Adolescence*, 34(135), 593.
11. *A Changing Discourse: From Management to Leadership*. In Early, P and Weindling, D. (ed). *Understanding School Leadership*. Paul Chapman Publications: UK.
12. Senge, P. M. (1990). *Organizations as learning communities*.
13. Pollard, A. (2002). *Reflective Teaching*. Continuum: London. Chapters – 1,8,9. 39
14. Hargreaves, A. (2000). *Teachers and Teaching: History and Practice*, Vol. 6, No. 2, 2000 *Four Ages of Professionalism and Professional Learning*

EDDL0020: HUMAN DEVELOPMENT AND LEARNING**(3 Credits - 45 hours)**

Objectives: *The purpose of the course is to give a comprehensive idea of the developmental, socio-cultural and environmental influences on the child's overall personality formation. It also provides students an idea on the process of adjustment and specific disabilities encountered by children at various stages. The overall learning is to enable students:*

- *To understand the various developmental aspects of children.*
- *To understand the stages of growth, maturation and development and its certain specific theories.*
- *To develop an understanding about the factors to enable effective learning.*
- *To understand adjustment as a process and the mechanism involved in effective adjustment.*
- *To understand the differently abled children and the various kinds of learning difficulties.*

Module I: Understanding Child and Childhood (10 hours)

Importance of understanding child and childhood, capabilities of children belonging to different socio-economic and cultural backgrounds, idea of multiple childhood, nature-nurture debate, language development, learning and acquisition, promoting autonomy in children, development of case studies of children belonging to different backgrounds

Module II: Development and Learning (10 hours)

Stages of development, growth and maturation, Adolescence: why it is a sensitive period, the importance of recognizing issues related to adolescence. Erikson's stages of psycho-social development, Vygotsky's theory on social constructivism, concept of tools, zone of proximal development, Piaget and Vygotsky debate.

Developing a personal narrative of experiences of adolescence

Module III: Enabling learning (10 hours)

Bronfenbrenner's ecological systems, theory of development, social context of learning, enabling school environment, promoting independence of thought and action, parenting at different stages of development: Students analyze views of parents on parenting and child care practices. Quality frameworks.

Module IV: Psychology of Adjustment and Adjustment Mechanisms (6 hours)

Adjustment as a process; a theory of cognitive adaptation. frustration and conflict; causes of maladjustment; contribution of Freud, Adler, Jung and Neo-Freudians to understand maladjustment, adjustment mechanisms. conflicts and defence mechanism, mental hygiene.

Module V: Differently-abled persons and learning (9 hours)

Understanding differently abled persons; educational implications: ADHD, autism, dyslexia. juvenile delinquency.

Develop a detailed discussion paper on various kinds of learning difficulties.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Write about the child and childhood (R); State the significance of childhood study (R); Explain the features of childhood (K); Find out the capabilities of children belonging to different socio-economic and cultural background (Ap); Differentiate the children on the basis of their SES and low SES (Ap); State the features of the children belonging to high SES and low SES

(R); Contrast of the children belonging to high SES and low SES (An); Explain the concept of multiple childhood (U); Explain the nature and nurture of the child (U); State the process of language development among the children (K); Create the sense autonomy among the children (Ap); Conduct studies on the children of different backgrounds (Ap)

Module II

State the stages of development (R); Explain the concepts of growth and maturation (U); State the principles of development (K); Define adolescence (R); Explain the features of adolescence period (U); Find out the problems of adolescents (Ap); State the Erickson's stages of psycho-social development (R); Analyze the psycho-social stages of development (An); Write the meaning of social constructivism (R); Apply the theory of Vygotsky's social constructivism (Ap); Explain the zone of proximal development (U); Differentiate between the theory of Piaget and the theory of Vygotsky (U)

Module III

Analyze Bronfenbrenner's ecological system (An); Explain the features of ecological system given by Bronfenbrenner (U); Explain the theory of development (U); Explain the concept of learning in social context (U); Define school environment (An); Find out the impact of school environment on the development of the students (Ap); Evaluate the school environment (E); Explain the role of parents in the development of children (U); Explore the views of students on parenting and child care practices (Ap); Find out the impact of parenting on the quality of the child development (Ap)

Module IV

State the adjustment as a process (R); Explain the theory of cognitive adaptation (U); Define frustration and conflict (R); State the causes of maladjustment (R); Explain the contributions of Freud, Adler, Jung and Neo-Freudians in the process of maladjustment (R); Find out the adjustment mechanism in specific situation of a student (Ap); Define defence mechanism (R) Elaborate on the use of defence mechanism (Cr); Use defence mechanism to protect himself/herself (Ap); Explain the nature and scope of mental hygiene (U)

Module V

Explain the concept of differently abled persons (U); Find out ADHD, Autism, Dyslexia, Juvenile delinquency among students (Ap); Define delinquent (K); Explain the causes of delinquency (U); State the preventions and treatments for avoiding delinquency (K); Develop a special package for the delinquents and educate them effectively (Ap); Find out the learning disabilities among the students (Ap)

Suggested Readings

1. Arkoff & Abe. (1968). 'Adjustment and Mental Health'. New York, McGraw- Hill
2. Bjorklund, D. (2010). 'Child and Adolescence Development-an integrated approach'. Blasi Wadsworth Cengage Learning Publications.
3. Bronfenbrenner, Urie. (1979). 'The ecology of human development'. Harvard University Press Cambridge.
4. Crow & Crow. (1956). 'Understanding Our Behavior'. N.Y. Alfred A Knoff Publications.
5. Erickson, H.Erik. (1993). 'Childhood and Society'. WW. Norton Publication.
6. Erickson, H.Erik. (2005). 'Stages of Psycho social Development'. Green Verlag, Gmbtt
7. Freud S. (1938). 'Psychopathology of Everyday Life-The Basic Writings of Sigmund Freud.' New York, Modern Library.
8. Kostelnik, J.M., Gregory, M.K., Soderman. K.A., & Whiren, P.A. (2012). 'Guiding children's social development and learning'. Wadsworth Cengage Learning Publications
9. Kozulin A., Gindis, B., Ageyev, S.V & Miller, M.S (2003): 'Vygotsky's Educational Theory in Cultural context'. Cambridge University Press.

10. Lahner, George. (1964). 'The Dynamics of Personal Adjustment'. New Jersey: Prentice –Hall.
11. Lerner, J. (1985). 'Learning Disabilities-Diagnosis and Teaching Strategies'. Boston Houghton Mifflin.
12. Lock, A & Strong, T. (2010). 'Social Constructionism – Sources and Stirrings in Theory and Practice'. Cambridge University Press
13. Mangal, S.K. (2010). 'Educating Exceptional Children-An Introduction to Special Education' .PHI Learning Private Limited,Delhi
14. Mangal, S.K. (1987). 'Abnormal Psychology' N.D-Sterling Publications (revised edition)
15. Mangal, S.K. (2002). 'Advanced Educational Psychology'. PHI Learning Private Limited,Delhi,
16. McLoughlin, J.A and Netick, A. (1983). 'Defining Learning Disabilities- A new and co-operative direction'.Journal of Learning disabilities.
17. Newman,M.B & Newman,R.P. (2006). 'Development through Life-A psycho-social approach',12th edition, Cengage Learning Stamford.
18. Sinha, AKP, Singh, R.P. (1971). 'Manual for Adjustment, Inventory for College Students'. Agra, National Psychology Corporation.
19. Telford, C.W & Sawrey,J.M. (1967): 'The Exceptional Individuals' .New Jersey,Prentice-Hall.

EDCI0021: CURRICULUM DEVELOPMENT AND INSTRUCTION

(3 Credits - 45 hours)

Objective: *This course will explore the various types of curriculum and the relevance of its study. It will help to understand how curriculum takes a shape, how curricular decisions impact students in particular and the society in general. The objectives of the course are to enable students to understand how the pattern of education changes with time influenced by thinkers, to identify the various resources that can make impact in curriculum design, how different ideas are embodied in the existing curriculum and how different agendas are permeated through curriculum and to discern how to look for change and develop a curriculum of their own to meet educational and organizational goals.*

Module I: Understanding curriculum (6 hours)

Contemporary definition of curriculum; curriculum criteria, curriculum goals and values, basic principles of curriculum and instruction

Brainstorming session on the issues and trends of school/college curriculum

Module II: Philosophical underpinnings of curriculum (15 hours)

Curriculum types and Models of teaching: Social, Information Processing, Personalist, and Behavioral, Child-Centered, Society-Centered, Knowledge-Centered, or Eclectic; Goals and Philosophies of Education across changing education paradigms - Idealism, Realism, Perennialism, Essentialism, Experimentalism, Existentialism, Constructivism and Reconstructivism

Analysis of the philosophical underpinnings of the present day curriculum

Module III: Approaches to curriculum development (10 hours)

Tagore, Gandhi, Krishnamurthy, Plato, Dewey, Montessori, Don Bosco, Freire,

Detailed discussion on the pedagogical approach of one of the above thinkers

Module IV: Curriculum development frameworks in 21st Century (6 hours)

NCTE Framework for 21st Century Curriculum and Assessment; UNESCO - A Futures Perspective in the Curriculum, Learning Environment, Skills, Assessment, Professional Development; Curriculum and Future - Concepts from Social Sciences

A review of the NCTE framework for 21st century Curriculum and Assessment

Module V: Curriculum development and assessment (8 hours)

Developing a curriculum document: Approach and organization, stages of curriculum development, guidelines of statutory bodies with regard to curriculum development – UGC, NCTE, NCF; Curriculum integration: disciplines, media and technology; evaluating and assessing a curriculum; Models of curriculum; Curriculum implementation - Factors influencing curriculum implementation

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the concept of curriculum (R); Different curriculum from course of studies and syllabus (U); Understand the characteristics of curriculum (U); Differentiate the traditional concept of curriculum from the new/modern concept of curriculum (E); Explain curriculum as a process (U); Identify the different sources of curriculum criteria (An); State the goals and values in curriculum planning (R); List down the general goals of curriculum planning (R); Identify the philosophical positions that influence curriculum planners and teachers (An); Use the basic elements of curriculum development in constructing new curriculum (Ap); Conclude the various factors influencing curriculum development (Cr); State the relationship between curriculum and instruction (R); Use the knowledge of curriculum development for designing appropriate learning activities (Ap); Short listed the basic principles of curriculum and instruction (K); List the principles of curriculum construction (R)

Module II

Explain the core ideas of constructivism (U); Assess the role of teachers in the curriculum implementation according to constructivism (E); Find out the constructivist's method of teaching in present day (Ap); Summarize the constructivist approach in the classroom teaching (Cr); Pinpoint the unique contribution of constructivist's approach to the teaching-learning environment (An); Explain the philosophy of existentialism (U); Apply the philosophy of existentialism in education (Ap); Relate some of the educational practices that are related to philosophy of Perennialism (Ap); Generalize the principles of Perennialism (S) Explain the basic tenets of Essentialism (U); Interpret and identify the educational practices that are associated with the philosophy of essentialism (An); State the curriculum proposed by essentialism (R); Explain the philosophy of progressivism(U); Explain the philosophical foundations of a student-centred curriculum (U); Recount the historical background of Reconstructionism (R); Apply the ideology of Reconstructionism in education (Ap); Critique the philosophy of Reconstructionism in general and its application in education in particular (E); List down the different types of curriculum (R); Assess the significance and pitfalls of integrated curriculum (E); Apply Tyler's model of curriculum in the construction of curriculum (Ap); Identify the basic steps of curriculum construction proposed by Tyler (An); Apply the five major steps in curriculum design proposed by Taba (Ap)

Module III

Explain the educational philosophy of Don Bosco (U); Judge the philosophy of Education of Don Bosco in the present era (E); Summarize the methods of education promulgated by Don Bosco (Cr); Assert the relevance of the philosophy of education of Gandhiji (E); Follow the teaching methods of Gandhiji (Ap); Critique the philosophy of education of Gandhiji (E); Explain the aim of education according to John Dewey (U); Recollect the educational methods of John Dewey (R); Contrast the philosophy of Education of Gandhiji and John Dewey (An); Summarize the philosophy of education of Krishnamurthy (Cr); Identify the roles of an educator in the teaching-learning process (An); Apply the principles of Montessori Method (Ap); Explain the curriculum proposed by Montessori (R); Critique the educational

philosophy of Maria Montessori (E); Explain the Banking concept of education of Freire. (U); Assess the Freire's philosophy of liberative education (E); Use the pedagogical methods of Freire (Ap); Assess the applicability of Freire's philosophy of education in the Indian context (E); Explain the Plato's philosophical foundations of education (U); Illustrate the qualities of good teachers proposed by Plato (U)

Module IV

Interpret the Indian National Curriculum Framework 2005 in the current scenario (U); Identify the shift of focus in the teaching-learning process (An); Redefine methods and focus of curriculum in the teaching-learning process (Ap); Synthesis the significance of school and classroom environment in the teaching-learning process (Cr); List down the various reforms proposed by the documents (R); Name a wide range of abilities and competencies that the 21st century literacies demand (R); Assess the significance of the knowledge of social science and humanities in planning, decision-making and problem-solving process (E); Explain evaluation as a tool and process (R); Illustrate the functions of evaluation at different levels of implementation (U); Differentiate between diagnostic evaluation from Summative evaluation (U); Identify the resources for curriculum implementation (An); State the roles of teachers in curriculum organization and implementation (R)

Suggested Readings

1. Dottrens, R. The Meaning of the Terms Curriculum and Syllabus, in *The Primary School Curriculum*, (France: UNESCO) pp79-89.
2. Dewey, J. *The School and Society in Society and Education*, Introduction by Philip W. Jackson (Chicago: The University of Chicago Press)
3. Pring, R. *Curriculum Integration in The Curriculum: Content, Design and Development* (ed), (London Institute of Education Bulletin, Spring). pp- 4-8.
4. Tyler Ralph, W. *Basic Principles of Curriculum and Instruction*. (University of Chicago Press).
5. Vallance, E. Hiding the Hidden Curriculum in *Curriculum Theory Network*. Stanford University 4:1, pp 5-21
6. Kumar, Krishna. Origins of India's 'Textbook Culture from Comparative Education Review 32(4) pp 452-464.
7. Bruner, J. Folk Pedagogies. In Leach, Jenny and Moon, Bob (eds) *Learners and Pedagogy* (pp4-20). London: Paul Chapman Publishing in Association with the Open University.
8. Keddie, Nell. Classroom Knowledge in Young, M.F. D. (ed), *Knowledge and Control*. (London: Collier Macmillan)
9. Coleman, J. The Concept of Equality of Educational Opportunity in *Equality and Achievement in Education*. (Boulder: Westview Press)
10. Winch, C. *Constructing Worthwhile Curricula in Quality and Education* (Oxford: Blackwell) pp45-56
11. Akkari, A. Socialization, Learning and Basic Education in Islamic Contexts in *Educational Theories and Practices from Majority World* (ed), Sage, New Delhi, pp220-244.
12. Bernstein, B. Class and Pedagogies: Visible and Invisible in Karabel and Hasley (ed) *Power and Ideology in Education*. (Oxford University Press)
13. Hoare. Q and Smith G. N. On Education in Selection from *The Prison Notebook of Antonio Gramsci* (ed). (India: Orient Longman Pvt Ltd)
14. Freire, Paulo chapter 2 *Pedagogy of the Oppressed* (New York: Seabury Press)
15. *Education for Poor: Quality and Relevance?* British Journal of Sociology of Education 13(4)
16. Kohlberg, L and Meyer, R. Development as the Aim of Education Harvard Education review 42(4)
17. Tanner, Laurel N. The Meaning of Curriculum in Dewey's Laboratory School (1896-1904) *Journal of Curriculum Studies*, 23(2) 101-117
18. Kumar, K. What is Worth Teaching? In *What is Worth Teaching* (Hyderabad, Orient Longman)

EDTP0022: PRINCIPLES AND TECHNIQUES OF TEACHING AND PEDAGOGY

(3 Credits - 45 hours)

Objective: The course on Principles and Techniques of Teaching and Pedagogy introduces the students to the concept, nature and scope of teaching. It also acquaints them with the principles, levels, strategies and skills of teaching. It will enable the students to understand the process of teaching and its various components. The theoretical perspective of teaching will help them in constructing the foundation of teaching while the models of teaching will guide them in practical aspects of teaching. Knowing the storehouse of teaching methods will enable the students to use them judiciously and wisely. Pedagogy will enable the students to understand teaching as an art and science. The students will also be able to update themselves with the innovative pedagogies.

Module I: Concept and aspects of teaching (10 hours)

Teaching: Concept, nature and scope; Teaching competency: Understanding the child, understanding the subject, contextualization, punctuality, regularity, integrity, humility, accountability, humanism, empathy, enthusiasm; Skills of teaching: Explaining, questioning, stimulus variation, reinforcement, achieving closure, etc.; Integration of different teaching skills and Strategies of teaching: Autocratic, Permissive, Democratic.

Study the biographies of famous teachers and develop teacher profiles within historical and contemporary perspectives.

Module II: Theories and models of teaching (10 hours)

Principles and maxims of teaching; Theories of teaching: behaviourism, cognitivism, constructivism, co-operative approach; Models of teaching: information processing models, social models, behavioural models and personal models

Demonstration on models of teaching by students

Module III: Teaching Methods (15 hours)

Teacher-centred methods: lecture, demonstration, team-teaching, mastery learning strategy; Learner-centred methods: programmed learning, personalized system of instruction, problem solving method; Activity-centred methods: seminar, workshops, peer-tutoring, group discussion, projects, heuristic method, panel discussion, brainstorming, symposium and role-play; Teaching aids: significance, types and uses

Classroom teaching practice

Module IV: Recent developments in Pedagogy (10 hours)

Pedagogy: concept and significance; History of pedagogy: Indian, Greek and Roman history of pedagogy; Innovative pedagogy: crossover learning, learning through argumentation, incidental learning, learning by doing, embodied learning; Pedagogical approaches for diversity in society and its interface with the classroom

Analysis of teaching in a real classroom situation

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the term teaching (R); Explain the nature of teaching (U); State the scope of teaching (K); Apply the theories in classroom practice (Ap); List the teaching competencies (R); Define teaching skill (R); Explain different teaching skills (U); Use different teaching skills in classroom (Ap); Write the meaning autocratic teaching (R); Explain the features of autocratic

teaching (U); State the meaning of permissive teaching (R); Analyze the permissive teaching (An); Explain the permissive teaching (U); Apply the permissive teaching in classroom (Ap); Define the democratic teaching (R); Explain the features of democratic teaching (U); Observe and evaluate the teaching (E)

Module II

State the principles of teaching (R); Explain the principles of teaching (U); Define the maxims of teaching (R); Use the principles and maxims in classroom teaching (Ap); Name the theories of teaching (R); Analyze the theories of teaching (Ap); Evaluate the any piece of research work (E); Explain the theories in classroom practice (Ap); Analyze the different theories of teaching (Ap); Summarize the different theories of teaching (Cr); Examine the different theories (E); Explain the concepts of behaviorism, cognitivism and constructivism (U); Differentiate between behaviorism, cognitivism and constructivism (U); Use cognitivism and constructivism in practice (Ap); State the meaning of models of teaching (R); State the elements of model of teaching (R); Explain the different models of teaching (U); Use the various models of teaching in classroom (Ap)

Module III

Write the meaning of method of teaching (R); Define teacher centric method (R); Name the teacher centric method of teaching (R); Explain the different teacher-centric methods (U); State the merits and demerits of teacher centric method (R); Demonstrate the teacher centric method of teaching (Ap); Define mastery learning (R); Explain the mastery learning teaching strategy or approach (U); Differentiate between the teacher centric and learners centric teaching strategies (U); Apply mastery learning strategy in the classroom (Ap); Analyze the features of mastery learning strategy (An); Explain the features of programmed instruction (PI) and personalized system of instruction (PSI). (U); Summarize the structure of PI and PSI. (S); Assess the effectiveness of PI and PSI as teaching strategies (E); Explain the problem solving method, activity-centred method, seminar, tutorial, brain storming, discussion etc. (U); Explain the nature, utility and types of teaching aids (U); Use the teaching aids in classroom for teaching effectively (Ap)

Module IV

State the concept and significance of pedagogy (R); Explain the concepts of pedagogy (U); Analyze the elements of pedagogy (An); Explain the historical background of pedagogy (U); Write the meaning of innovative pedagogy (R); Demonstrate the innovative pedagogy in the classroom (Ap); Explain the concepts of crossover learning, learning through argumentation, incidental learning, learning by doing etc. (U); Explain the pedagogical approaches in diversifies society (U); Analyze the classroom teaching (An); Use new pedagogical approaches in different situations (Ap)

Suggested Readings

1. Aggarwal, J. C. Principles, methods and techniques of teaching. Delhi: Vikas Pub House.
2. Anderson. L. Wet al. International Encyclopedia of Teaching and Training Education, Pergmon press.
3. Joyce, B. & Weil, M. Models of teaching. New Delhi: Prentice Hall.
4. Jangira, N. K. Professional Enculturation: Innovative Experiments in Teaching and Training, New Delhi; Bookworth of India.
5. Ashton-Warner, S. Teacher. New York: Simon & Schuster.
6. Hall, G. E. & Quinn, L. F. & Gollnick, D. M. Introduction to Teaching: Making a Difference in Student Learning. Sage Publisher.
7. Puri, U. Teaching Techniques. ND: Pragun.
8. Sharma, B. L. & Saxena B. M. Methods of Teaching. Meerut: R. Lall.
9. Sharma, T. R. & Bhargava, R. Modern Teaching Aids. Agra: HP Bhargav Books.

EDTE0023: TEACHER EDUCATION

(3 Credits - 45 hours)

Objectives: *The course in teacher education is designed to familiarize the students with the fundamentals of teacher education and the changes that were brought about as a result of the changes in the educational scenario. It will also enable the students to understand the concept and structure of teacher education, teaching as a profession and provide insight into the developments and trends in teacher education.*

Module I: Concept and Fundamentals of Teacher Education (13 hours)

Meaning, nature and scope of teacher education; Aims and objectives of teacher education; Historical perspectives of teacher education - Kothari Commission, National Commission on Teachers (1983-85), NPE (1986), Revised POA (1992); Recent developments in teacher education - NCF 2005, NKC 2007 & NCFTE 2009. History and status of Teacher Education in North East India. Problems and issues of Teacher Education in N.E. India.

Comparative analysis of Teacher education in the past and present.

Module II: Teaching as a Profession (12 hours)

Approaches to teacher education: Behaviouristic and constructivist approaches; Modification of teaching behaviour: Simulated teaching, Flanders' Interaction Analysis; Performance appraisal of teacher; Teacher effectiveness; Code of conduct and ethics in teacher education.

Classroom observation and analysis using Flanders' Interaction Analysis

Module III: Structure of Teacher Education Programmes (10 hours)

Role of professional organizations and bodies of Teacher Education; Pre-service and In-service teacher education; Teacher education by open and distance learning; Role of different agencies in quality assurance – MHRD, UGC, NCERT, NCTE, SCERT, NAAC, RIE, SIE, IASE, UGC-HRDC

Analysis of a distance learning teacher education programme

Module IV: Recent trends in Teacher Education (10 hours)

Internship, Practice teaching for developing an effective teacher, Integrated Teacher education programme; Action research; ICT in teacher education; preparing teachers for inclusive classrooms; Issues and challenges in teacher education.

Analyse the course structure of an integrated teacher education programme.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the meaning of teacher education (R); Illustrate the nature and scope of teacher education (U); Write the aims and objectives of teacher education (R); Describe the historical background of teacher education in India. (R); State the recommendations of Kothari Commission and National Commission on teachers (R); Explain the mechanism of growth and development of teaching profession as per NPE, 1986 and POA, 1992 (U); Use some innovations in teaching-learning process (Ap); Explain the recent developments in teacher education (U); Analyze NCFSE- 2005, NKC and NCFTE-2009 (An); Apply the important recommendations of NCFSE, NKC and NCFTE in practice (Ap)

Module II

State the basic features of Behavioristic approach to teacher education (R); Use the Behavioristic approach in teacher education programmes (Ap); Define constructivism (R); Explain constructivist approach to teacher education (U); Differentiate between the

behaviourist approach and constructivist approach to teacher education (Ap); Write the meaning of modification of behavior of teachers (R); Explain the simulated teaching as an approach (U); Apply simulated teaching approach for inculcating some social skills among the pupil teachers (Ap); Explain FIACS in detail (U); Analyze the behavior of the teacher by using FIACS (Ap); Evaluate the teacher (E); Define the term 'code of conduct' (R); Apply code of conduct and ethics in teaching profession (Ap)

Module III

State the nature of pre-service teacher education programme (R); State the objectives of pre-service teacher education programme (R); Explain the course structure of pre-service teacher education programme (U); Analyze the course content of pre-service teacher education programme (An); Use the designed curriculum of pre-service teacher education programme (Ap); Explain the concept of in-service teacher education programme (U); Analyze the components of in-service teacher education (An); Summarize the features of in-service teacher education programmes (Cr); Evaluate the pre-service teacher education programme of an institution (E); Write the meaning of open and distance learning (R); Explain the features of open and distance learning (U); Use open and distance learning system for teacher education programmes (Ap); Describe the role of different agencies in teacher education programmes like – MHRD,UGC,NCERT,NCTE,SCERT,RTE, etc.(R)

Module IV

Write the meaning of internship (R); Explain the objectives of school internship (U); Perform internship in schools effectively (Ap); Analyze the components of school internship (An); Assess the school internship (E); Define practice teaching (K); Write the objectives of practice teaching (K); Make the lesson plan and the use it in classroom for teaching (Ap); Analyze the components of lesson (An); Synthesize and create content of the lesson (Cr); Evaluate the performance of students (E); Explain the concept of integrated teacher education programme (U); Analyze the elements of integrated teacher education programmes (An); Evaluate the integrated teacher education programme of an institution (E); Define inclusive education (R); Explain the features of inclusive education (U); Use ICT in Teacher education (Ap); Prepare teachers for inclusive education and use those teachers in inclusive classrooms (Ap); Define action research (R); Analyze the features of action research (An); Explain the features and steps of action research (U); Apply action research and solve the problem (Ap)

Suggested Readings

1. Aggarwal J.C. Teacher education, theory and practices. New Delhi: Doaba Home.
2. Altekur. A.S. Education in ancient India. Banaras: Nand kishore Bros.
3. Anderson.L.W.et al. International Encyclopedia of Teaching and Training Education. Pergmon press.
4. Biddle, B.J., and Ellena. Contemporary research on teacher-effectiveness.
5. Buch. M.B. First survey of research in Education. Baroda: SERD.
6. Buch.M.B. Second survey of research in Education. Baroda: SERD.
7. Buch.M.B. Reading in in-service education. Sardar Patel Palasane, M.M. University.
8. Dunkin Michael J. The international encyclopedia of teaching and teacher education, Pergmon education forum, Vol 4 no 12, New York.
9. Harvilas, S. and Naik .J.P. A history of education in India. Bombay: Macmillan and co.
10. Hittlilman, D.R. A model for a competency based teacher preparation in Program-teacher education Forum, vol 4 no 12, New York.
11. Jangira N.K. Teacher training and teacher effectiveness an experience in Teaching. New Delhi: National Publishing House.
12. Kumar. T. P. Teacher education. APH Publishing Corporation.

13. NCERT 1968: The Third Indian year book on education. New Delhi: NCERT.
14. NCTE, Teacher education curriculum (1978): A Framework. New Delhi: NCERT.
15. Shrimali .K.L. Better teacher Education. New Delhi: Ministry of education Govt. of India.

EDME0024: MEASUREMENT AND EVALUATION IN EDUCATION

(3 Credits - 45 hrs)

Objectives: *The course aims at providing fundamental knowledge and skills on measurement and evaluation in education. It will also help the students to understand and evolve suitable and appropriate evaluation strategies while assessing performance. The course will acquaint the students with the functions, problems and current trends in educational measurement and enable them to develop basic skills and competencies in the use of various types of evaluation and assessment tools and techniques, their administration, analysis, interpretation, reporting and feedback and to construct a standardized test.*

Module I: Educational Measurement (7 hours)

Overview of measurement and assessment; Types of measurement - psychological and physical; Functions of measurement - Prognosis, Diagnosis, Research; Scales of measurement, Properties and Types - Nominal, Ordinal, Equal interval, Ratio; General problems of measurement; High stakes' testing, Performance and portfolio assessment.

Critical evaluation of the current trends in educational measurement

Module II: Dimensions of Educational measurement and Evaluation (10 hours)

Diagnostic, Aptitude, Achievement, Intelligence; Mode of assessment - formal, informal, formative, summative, continuous, terminal, process, product, internal and external; Process of assessment - Teacher-made test, standardized test, Norm reference test and criterion reference test.

Review of Stanford-Binet Test and General Aptitude Test Battery (GATB)

Module III: Reliability and Validity of a Test (8 hours)

- a) Overview of reliability - Methods of estimating reliability with computation - test retests method, Equivalent forms method, Split half method, Kuder-Richardson method; Inter-rater consistency; Interpreting reliability coefficient; factors influencing reliability measures.
- b) Nature of validity, major considerations in validation – content consideration, construct consideration, test-criterion relationship, consideration of consequences; Methods of estimating validity; factors influencing validity; Relationship between reliability and validity.

Practice session on estimating reliability and validity

Module IV: Tools and techniques for educational measurement (10 hours)

Overview of constructing various types of objective tests; Guidelines for writing objective test items; Essay questions: forms, uses, guidelines for constructing, scoring criteria. Interpretive exercises: nature, forms, and uses of the interpretive exercises, Advantages and limitations

Administration of a group test of intelligence using a standardized tool

Module V: Standardization of a test (10 hours)

Planning the test: Determining the objective and test specification, preparing the preliminary format - writing, arrangement, review and editing of test items; tryout of the test - administration, scoring and item analysis; preparing the final form of the test - selection of items, fixing the time limit, direction to the examinee, preparation of scoring key; administration of the final form of the test - determining validity, reliability, norms, standard scores; manual of the test, interpretation of test results, characteristics and uses of standardized test.

Students will prepare, administer and standardize a test, following the set procedures of standardization of a test

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the concept of measurement (R); State the features of measurement (R); Explain the principles of measurement (U); Name the types of measurement (R); Explain the different types of measurement (U); Illustrate the functions of measurement (U); Differentiate between prognostic and diagnostic functions of measurement (U); Illustrate the different scales of measurement (U); Apply the different scales in different situation (Ap); Analyze the process of measurement (An); Synthesize the characteristics of effective process of measurement (R); State the current trends in educational measurement (R); Find out the different abilities of the students (Ap)

Module II

State the different attributes of a student (R); Measure the different attributes of a student (Ap); Explain the different modes of measurement (U); Differentiate between formal and informal measurement and formative and summative process of measurement (U); Define the term evaluation (R); State the features of evaluation (R) Explain the features of evaluation (U); Explain the principles and steps of evaluation (U); Differentiate between the norm referenced evaluation and criterion referenced evaluation (U); Develop a teacher made test (Ap); Synthesize the process of internal evaluation (Cr); Analyze the external evaluation (An); Judge the worth of an object scientifically (E)

Module III

State the meaning of reliability (R) ; Analyze the concept of reliability (An); Name the methods of computing co-efficient of reliability (R); Apply the different methods of computing co-efficient of reliability (Ap); Explain the different factors affecting reliability (U); Interpret the computed co-efficient of reliability (U); Define the term validity (R); State the major consideration (R); Explain the different considerations (Ap); Identify the various considerations (Ap); Name the different types of validity (R); Explain the types of validity (U); Apply the different types of validity in different situation (Ap); Find out the content validity of test items (Ap); Analyze content and construct types of validity (An); Identify the factors affecting validity (Ap); Synthesize the factors affecting validity (Cr); State the relationship between reliability and validity (R)

Module IV

State the purpose of classroom testing (R); Write the meaning of test item (R); State the types of test items (R); Differentiate between objective type test and essay type test items (U); Write the guidelines for writing the objective type test questions (R); Develop the objective type test (Ap); Analyze the test items (An); Explain the concept of essay type test (U); State the guidelines for essay type test items (R); Develop the essay type test (Ap); Write the merits and demerits of objective and essay type test (R); Explain the nature and forms of interpretative exercise (U); Interpret the interpretative exercises (Cr); Use the interpretative exercises in practice (Ap)

Module V

Define an achievement test (R); Write the objective and specifications of the test (R); Explain the different steps of preparation of the test (U); State the aspects of planning of a test (R); Develop the preliminary draft of a test (Ap); Analyze the items of the preliminary draft of the test (An); Summarize the items and make a final draft of the test (Cr); Evaluate the final

draft of the test (E); Find out the reliability and validity of the test (Ap); Use the test for the purpose which it meant (Ap); Write features of a standardized test (R); Develop the manual of the test (Ap)

Suggested Readings

1. Gregory, R. J. Psychological testing: History, principles and application. Delhi: Pearson Education pvt. Ltd.
2. Kaplan, R.M. & Saccuzzo, D. P. Psychological testing: Principles, applications, and issues. Kundli Haryana: Thomson Wadsworth.
3. Kubiszyn, T. & Borich, G. Educational testing and measurement: Classroom application and practice. Kundli Haryana: John Wiley & Sons, Inc.
4. Linn, R. L. & Gronlund, N. E. Measurement and assessment in teaching. New Delhi: Pearson Education.
5. Sharma, R. A. Essentials of measurement in education and psychology. Meerut: R. Lall Book Depot.
6. Sidhu, K. S. New approaches to measurement and evaluation. New Delhi: Sterling Publishers Pvt. Ltd.
7. Ebel, R. L. & Frisbie, D. A. Essentials of educational measurement. New Delhi: Prentice-Hall of India Pvt. Ltd.
8. Patel, R. N. Educational evaluation theory and practice. Mumbai, India: Himalaya Publishing House Pvt., Ltd.
9. Singh, A. K. Tests, measurements, and research methods in behavioural sciences. Patna: Bharati Bhawan Publishers and Distributors.
10. Swain, S. K., Pradhan, C., & Khatoj, P. K. Educational measurement statistics and guidance. New Delhi: Kalyani Publishers.

EDPL0025: EDUCATIONAL LAW AND GOVERNMENT POLICY

(3 Credits - 45 Hours)

Objective: The course on Educational Law and Government Policy provides students a foundation to understand the legal, ethical, and policy dimensions of education. It offers an introductory survey of government policy issues, commission reports and laws governing schools with a special emphasis on case law. Detailed discussions will be held on constitutional provisions related to education and minority issues while understanding RTE, RTI and other relevant laws and ordinances.

Module I (10 Hours)

Jurisprudence, Provisions of criminal and civil laws pertaining to educational institutions; FIR; Arrest; Bail; Detention; Search.

Module II (10 Hours)

Relevant provisions from the constitution of India relating to education; Minority institution Act; Fundamental Rights (Article 13, 15, 21A, 28 & 30); Fundamental Duties 51A; Directive Principles of State Policy (37); Fifth and sixth schedule provisions.

Module III (5 Hours)

Landmark judgments related to education

Module IV (10 Hours)

Government policies, commissions and recommendations; The Panchayats Act (243B, G); The Municipalities Act (243Q, W); Fifth and sixth schedule provisions

Module V (10 Hours)

The Right of Children to Free and Compulsory Education (RTE) Act, 2009; Right to Information (RTI) Act 2005; North-Eastern education code

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Know the scientific study of law (R); State the provisions of criminal and civil laws related to educational institutions (R); Explain the provisions of criminal and civil laws in relation to educational institutions (U); Differentiate between the criminal and civic laws (U); Apply the laws for making and running educational institutions effectively (Ap); Explain the concepts like FIR, Arrest, Bail, Remand etc. (U)

Module II

List the relevant provisions of Indian constitution related to education (R); Explain the different provisions relating to education in Indian Constitution (U); Explain the Minority act (U); Define fundamental right (R); State the different Fundamental Rights (R); Use the Fundamental Rights in life (Ap); Explain the Fundamental Rights (U); Demonstrate the Fundamental defects in real life situation (Ap); State the Article 45 of Indian Constitution (R); State the efforts made by Government of India in accordance with Article 45 (R); Find out the effect of article- 45 of the Indian Constitution (Ap); Explain 42nd Amendment in Indian Constitution (Ap); State the Constitutional provisions like- Article 27, 28, 28 (1), 29 (2), 30, 30 (2), 45, 46, 337, 350A (R); Explain 83rd Amendment in Indian Constitution (U); Explain 86th Amendment in Indian Constitution (U); State the salient features of RTE Act, 2009 (R); State the Directive Principles of state policy (R)

Module III

List the significant judgments given by the court related to education (R); Analyze the judgments relate to education (An); Follow those judgments in practice (Ap)

Module IV

State the different commissions and committees on education in India (R); Explain Indian education commission (1882-83), Indian University commission (1902), University education commission(1948-49), Secondary education commission (1952-53), (1964-65) (U); Explain the features of NPE-1986,POA-1992(U); State the Panchayats Act (243B,G) and Municipalities Act (243 W) (R); Use the Panchayat and Municipalities for making education more vibrant (Ap)

Module V

Describe the Rights Based Framework of education (R); Explain the concept of UEE (U); State the different interventions for achieving the goal of UEE (R); Implement the prescriptions of Article-21A (Ap); State the need of RTE Act, 2009 (R); Implement SSA in accordance with RTE, Act (Ap)

Suggested Readings

1. Citizen's charter
2. Jain, M. P. Indian Constitutional Law. Jain Book house. Delhi
3. National Policy on Education 1986
4. Pandey, J.N. Constitutional Law. Jain Book house. Delhi
5. Report to the People on Education 2010-11 (MHRD)
6. Sadgopal, A. Right to education vs. right to education act. Social Scientist, 38(9/12), 17-50.
<http://eoc.du.ac.in/RTE%20-%20notified.pdf>

EDFM0026: FINANCIAL MANAGEMENT AND ACCOUNTING

(3 Credits - 45 hours)

Objective: *The purpose of this course is to provide students with working knowledge of accounts and finance in relation to education. The course will prepare students to understand taxation regulations related to education.*

Module I: Introduction (8 hours)

Evaluation of Financial Accounting; Difference between Accounting and Book Keeping; Accounting Concepts; Principles, Bases and Policies.

Module II: Journal (8 hours)

Double Entry Accounting; Journal; Posting; Ledger.

Module III: Balance Sheet (8 hours)

Trial Balance; Final Account – Trading Account, Profit And Loss Account, Receipt And Payment Account; Income Expenditure Accounts; Balance Sheets.

Module IV: Financial Management (10 hours)

Decision Making; Meaning and Scope; Cost Analysis; Budgetary Control; Standard Costing; Financial Analysis; Relevant Cost; Management Accounting Framework; Function of Management Accounting; Internal Audit; School Accounting and Auditing; Investment.

Module V: Taxation Management (11 hours)

Basic Concepts; Deduction from Gross Total Salaries; Income From House, Property; Profits and Gains of Business and Profession; Capital Gains; Income from other Sources; Set off and Carry Forward of Losses; Assessment of Individuals and Computation of Tax at Source, Assessment of Companies and Fringe Benefit and Service Tax. VAT/ GST.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the meaning of evaluation of financial accounting (R); Illustrate the concept of evaluation of financial accounting (U); Define financial accounting (R); Evaluate financial accounting (E); Define book keeping (R); Differentiate between accounting and book keeping (U); State principles of accounting (R); Use the principles in accounting (Ap); Explain the bases and policies of financial accounting (U)

Module II

Define double entry accounting (R); Explain the features of double entry accounting (U); Define journal (R); Explain the concept of journal and its utility (U); Explain the concept of posting (U); Differentiate between journal and posting (U); Define ledger (r); Prepare the ledger (Ap)

Module III

Write the meaning of balance sheet (R); Explain the basic features of a balance sheet (U); Define trial account (R); Explain the basics of trial balance (U); Prepare the balance sheet (Ap); Define 'final account' (R); Explain final account and trading account (U); Explain profit and loss accounts (U); Differentiate between profit and loss accounts (U); Write the meaning of receipt and payment (K); Differentiate between receipt and payment (Ap); Explain the income and expenditure accounts (U); Prepare the income and expenditure accounts (Cr)

Module IV

Describe the nature and scope of decision making (R); Explain the basic features of effective decision making (U); Define 'cost analysis' (R); Explain the components of 'cost analysis' (U); Find out the cost effectiveness (Ap); State the concept of budgeting control (R); explain the features of budgetary control (U); Define 'standard cost' (R); Explain the concept of standard cost (U); Do the cost analysis (Ap); Define financial analysis (R); Explain the components of financial analysis (U); Do the financial analysis (Ap); Explain the term 'relevant cost' (U); Identify the relevant cost (Ap): Explain the nature and scope of management accounting framework (U); write the functions of management accounting (R); Explain the features of internal auditing (U); State the meaning of school accounting and auditing (R); Do the school accounting and auditing (Ap); Explain the concept of investment (U)

Module V

State the basic concept of taxation management (r); State the different deductions from gross total salary (R); Explain the concept of gross salary (U); Explain the nature of different deductions from gross salary (U); Explain the nature of capital gains and income from other sources (U); Set off and carry forward of losses (R); Compute the income tax of a salaried and a businessman (Ap); Analyze the income of a salaried man (An); Analyze the income of a business man (An); Explain the concepts of service tax, VAT, and GST (U)

Suggested Readings

1. Block, S. B., G. A. Hirt, & B. R. Danielsen. Foundations of Financial Management. New York, NY: McGraw-Hill/Irwin.
2. Das, K.R., Sinha, K.M., & Choudhury, P. Theory and practice of bookkeeping and accountancy. Guwahati: lawyers book stall.
3. Lal, J & Srivastva, S. Financial Accounting: Principles & Practices. New Delhi: Chand Publications.
4. Wilson, M. Advanced Accountancy. Chennai: Scitech Publications.

EDLE0027: LIFE SPAN DEVELOPMENT AND EDUCATION**(3 Credits - 45 hours)**

Objectives: *This paper gives an overview of cognitive, emotional, psycho-sexual, social and moral development during the lifespan of an individual. Various theories of understanding human development are presented and discussed with a view to enable students to understand human growth and development and the role of education in holistic development of an individual.*

Module I: Introduction to Life Span Development (8 hours)

Life Span Perspective: Importance of studying Life-Span Development, Characteristics of life-span development, Nature of Development, Scope of Life span development. Theories of Development (Brief discussion of all theories), Influence of Socialization and Development.

Analyze the role of education in socialization and development of the child.

Module II: Biological Bases of Human Development and Anatomy of the Nervous system (14 hours)

The Evolutionary perspective and Heredity-Environment Correlations, genetic foundation, Conception, effect of Teratogens on Prenatal Development, Neonatal health - Low birth weight, Neonatal Assessment; Neuron: Structure, types and functions. Structure of the nervous system, physiological basis of the action potential (neural response); Structure and function of the brain: fore brain, mid brain, hind brain, cerebral cortex, temporal, parietal and occipital lobes; prefrontal cortex. The effect of hormones on the nervous system.

Debate on heredity and environment: essential factors affecting human development.

Module III: Physical development across life span (11 hours)

Physical growth during childhood, adolescence and old-age brain development across life span, Bio- Psycho-Social health model, aging, biological theories of aging and death.

Discussion on educational implications of stages of physical development

Module IV: Emotional and Moral Development (12 hours)

- a) Development of Emotion, Temperament, Attachment, Love, intimacy, sexuality, self-identity, gender identity and personality across the life span.
- b) Theories of moral development. Changes in moral reasoning (Kohlberg's Theory). Development of values, Religion, Spirituality and Meaning in Life, Fowler's Theory

'Emotions are springs of human actions'- A group discussion on teachers' role in bringing about balanced emotional development of students

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Understand the meaning of life span (U); Explain the process of life (U); Write about the concept of life span (R); Explain the importance of life span development (U); State the characteristics of lifespan development (R); Differentiate between growth and development (U); Understand the meaning of development (R); Analyze the nature of development (An); Illustrate the scope of life span development (Ap); Analyze the theories of development (An); Apply the principles of the theories of development in educating our children (Ap); State the meaning of socialization (R); Discuss the influence of socialization on development process of an individual (Ap); Summarize the role of education in development of a child (Cr)

Module II

Understand the contributions of heredity and environment on the human development (U); Understand about the biological bases of human development (U); Identify the major developmental periods of an individual (Ap); Find out the effect of teratogens on prenatal development (R); Analyze the problems faced in neonatal health (An); Apply the knowledge in real life situations (Ap); State the meaning of neurons (R); Illustrate the structure of a neuron (Ap); Describe the types and functions of a neuron (U); Explain the structure of nervous system (U); Understand the physiological basis of neural response (U); Illustrate the structure of brain (Ap); Write the functions of the brain parts (K); Explain the effect of hormone on the nervous system (U)

Module III

State the developmental stages of a child (R); Understand the characteristics of a child at various stages of childhood (U); Describe the physical development aspect of a child at the various stages (U); Identify the problems faced by a child during the physical development (Ap); Explain the period of adolescence (U); Find out the characteristics of the stage of adolescence (Ap); Understand the physical development of an adolescent (U); State the bio-psycho social health model (R); Understand the concept of aging and death (U); Find out the educational implications of the stages of physical development (Ap)

Module IV

State the meaning of emotion (R); Write about the different types of emotions (R); Understand the emotional development of an individual at different stages of development (U); Understand the meaning of temperament, love, intimacy in relation to emotional development (U); Understand the concept of sexuality, self-identity, gender identity in relation

with emotional development (U); Explain the major theories of moral development (U); Find out the implications of the theories of moral development in an individual's life (Ap); Explain the process of value development in an individual (U); Understand the concept of religion development and spirituality development in an individual (U); Understand the Fowler's faith development theory (U); Identify the role of teachers in bringing about a balanced emotional development of students (Ap)

Suggested Readings

1. Allyn and Bacon, S. M. An introduction to Physiological Psychology. USA: Random House
2. Berk, L.E. Child Development. New Delhi: Prentice Hall.
3. Bhaskar, R. Fundamentals of child psychology. Delhi: Swastik Publishers and Distributers
4. Carlson, N.R. Physiology of behaviour Boston
5. Chatterje,C., Suhita, P, Priyadarshi,C. and Vijayaraghavan, M.(Eds). Discourses on Aging and Dying. Los Angeles: Sage
6. Hurlock, E.B. Child development. New Delhi: Tata McGraw-Hill Publishing Company Limited
7. Hurlock, E.B. A Life-Span Approach. New Delhi :Tata McGraw-Hill Publishing Company Limited
8. Leukel, F. Introduction to physiological psychology. New Delhi: CPS Publishers
9. Mallon, B. Dying, death and grief, working with adult bereavement. Los Angeles: Sage
10. Mishra, A.K. Psychology of Aging. Jaipur: Sublime Publications
11. Morgan, T.H and Steller, A.(1965).Physiological Psychology. New York: McGraw Hill
12. Santrock, J.W. Life –Span development. New Delhi: Tata McGraw-Hill
13. Santrock,J.W. Child Development. New Delhi: Tata McGraw-Hill Edition
14. Sharma,R. N. and Sharma, R. Child Psychology. New Delhi: Atlantic

EDLI0028: LEARNING AND INDIVIDUAL DIFFERENCES

(3 Credits - 45 hours)

Objectives: *The course on Learning and Individual Difference provides the students an understanding of the concept of learning, its nature, scope, types and styles. It acquaints the students with the factors influencing learning. It introduces the students to the concept of Transfer of Learning, its types, theories and the educational implications of transfer of learning. It also provides insights to the students on individual difference, its determinants, types and its implications on learning in particular and educational programme as a whole.*

Module I: Understanding Learning (10 hours)

Learning: Concept and Scope; Nature of learning: learning as a process and learning as an outcome; Laws of learning; Types of learning: factual, associations, conceptual, procedural, generalizations, principles and rules; Methods of effective learning; Learning curves - Types, features and its educational implications; Plateaus in Learning; Learning styles.

Students analyze their own learning styles

Module II: Factors Influencing Learning (12 hours)

Factors influencing learning - Intellectual, Emotional, Physical and Social; Concept and nature of attention, determinants of attention, relationship with interest; Concept, nature and types of motivation – intrinsic, extrinsic and achievement; Learning and maturation; Learning to think, reason and solve problems

Discuss the role of teacher in addressing various factors influencing learning

Module III: Transfer of learning (10 hours)

Transfer of learning - Concept, Importance, Nature; Types of transfer of learning; Theories of transfer of learning - Theory of mental discipline, Theory of identical elements, Theory of generalization and theory of ideals; Methods of enhancing transfer of learning

Developing a narrative of personal experiences on the basis of transfer of learning in various situations

Module IV: Individual Difference (13 hours)

Concept of individual difference; Dimensions of individual difference; Determinants: Role of heredity and environment, their inter-relationship; Types/varieties of individual differences - Physical, mental, motor, emotional, interest and aptitude, attitudes, social and moral development. Individual difference and education; Influence of individual differences on learning outcomes; Provisions for individual differences in educational institutions; Implications of individual differences for organizing educational programmes

Sharing session on the problems and issues related to individual differences as faced by the students

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define 'learning'(R); Analyze the definition of learning (An); Construct their own definition (Ap); Explain the nature and scope of learning (U); Summarize the basic features of learning (Cr); Evaluate the learning of an individual (E); State the laws of learning (R); Explain the laws of learning (U); Apply the laws of learning in the process of their learning (Ap); Name the types of learning (R); Explain the different principles of learning (U); Use different methods for effective learning (Ap); Explain the learning curve by indicating the types and features (U); State the meaning of plateaus in learning (R); identify using different learning styles (Ap); Analyze the learning styles of their classmates (An); Evaluate the effectiveness of learning styles (E)

Module II

State the factors affecting the process of learning (R); explain the physical and social factors influencing the process of learning (U); Define the term 'attention' (R); Explain the determinants of attention (U); Find out the relationship between attention and interest (Ap); State the meaning of motivation (R); Name the types of motivation (R); Describe the learning and maturation (R); Find out the level of maturation and its effect on learning (Ap); Use components of learning in practice and solving the problem (Ap)

Module III

Define the concept of transfer of learning (R); Explain the nature and types of transfer of learning (U); Name the theories of transfer of learning (R); Explain the theory of mental discipline (U); Apply the theory of discipline in creating learning among the students (Ap); Analyze the theory of identical elements (An); Apply the theory of identical elements in teaching-learning process (Ap); Differentiate between the theory of generalizations and theory of ideals (Ap); Synthesize the educational implications of transfer of learning (Cr); Explain the methods of enhancing transfer of learning (U)

Module IV

Describe the meaning of individual difference (U); State the dimensions of individual difference (R); Explain the significance of individual differences (U); State the determinants of individual differences (R); Explain the heredity and environment in relation to individual differences (U); Find out the influence of environment on the individual differences of students (Ap); Analyze the causes of individual differences (An); Classify the individual differences in different categories (Ap); Explain the effect of individual differences on learning outcomes of the students (U); State the provisions for individual differences in educational institutions (R);

Use the provisions for facilitating differently-abled students in educational institutions (Ap); Identify the individual differences and using in organizing various activities in the educational institutions (Ap)

Suggested Readings

1. Bhatnagar, S. Advanced Educational Psychology. Agra: Bhargava Book House.
2. Chand, T. Educational Psychology. Agra: Bhargava Book House.
3. Crow, R.B. & Crow, A. Educational Psychology. New Delhi: Eurasia Publishing House.
4. Decece, J. P. The Psychology of Learning & Instruction. New Delhi, Prentice Hall.
5. Dhir, R.N. Educational Psychology. Chandigarh: Abhishek Publication.
6. Driscoll, M. P. Psychology of Learning for Instruction. Boston, Allyn and Bacon
7. Gagne, R. M. The Conditions of Learning. New York, Rinehart & Winston
8. Guilford, J.P. The Nature of Human Intelligence. New York: McGraw Hill.
9. Hall, C & Hall, E. Human relations in education. Routledge.
10. Holt, J. How children fail? Penguin.
11. Hulac, D. M., & Benson, N. Getting Students to Work Smarter and Harder: Decreasing Off-Task Behaviour through Interpersonal Techniques. School Psychology Forum,5(1), 29-36.
12. Judd, C.H. Educational Psychology, Guwahati: Nivedita DK Distributions.
13. Kumar, K. What is worth teaching? Orient Black Swan.
14. Kuppaswamy, B. Advanced Educational Psychology. Jalandhar: Jalandhar University
15. M. Gauvain & M. Cole, (Eds). Readings on the development of children. New York: W. H. Freeman & Co.
16. Mangal, S. K. Essentials of Teaching Learning and Information Technology. Ludhiana: Tandon Publishers.

EDOC0029: ORGANISATIONAL COMMUNICATION

(3 Credits- 45 hours)

Objectives:

- To enable the students to learn effective professional communication styles.
- To create some organizational communication skills among the students
- To make the students well aware of the process of feedback and professional boundaries.

Module I Conceptual Framework of Communication (10 hours)

Concept and functions of Communication; Communication and four senses; Communication process, communication model and its elements; scope of communication

Module II Organisational Communication (12 hours)

Relationship between Organisation and Communication; common modes of communication in an organisation: writing, conversation, reading, media, charts, proceedings, TV, telephone, e-mail and other modes of communication; Formal and informal communication; practical approaches in understanding administrative communication: cross communication, downward communication, upward communication

Module III Communication Techniques (13 hours)

Presentation skills, effective use of voice in presentation: articulation, tone, pitch; making effective presentations; use of visual aids in presentation; communication in teams: project teams, quality improvement teams, virtual teams; communicative dimension of team work- roles, norms, decision-making processes and management of conflict.

Module IV Feedback and professional boundaries (10hours)

Feedback, Administrative feedback, models of feedback, assessing the listening skills; maintaining Professional Communication- professional boundaries, violation and maintaining of boundaries

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I: Define communication (R); Summarize the importance of communication (U); Explain feedback (R); Appraise the need and significance of feedback (E); State the concept of Administrative feedback (R); Explain the purpose of administrative feedback (U); Interpret the different forms of feedback (U); Illustrate Jeo-hari Window model of feedback (U); Apply Jeo-hari Window to assess themselves (Ap); Explain Ladder of Inference as a model of feedback (U); Judge the best model of feedback in their own work place (Ap) Explain the meaning of professional boundaries (R); Identify some of the common violation of professional boundaries (An) ; Propose ways and means for maintaining professional boundaries (Cr)

Suggested Readings

1. Baker, G.S. *Fitly Spoken: Developing Effective communication and social skill*. New York: Paperback
2. Gillis, T. *The IABC Handbook of organisational communication: A guide to internal communication, public relations, Marketing and Leadership*. New York: Jossey-Bass.
3. Hardman, E. *Active Listening 101: How to turn down your volume to turn up your communication skills*
4. Hargie, O. *Skilled Interpersonal Communication: Research Theory and Practice*. London: Routledge.
5. Harris, E. T. and Nelson, D. M. *Applied organisational communication: Theory and practice in global environment*. London: Routledge.
6. Krishnamachuryulu, R. & Lalitha. *Business communication: Global Media*
7. Lewis K. L. *Organisation change: Creating change through strategies communication*. New York. Wiley.
8. Miller, K. *Organisational Communication: Approaches and Processes*: London: Wadsworth Publishing
9. Tourish, D and Hargie, O. *Key Issues in organizational communication*. London: Routledge.

Specialisation: Educational Leadership

EDEA0030: EDUCATIONAL ADMINISTRATION

(3 Credits-45 hours)

Objectives:

- *To enable students to acquire knowledge and skills in the field of educational administration.*
- *This create awareness about among the students about the fundamental educational administrative functions.*
- *To enable the learners to have some leadership qualities.*

Module I Conceptual Framework of Educational Administration (12 hours)

Nature and scope of educational administration; Objectives of educational administration; Elements of educational administration; Characteristics of successful administration; Democratic administration.

Module II School Management (10 hours)

Concept of School; Need of school; School management; Headmaster/Principal as the school manager and her/his qualities; Role of teachers and community in school management; Infrastructural resource management

Module III Concept of Supervision (12 hours)

Meaning of supervision; Difference between supervision and administration; Effective supervision; Functional basis of supervision; Supervision as leadership

Module IV Evaluation and Supervision. (11 hours)

Concept of evaluation; Principles of evaluation; Evaluation of supervisory programme; Evaluation of Educational administrative programme; Evaluation as a continuous programme for quality improvement

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Write the definition of educational administration (R); Explain the concept of educational administration (U); Illustrate the scope of educational administration (U); Write different objectives of educational administration (K); Analyze the definition of educational administration (An); Synthesize the definition of educational administration (S); Construct his/her own definitions (Cr); Explain the different elements of educational administration (U); Outline the important features of successful educational administration (U); Differentiate between educational administration and educational management (U); Discuss the concept of democratic administration (Cr); Use the democratic education administrative in practice (Ap); Identify the democratic educational administration (Ap) Importance of Democratic Administration (E)

Module II

Write the historical background of the concept 'school' (R); Explain the concept of school (U); Describe the need of school (K); Define the term management (R); Explain the concept of school management (U); State the role of headmaster as school manager (R); Perform the role of a successful headmaster (Ap); State the role of teachers in school management (R); Differentiate between the role of headmaster and teachers in school management (U); Explain the questions of an effective and efficient Headmaster / Principal (U); Find out the relationship between the role of headmaster and teachers (Ap); Analyze the duties of head master and teachers (An); Summarize the role of community in school management (S); Define physical resources of a school (R); Plan and use the resources for judiciously and giving maximum output (Cr)

Module III

Write the meaning of supervision (R); Explain the concept of supervision (U); Analyze the elements of supervision (An); Explain the elements of supervision (U); Establish the relationship among the elements of supervision (An); Differentiate between supervision and administrative (U); Explain the features of an effective supervision (U); Use the aspects of effective supervision (U); State the functional basis of supervision (R); Explain the functional basis of supervision (E); Apply the effect of supervision on the teaching learning process (Ap); State the qualities of a good supervisor (R)

Module IV

Define the term 'evaluation' (R); Explain the different principles of evaluation (U); Apply the principles in supervisory work (Ap); Explain the steps of evaluation (U); Contrast and

compare between Evaluation and Supervision (E) Evaluate the supervisory programme (E); Evaluate the educational administration (E); Find out the problems in supervisory programme and giving the solution (Ap); State features of an effective evaluation programme (R) Discuss on effective evaluation programme (Cr)

Suggested Readings

1. Adams, H.P & Duckey, F.G. Basic Principles of supervision.
2. Arif, S., & Sohail, A. What Really Works in Leading a School? International Journal of Learning, 16(10), 695-707.
3. Boghossian, P. Behaviorism, Constructivism, and Socratic Pedagogy. Educational Philosophy & Theory, 38(6), 713-722.
4. Cara, C. The Power of One with Many Revisited: Creating Inclusive, Accessible, Collaborative Education for All. International Journal of Learning, 14(8), 221-233.
5. Chandler, L. Design Dynamics and Mastery: A Multi-modal Teaching Tool for Design Students. International Journal of Learning, 14(5), 51-57.
6. Donahoo, S. & Hunter, R. Teaching Leaders to Lead Teachers: Educational Administration in the Era of Constant Crisis. Advances in Educational Administration, Volume 10, 1-4. Elsevier Ltd.
7. English, F. (ed.). Encyclopedia Educational Leadership and Administration (Vol. 1). Sage Publication: Thousand Oaks.
8. Stanley, A. G. & Samier, E. A. Political Approaches to Educational Administration and Leadership. Routledge: New York.
9. Starratt, R. Centering Educational Administration: Cultivating Meaning, Community, and Responsibility. Lawrence Erlbaum Associates, Publishers: New Jersey
10. Tarc, A. Education as Humanism of the Other. Educational Philosophy & Theory, 37(6), 833-849.
11. White, R. & Cooper, K. (Ed.). Principals in Succession Transfer and Rotation in Educational Administration. Springer: New York.

EDSR0031: ETHICS AND SOCIAL RESPONSIBILITY IN EDUCATION

(3 Credits- 45 hours)

Objectives:

- To acquaint the students with the conceptual framework of ethics
- To create awareness among the students about social responsibility
- To enable the students to have theoretical perspectives of ethics and social responsibility

Module I Educational Ethics (9 hours)

Concept of Ethics and educational ethics; Need of ethics in educational settings; Components of ethics; types of values, morals

Module II Theoretical Perspectives of ethics (12 hours)

Ethical theories: Utilitarianism, Kantian ethics, Natural rights theories; religious ethics; virtue ethics; Kantian vs utilitarian; gender and ethics; ethics and leadership. Concept of ego: psychological, ethical, rational. Moral philosophy

Module III Ethics and Social Responsibilities (12 hours)

Concept of social responsibility; Need of social responsibility; Types of social responsibility; Social responsibility of educators; Strategies of social responsibility

Module IV Professional Development (12 hours)

Concept of profession; Criteria for a profession; Teaching as a profession; Workplace and code of conduct, Technology and globalization in relation to professional ethics and developmental activities

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the meaning of ethics (R); Define Ethics(R) Explain the concept of ethics (U); Illustrate the need and purpose of ethics (U); Find out the relevance of ethics in 21st century (Ap); Write the importance of ethics in education system (R); Find out the components of ethics (Ap); Understand the relationship between values, morals and ethics (U); Differentiate between values, morals and ethics (An); the utilitarianism theory of ethics (U); Explain the Kantian theory of ethics (U); Explain the natural rights theory of ethics (U); Explain the religious theory of ethics (U); Find out the differences between Kantian and utilitarian theory of ethics (Ap); Understand the relationship among gender and ethics and leadership and ethics (U); State the meaning of ego (K); Explain the types of ego (U)

Module III

Write about the meaning of social responsibility (R); Explain the need of social responsibility (U); Find out the role of social responsibility (Ap); Analyze the problems of DPEP (An); Explain the types of social responsibility (U); Find out the effects of social responsibility on the development of ethics (Ap); Evaluate the social responsibility of teachers (Ap); Explain the strategies of social responsibility (U) ;Evaluate the strategies of social responsibility(E);Solve the problems encountered in the process of delivering social responsibility(Cr)

Module IV

Write about the meaning of profession (R); State the criteria of a profession (R); Identify how ethics influences a profession (Ap); Understand the importance of teaching as profession (U); Evaluate the role of ethics in a workplace (Ap); Describe the code of conduct of a teacher as per the rule of UGC (U); Explain the impact of technology on the development of ethics; Analyze the influence of globalization on ethics and developmental activities (An);Importance of code of conduct(E);List some code of conduct for teachers(An)

Suggested Readings

1. Hill, I. Curriculum Development and Ethics in International Education: Education for Disarmament, pp 49-58. Retrieved from Disarmament Forum.
2. Raina, R. Situating Ethics in Technology and Science, Economic and Political Weekly, June 5, (vol xlv no 23)
3. Roddick, A. Professionalism and Ethics. In Understanding Facilitation: Theory and Principles (pp 189 - 216).Christine Hogan. London: Kogan Page.
4. Sikand, Y. Deoband's Fatwas on Muslim Women, Economic and Political Weekly. May 22, (vol xlv no 21)
5. Sreekumar, N. Ethics, profession and developmental concerns, Economic and Political. Weekly June 26,

Specialization: Educational Psychology**EDSP0032: COUNSELLING SKILLS FOR EDUCATIONAL PSYCHOLOGISTS**

(3 Credits-45 hours)

Objectives:

- *To create understanding among the students about the conceptual framework of counselling skills*
- *To orient students about the skills of educational psychologists for counselling*
- *To make the students well aware of the process of identifying counselling skills*

Module I Introduction to Counselling (12 hours)

Meaning, nature, objectives and scope of counselling, counselling as a process: factors affecting counselling process, stages of counselling process, types: individual and group; approaches of counselling: Directive, Non-directive and Eclectic Counselling

Module II Theories of Counselling (12 hours)

Gestalt Counselling, Psychoanalytic Counselling, Cognitive Psychologists, Personality -Cattle's Truth Theory, Behavioral Counselling

Module III Introduction to Educational Psychologists (11 hours)

Concept of Educational psychologists, need of educational psychologists, educational psychology as a career, key skills for educational psychologists, concept of guidance ,need and types of guidance, guidance and counselling services, tools and techniques to be used for student counselling process

Module IV Teacher as a Guide and Counsellor (10 hours.)

Role of teacher as an educational psychologist, guidance worker and counsellor, Counselling skills: Building trust, Listening, Attending, Building rapport, Demonstrating Empathy, Observing; Difference between counsellors, educational psychologists, clinical psychologists

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Write the meaning of counselling (R); Explain the nature and scope of counseling (U); List down the objectives of counselling (An); Explain counselling as a process (U); Find out the factors affecting counselling (Ap); List down the stages of counselling process (U); explain the types of counselling namely individual and group counselling. (U); Describe the approaches of counselling namely directive, non- directive and eclectic counselling (U)

Module II

List down the different theories of Counselling (An); Explain the gestalt theory of counselling (U); Explain the Psychoanalytic theory of counselling (U); Explain the Catell's truth theory (U); Understand the behavioral counselling theory (U); Compare the different theories of Counselling (An);Elaborate the theories of Counselling(Cr);

Module III

Create understanding about the conceptual framework of Educational Psychology (Cr); Explain who are called as Educational psychologists (U); Identify the need of educational psychologists (An); Understand educational psychologists can be taken as a career (U); List out the key skills needed for educational psychologists (An); Assess the skills needed in day to day life as a counselor (E); Understand the concept of guidance (U); Point out the need of guidance (U); Classify the types of guidance (U); Summarize the importance of guidance and counselling services in our society (E); Create the tools and techniques to be used for student counselling (Cr); Make use of the tools for counselling(Ap)

Module IV

Define the role of a teacher as an educational psychologist (R); Assess the role of teacher in counselling process (E); Identify the counselling skills (Ap); Analyze the importance of counselling skills for the students (An); Evaluate the significance of listening, attending , empathy and observing as a skill of counselling (E); Differentiate between counselors and educational psychologists (U); Differentiate between counselors and clinical psychologist (U); Understand the relationship between the educational psychologist, clinical psychologists and counselors (U) Improve on the role of teachers in counselling process(Cr)

Suggested Readings

1. Kinra, K. K. (2008) Guidance and Counselling, Pearson India
2. Alam, Shah. (2008) Basics of Guidance and Counselling, Global Vision Publishing House
3. Hansen, J. C. (1982) Counseling Process and Procedures. New York: Macmillan.
4. Madhukar, I. (2000) Guidance and Counseling. Authors Press.
5. NCERT.(2009) Guidance and Counseling. Module –I, NCERT, New Delhi
6. NCERT. (2009) Guidance and Counseling, Module –II NCERT, New Delhi
7. NCERT. (2009)Guidance and Counseling. Module –IX NCERT, New Delhi
8. Oberoi, S.C. (2016) Guidance and Counseling. Paperback, R.Lall publishers
9. Pandey, V.C. (2005) Educational Guidance and Counseling. Isha Books
10. Rao, S.N. (1993) Counseling and Guidance, McGraw Hill Education

EDCA0033: CHILD AND ADOLESCENT MENTAL HEALTH**(3 Credits-45 hours)****Objectives:**

- *To create awareness among the students about mental health of children and adolescents*
- *To acquaint the students with the critical issues of children and adolescents*
- *To acquaint the students with various problems pertaining to mental health of child and adolescents*
- *To create understanding among the students about parenting and role of teachers in the mental health of children and adolescents.*

Module I Introduction to Mental Health (11 hours)

Concept of mental health: Historical background of mental health, objectives, scope, and need of mental health, factors affecting mental health; characteristics of a mentally healthy person; Mental health promotion, preventive intervention & treatment

Module II Mental Health as a Primary Health Concern among children (12 hours)

Childhood as critical stage of development: Child mental health as a primary health concern, factors affecting child mental health; Children with problem behaviours and developmental difficulties- language difficulties, Autism, Need for a comprehensive mental health system; Integrated approaches to early childhood mental health; Government policies and programs addressing childhood well- being

Module III Mental Health as a Concern among Adolescents (12 hours)

Concept of adolescents and adolescence, Adolescence as a period and its characteristics, Adolescence as period of stress and storm; Indicators of mental health development among adolescents, Introduction to problem behaviours among adolescents - delinquency, anxiety, conflict, stress, depression, drug abuse, substance abuse, alcoholism, adjustment mechanisms

Module IV Education and Mental Health (10 hours)

Mental health services in schools; child guidance clinic; Role of parents and teachers in fostering mental health among children and adolescents; promoting psychological well-being among children and adolescents; guidance and counseling

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

- Find the historical background of mental health (R); Define the mental health (R); State the objectives of mental health (R); Explain the need and scope of mental health (Ev); Write the

factors affecting mental health (r); Compile the characteristics of mentally healthy person (Cr); Illustrate the ways and means to promote mental health (U); Discuss preventive measures for mental health (Cr); Apply treatments for restoring the mental health (Ap); Compare mental health and physical health (An)

Module II

State the features of childhood stage (R); Explain the mental health as the primary aspect in childhood (U); Illustrate the factors affecting mental health in childhood (U); Identify the children with problematic behavior and some developmental difficulties (Ap); Design the stated comprehensive mental health system (Cr); Analyze the comprehensive mental health system (An); Explain the integrated approaches to early childhood mental health (U); State the Government policies and programmes for the childhood well-being (R); Determine the mental health system (E)

Module III

Define the concept of adolescent and adolescence (R); Explain the features of adolescence period (U); Explain adolescence as a period of stress and storm (U); State the indicators of mental health development among adolescents (R); Find out the problems of adolescents (Ap); Find out the solutions of the problems of adolescents (Ap); Discuss the mechanism of adjustment for adolescent (Cr)

Module IV

Investigate the status of mental health of school going children (An); Classify the students in accordance with their level of mental health (An); Provide some mental health services to the students belonging to low level of mental health (Ap); Explain the concept of child guidance clinic (U); State the role of child guidance clinic in helping the children concerning to their mental health (R); Explain the role of parents and teachers in helping the enhancement of mental health of the children (U); Define the term 'well-being' (R); Plan and Promote psychological well-being among the school going children through guidance and counseling (Ap)

Suggested Readings

1. Chauhan, S.S. (2010). Advanced Educational Psychology, Noida. Vikas Publishing House Pvt. Ltd.
2. Goswamee, G. (2008) Child Development and Child Care. Guwahati: Arun Prakashan
3. Hadfield, J.A., (1952) Psychology and Mental Health, A Contribution to developmental Psychology, George Allen & Unwind
4. Kapur, M. (1995) Mental Health of Indian Children. New Delhi: Sage Publications.
5. NCERT. (2009) Developing Mental Health and Coping Skills, Module 10, NCERT, New Delhi
6. Nayar, S. U. (2012) Child and Adolescent Mental Health. New Delhi: Sage Publications.
7. Sharma, Neerja (1999) Understanding Adolescence. New Delhi. National Book Trust, India.
17. Mangal, S.K. Advanced Educational Psychology. New Delhi: Prentice hall of India.
18. Vygotsky, L. Interaction between learning and development. In Gauvain and Cole (Eds) Readings on the development of children. New York: Scientific American books.

EDFE0101: FOUNDATIONS OF EDUCATION

(4 Credits – 60 hours)

Objectives: This course on Foundations of Education aims at

- Acquainting students with the meaning, aims and objectives of education
- Providing the students with a holistic view of the forms and bases of education
- Helping them to identify the various dimensions of education and educational institutions

- *Helping them to understand the importance and needs of child-centred education and the various methods of education*

Module I: Meaning, Aims and Objective of Education (16 hours)

Education: meaning, concept, nature and Functions - Narrow and broader concepts of education. Education as a process, a product and a discipline. Aims of education – individual, social and national aims. Objectives of Education – Four pillars of education (Delor’s Report: Learning to Know, Learning to Be, Learning to Do, and Learning to Live Together).

Module II: Forms and Bases of Education (15 hours)

- a) Forms of Education: Formal education, Informal education and non-formal Education – Meaning, concepts, nature and importance
- b) Bases of Education: philosophical, psychological, sociological and biological

Module III: Dimensions of Education (14 hours)

The learner, the teacher-qualities and responsibilities; curriculum and co-curricular activities - meaning and modern concept, need and importance; Educational Institutions – school, family and social institutions, religious institutions, state, etc. – their roles in education.

Module IV: Child-Centrism in Education and Educational Methods (15 hours)

Practices and significance of child centered education; Play and play-way in education - Kindergarten, Montessori, basic education and project method.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the term ‘education’ (R); Explain the meaning and nature of education as a concept (U); State the objectives of education (R); Illustrate the functions of education (U); Analyze education as a process and a product (An); Establish education as a discipline (Ap); State individual, social and national aims of education (R); Differentiate between individual and social aims of education (Ap); Differentiate between the aims and objectives of education (Ap); Explain the four pillars of education as per Delor’s Report (U)

Module II

Describe the features of formal education (R); Write about non-formal education (R); Illustrate the concepts of formal and non-formal education (U); State the concept and importance of informal education (R); Explain the philosophical basis of education (U); Synthesize the philosophical basis of education (Cr); Explain the psychological and sociological bases of education (U); Illustrate the biological basis of education (U)

Module III

State the dimensions of a learner (R); State the qualities of a teacher (R); Explain the relationship between teacher and learner (U); Define the term ‘Curriculum’ (R); Explain the various dimensions of curriculum (U); Analyze the curriculum (An); Use the curriculum in practice (Ap); Evaluate the curriculum (E); State the features of a good school (R); Explain the rules family, social and religious institutions in the field of education (U)

Module IV

State the concept of child-centred education (R); Explain the features of child-centred education (U); Make the process of education child-centred in nature (Ap); Write the meaning and significance of play way method in education (K); Explain the contributions of Maria Montessori in pre-primary education (U); State the concept of Basic education (K); Analyze the basic features of basic education (An); Find out the scope and space of Basic education in

NCFSE-2005 (Ap); Explain the structure of Project method of teaching and learning (U); Apply project method for teaching and creating learning among the students (Ap)

Suggested Readings

1. Aggarwal, J.C. (2017). Theory and Principles of Education. New Delhi: Vikas Publishing.
2. Chakraborty J.C (1982). Modern Education: Its aims and principles. Calcutta: S.Chakraborty.
3. Chandra, S.S. and Sharma, R.K (2004). Principles of Education. New Delhi: Atlantic Publisher.
4. Chaube. S.P and Chaube, A. (2007). Foundations of Education. Noida: Vikas Publication.
5. Daly. A. J. (2010). Social Network Theory and Educational Change. California: Harvard Education Press.
6. Gutek, G. L. (2004). The Montessori method. London: Rowman and Littlefield.
7. Hayden, M. and Thompson, J (eds.) (1998). International Education: Principles and Practice. London: Routledge Falmer Taylor & Francis Group.
8. Isaacs, B. (2012). Understanding the Montessori approach: Early years' education in practice. New York: Routledge.
9. Kundu, D. and Tarun, R.M. (1990). Modern theory and principle of education. New Delhi: The world press private limited.
10. Saxena, N.R. S (2014). Philosophical and sociological foundations of education. Meerut: Vinay Rakheja.

EDPF0102: PHILOSOPHICAL FOUNDATIONS OF EDUCATION

(4 Credits – 60 Credits)

Objectives: *This course aims to*

- *assist learners to understand the theoretical bases of education.*
- *help students to reflect upon the philosophical ideologies of Western and Indian thinkers.*
- *develop in the students an understanding of the link between educational philosophy and national values*
- *make students comprehend the basics of Philosophy of Knowledge and Value as a part of education.*

Module I: Philosophy and Education (10 hours)

Introduction to the historical and philosophical traditions in education - Socrates and philosophical ideals, relationship and influence of philosophy on education

Module II: Western and Indian Philosophical ideologies (15 hours)

Comparative analysis of Western and Indian Philosophical ideologies:

- a) Indian: Swami Vivekananda, Rabindranath Tagore, Mahatma Gandhi, Aurobindo Ghosh, Krishnamurti.
- b) Western: Plato, Jean Jacques Rousseau, Friedrich Froebel, John Dewey, Paulo Freire.

Module III: Schools of Philosophy and National Values (15 hours)

- a) Indian schools of Philosophy: Vedic philosophies and Buddhism - in terms of knowledge, reality and value.
- b) Western Schools of Philosophy: Idealism, Naturalism, Pragmatism, Realism, Humanism: special reference to principles, aims of education, curriculum, teaching methods, teacher, discipline, role and place of student.
- c) Inculcation of core national values as enshrined in the Constitution of India

Module IV: Education and Epistemology (10 hours)

Knowledge - Nature, role of knowledge, scientific inquiry, senses and feelings, experience (empiricism), reasoning and logic - inductive and deductive

Module V: Education and Axiology (10 hours)

Values - conceptual basis, need and importance, role of education, morality and actions, aesthetics, ethics - Kantian ethics, responsibility and freedom

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define 'philosophy' (R); Explain the historical background of philosophical traditions (U); State the contributions of Socrates in philosophy (R); Describe the different philosophies (R); incorporate the applications of different philosophies in education (Ap)

Module II

Explain the features of Indian Philosophical Ideologies (U); Explain the features of western Philosophical ideologies (U); Compare the Indian and Western Philosophical ideologies (Ap); State the contributions of Indian thinkers like: Swami Vivekananda, Rabindranath Tagore, Gandhi, etc. (R); Explain the contributions of western thinkers like Plato, Rousseau, Froebel, Dewey and Freire (U)

Module III

Explain the Vedic philosophy (U); Analyze the Vedic philosophy in terms of knowledge, reality and values (An); State the philosophy of Buddhism (R); Analyze the philosophy of Buddhism in terms of knowledge, reality and values (An); Practice the philosophy of Buddhism in life (Ap); Use the western schools of philosophy in education (Ap); Find out the basic features of naturalism, idealism, pragmatism, realism and humanism (Ap); Explain the core national values as per Indian Constitution (U); Use the national core values in life (Ap)

Module IV

State the concept of 'Knowledge' (R); Explain the concept of 'Knowledge' (U); State the methods of knowledge (R); Compare the methods of knowledge (Ap); Define scientific method of acquiring knowledge (R); Explain the concepts of inductive and deductive reasoning (U)

Module V

Define the term 'value' (R); Explain the conceptual framework of values (U); Identify and classify the values (Ap); Practice the different values in real life situations (Ap); Define ethics (R); Explain the concepts of responsibility and freedom (U)

Suggested Readings

1. Ayer, A.J., The Problem of Knowledge. Penguin.
2. Dewey, J., Democracy and Education. Macmillan, New York.
3. Dewey, J., Experience and Education. Macmillan, New York.
4. Durkheim, E., Education and Sociology. Free Press, Chicago.
5. Froebel, F., The Education of Man. Fairfield, Kelley, New Jersey.
6. Hirst, P.H., Knowledge and the Curriculum. Routledge and Kegan Paul.
7. Hirst, P.H. and Peters, The Logic of Education. Routledge and Kegan Paul.
8. Hobbes, T., Leviathan. Collier-Macmillan.
9. Hume, D., An Enquiry Concerning Human Understanding. La Salle.
10. Kant, I., Critique of Pure Reason. Dent.
11. Moore, T.W., Educational Theory: An Introduction. Routledge and Kegan Paul.
12. Peters, R.S., Ethics and Education. Allen and Unwin.

EDTP0103: THEORIES AND PRINCIPLES OF EDUCATION

(3 Credits - 45 hours)

Objectives: *The objectives of this course are:*

- *to acquaint the students of Education with the fundamental aspects of education, with special reference to the dimensions of education suggested by Ducasse*
- *to give them an understanding of the process of conscious learning and issues in formal discipline*
- *to develop a critical outlook towards current trends in education*

Module I: Understanding 'Education' (10 hours)

Divergent description of Education, education as a process, functions of education (context of individual and social aim, factors influencing functions), education and schooling, education and indoctrination, heredity and educational attainment, individual differences in education.

Module II: Facets of Education (12 hours)

- a) Aspects of education - explanation, interpretation, application, perspective, empathy, self-knowledge.
- b) Ducasse's dimensions of education - intellectual education, physical education, vocational education, education in social dexterity, education of the will, aesthetic education, moral and religious education, liberal education.

Module III: Conscious Learning and Formal Discipline (10 hours)

- a) Conscious Learning - factors in conscious learning, the evolution of judgement, the evolution of ideas.
- b) Formal Discipline - rise of the concept of formal discipline, criticism by psychologists, positive discipline as formal discipline.

Module IV: Current trends in Education (13 hours)

- a) Indian constitution and education, globalization and education, privatization in education, modernization of Indian education
- b) Developing trends in environmental education, value education, human rights education etc.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the term 'Education' (R); Explain the process of education (U); State the functions of Education (R); Identify the factors influencing the process of Education (Ap); Explain the factors influencing the process of Education (U); Differentiate between Education and Indoctrination (Ap); Analyze the components of Indoctrination (An); Synthesize the segments of the process of Education (Cr); Explain the contributions of heredity and environment in the process of education (U); Explain the concept of individual differences in Education (U); Identify the individual differences among the students and teaching accordingly (Ap)

Module II

State the aspects of education (R); Explain the concepts of perspective and empathy (U); Define the imparting of knowledge and knowledge itself (R); Explain the process of comprehension including translation and interpretation (U); Apply the knowledge in real life situations (Ap); Analyze the knowledge (An); Summarize the knowledge and building a theory (S); Evaluate the theory (E); State the different dimensions of education as given by Duccasea (E); Explain intellectual, physical and vocational education (U); Explain education in social

dexterity, education of the will (U); State the meaning of moral and religious education (R); Apply moral education in real life situation (Ap)

Module III

Define conscious learning (R); Explain the factors of conscious learning (U); State the meaning of evolution of judgment (R); Write about the evolution of idea (K); Differentiate between the idea and evolution of judgment (Ap); Explain the concept of formal discipline (U); Reflect positive formal discipline in our behaviour (Ap)

Module IV

State the provisions in Indian constitution about education (R); Explain the Article 45 of Indian Constitution (U); Explain some of the other provisions indicated in Indian Constitution (U); Define the term 'Globalization' (R); Explain the globalization of education (U); State the features of privatization of education (R); Explain the features of modernized Indian Education (U); Define 'environmental education', 'value education' and 'human rights education' (R); Apply the basics of environmental education and value education in our lives (Ap)

Suggested Readings

1. Moore, T.W. Punishment and Education. Proceedings of the Philosophy of Education Society of Great Britain.
2. Newman, J.H. On the Scope and Nature of University Education. Dent.
3. Peters, R.S. Essays on Educators. Allen & Unwin.
4. Piaget, J. The Moral Judgment of the Child. Routledge & Kegan Paul.
5. Plato. The Republic. Penguin.
6. Rousseau, J.J. Emile. Dent.
7. Ryle, G. The Concept of Mind. Penguin.
8. Scheffler, I. The Language of Education. Charles C.Thomas.
9. Snook, I.A. Indoctrination and Education. Routledge & Kegan Paul.
10. Spencer, H. Education. Dent.
11. Skinner, B.F. Walden Two. Macmillan, New York.
12. White, P.A. Democracy and the Public Interest in the Philosophy of Education, Oxford Readings in Philosophy. Oxford University Press

EDES0104: EDUCATION AND SOCIETY

(3 Credits – 45 hours)

Objectives: This course on Education and Society will enable the students to:

- Understand and describe the relationship between society and education
- Elaborate on the roles played by education in bringing about social change
- Appreciate the importance of education for social change, national integration and international understanding in a diverse social context
- Identify current social problems and suggest ways and means to tackle them.

Module I: Sociology and Education and Agencies of Education (12 hours)

Meaning of educational sociology and sociology of education; relationship between sociology and education; sociological determinants of education; agencies of education - family, school, community, religious institutions, state

Module II: Education, culture and social change (10 hours)

Meaning, concept, nature and components of culture, their role in transmission and preservation

of culture; cultural lag and cultural change; social change – social mobility, stratification and the roles of education in bringing about change in social change

Module III: Education and Society (15 hours)

Education and social groups - types of groups, social interaction and its educational implications, socialization - concept, factors and implications; education for national integration, international understanding and democracy.

Module IV: Current Social Problems in India (8 hours)

Equalization of educational opportunities; role of education in solving social problems such as illiteracy, nutrition, sanitation and unemployment; lifelong education

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define 'sociology' (R); Write the meaning of educational sociology (R); Explain the concept of sociology of education (Ap); Find out the relationship between sociology and education (Ap); State the sociological determinants of education (R); Explain the role of family, school, community and religious agencies in education (U); Describe the state as an agency for the development of education (R)

Module II

Define the term 'culture' (R); Explain the nature and components of culture (U); Find out the features of the culture of a particular ethnic group (Ap); Explain the process of transmission and preservation of culture (U); Explain the concept of 'cultural lag' (U); State the factors affecting the social change (R); Illustrate the social mobility and stratification (U); Find out the impact of education on social change in any society (Ap)

Module III

Define the social group (R); Explain the nature and features of a social group (U); State the types of social groups (R); Explain the concept and significance of social interaction (U); Identify the impact of social interaction of the life of the people (Ap); Explain the concept of national integration (U); Identify the factors influencing the sense of national integration (Ap); Illustrate the role of education in the process of national integration (U); Explain the significance of International understanding (U); Define the concept of democracy (R); State the features of democracy (r); Practice the democratic values (Ap)

Module IV

State the concept of equal educational opportunities (R); Illustrate the provisions of equal educational opportunities (U); Find out the problem of unequal educational opportunities in the society (Ap); State the constitutional provisions for equal educational opportunities (R); State measures adopted by the Indian Government for the removal of illiteracy (R); Explain the problem of health and nutrition (U); State some of the health and nutrition programmes in India (R); Define 'unemployment' (R); Explain the causes of unemployment (U); Mention the types of unemployment (R); State the measures for checking the problems of unemployment (R); Explain the concept of lifelong education (U)

Suggested Readings

1. Dash, B.N. (2004). Teacher and Education in Emerging Society. New Delhi: Neel Kamal Publication
2. Gul, S. B. and Khan, Z. N. (2010). Philosophical and sociological foundations of education. Create Space.
3. Khana, S.D. (2000). Education in the Emerging Indian Society. Delhi: Doaba House.

4. Kumar, T.P and Talawar, M. S. (2010). Philosophical and sociological foundations of education. Mumbai: Himalaya publishing house.
5. Sachdeve, M.S. and Sharma, K.K. (2015). Contemporary India and Education. United States: Twenty first century publications.
6. Saxena, N.R. S. (2014). Philosophical and sociological foundations of education. Meerut: Vinay Rakheja.
7. Sharma, M (2011). Philosophical and sociological foundation of education. Guwahati: Eastern Book House.
8. Sharma, R.S. (1998). Perspective in Modern Education. Delhi: Neel Kamal Publication.
9. Singh, Y.K. (2008). Sociological foundations of education. New Delhi: A P H Publishing Corporation.
10. Singh, Y.K.(2000). Education in Modern India. New Delhi: Deep and Deep Publications.

EDLE0105: LIFE SKILLS EDUCATION

(3 Credits – 45 hours)

Objectives: *A holistic approach to the human body, mainly the connection between the brain and the body will enhance learning and growth. With this in mind, the course on Life Skills Education aims to*

- *train the students to integrate academic skills with physical skills and competency development*
- *prepare and provide the students with intrinsic motivation to achieve their goal of life*

Module I: Understanding of Life Skills (13 hours)

Skills and life skills; Origin and development of Life Skills; Understanding life skills; Significance of life skills; Introduction to 10 core skills: Social, thinking and coping skills.

Module II: Social skills (12 hours)

Understanding self - self-concept, self-esteem, self-control, self-realization, self-awareness; Communication - types, styles, barriers, skills of effective communication; Interpersonal relationships - healthy relationship, Empathy: altruism, empathy and voluntarism.

Module III: Cognitive skills (10 hours)

Cognitive skills - nature, elements, types; Critical thinking - nature, stages; Creative thinking - nature, stages; Problem solving: factors, steps; Decision making - process, need, consequences.

Module IV: Coping Skills (10 hours)

Coping with emotion: definition, characteristics, types, classification - wheel model, two dimensional approach, coping strategies; Coping with stress: stressors, sources of stress; General adaptive syndrome model of stress coping strategies

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Differentiate a skill from a talent (U); Classify a general skill from specific skill (An); State transferable/functional skill (R); Classify skills on the bases of personal trait/attitude, functional skill and knowledge based (An); Define life skill and life skill education (R); Summarize the significance of life skill education (Cr); List down the components of life skills (R)

Module II

Define self-concept (R); Differentiate self-concept from self-awareness (U); Infer different factors that influence self-concept of an individual (An); Apply different methods to improve their knowledge of themselves (Ap); Relate different theories of self- understanding in their daily life (An); Interpret the actions and view-points of people about themselves using social

comparison theory of self- understanding (Ap); Explain the concept of self-awareness (U); Identify people who possess self- awareness (An); Formulate strategies for developing or enhancing self-awareness (Ap); Synthesize the various level of self-awareness development in human being (S); Define self-esteem (R); Illustrate the outward signs of positive self-esteem (U); Assess the significance of self-esteem in the life of an individual (E); Enumerate the different factors for developing self-esteem (U); Explain the significance of parenting style as an important factor or an hindrance towards developing self-esteem among children (R); Suggest tips for improving one's self-esteem (Ap); Differentiate self-esteem from self-efficacy (An); State the six pillars of self-esteem (R); Define empathy (R); Differentiate empathy from sympathy (An); Relate empathy with sympathy (Ap); Explain the different types of empathy (U); Elucidate the different dimensions of empathy (U)

Module III

Define thinking (R); State the key elements of thinking (R); Define a concept and its development (R); Define creativity (R); Relate the investment theory of creativity with the actual practice in the day to day life (Ap); Summarize the resources of creativity (Cr); Identify the characteristics of a creative individual (An); Assess the stages of creative thinking (E); Propose different techniques for enhancing creativity (Ap); Explain critical thinking (U); Point out the prominent features of critical thinking (An); Determine the impediments of critical thinking (An); Identify some of the educational practices that impede development of critical thinking among students (An); Suggests ways and means to develop critical thinking among students (U); Explain decision making process (U); Identify the types of decision making that we make in life (An); Explain the decision making procedure for arriving at a proper decision (U)

Module IV

Define emotion (R); Recall the basics of coping with emotion (R); Assess the advantage of coping with emotion (E); Define stress (R); Explain the types of stress (U); Identify the stressors during their time of stress (An); Point out the importance of stress in their life (An) To generalize the symptoms of stress (Cr); Determine the ways to control stress (E); Predict the outcomes of stress (U); Explain the wheel model of emotion (U); Name the primary emotions (R); Illustrate that emotion is a combination of two or more primary emotion (U)

Suggested Readings

1. Bharath, S., & Kumar, K. K. Health Promotion Using Life Skills Education Approach for Adolescents in Schools--Development of a Model. *Journal of Indian Association For Child And Adolescent Mental Health*, 4(1), 5-11.
2. Compton, N. *The Indispensable Book of Practical Life Skills*, Hammond
3. Dudhade, B. A. *Life Skills Education*, Neelkamal Publication
4. Forde, S. D. Look after Yourself, or Look after One Another? An Analysis of Life Skills in Sport for Development and Peace HIV Prevention Curriculum. *Sociology of Sport Journal*, 31(3), 287-303.
5. Jeeraporn, K., Rutja, P., Nantawon, S., Villarruel, A. M., & Dechavudh, N. The Effect of a Parent Training Program, In Conjunction with a Life Skills Training Program for School-age Children, on Children's Life Skills, and Parents' Child-rearing Skills and Perceptions of Support for Child Life Skills Development. *Pacific Rim International Journal of Nursing Research*, 17(1), 3-27.
6. Kar, A. K. Importance of Life Skills for the Professionals of 21st Century. *IUP Journal of Soft Skills*, 5(3), 35-45.
7. Mitra, B. *Personality Development and Soft Skills*, Oxford University Press
8. Pestalozzi, T. *Life Skills 101: A Practical Guide to Leaving Home and Living on Your Own*, Stonewood Publications
9. Pharaoh, H., Frantz, J., & Smith, M. Life skills as predictors of engagement in health risk behaviours: A survey of secondary school learners. *African Journal for Physical, Health Education, Recreation & Dance*, 70-81.

10. Rao, K. R. & Dinakar, P. Life Skills Education, Neelkamal Publication
11. Trottier, C., & Robitaille, S. Fostering Life Skills Development in High School and Community Sport: A Comparative Analysis of the Coach's Role. *Sport Psychologist*, 28(1), 10-21.
12. Verma, S. Development of Life Skills and Professional Practice (WBSCTE), Vikas Publications
13. Woititz, J. G. & Garner, Alan. Life Skills for Adult Children, Health Communications publications
14. Shankar, R. The Art of Stress - Free Living, Neelkamal Publications
15. Nair, V. Master of Life Skills, HarperCollins India
16. Friel, J. & Friel, L. Adult Children: Secrets of Dysfunctional Families, Health Communications.

EDGE0106: GENDER EDUCATION

(4 Credits - 60 hours)

Objectives: *The course on Gender Education aims to*

- *provide a critical perspective on the gendered structure of society covering an array of sectors*
- *understand the concept and importance of gender justice and equality.*
- *analyze the status of education of girls in schools and develop an insight into policy, perspectives, issues and concerns of girl's education in India*
- *To sensitize students about the gender issues in general and education in particular*

Module I: Gender studies (13 hours)

Concept, Need, Scope; Gender studies as an academic discipline; Gender and Economy and Work Participation; Gender and globalization; Gender and education

Module II: Identification of structures of domination and control (12 hours)

Society, Family and school in India; Issues in school education - Problems of access, enrollment, retention, stagnation, drop-out and push out; Higher Education and Professional Spaces.

Module III: Gender and Education (10 hours)

Gender as the Basis of Inequality - Issue of patriarchy, hierarchy, power, dominance, subjugation; gender disparity in Education – gender bias in school curriculum, Andro construction of knowledge and educational goals from gender perspective.

Module IV: Issues of Indian women (10 hours)

Family, caste, class, culture, religion related issues; Women's education; Co-education - its educational implications; Literacy and Non-formal education for women's development; Education of Girl child in India: present status and challenges ahead

Module V: Women's Movements and routes towards change (15 hours)

Pre-independent, post Independent and current women's movements; National committees and commissions for women; governmental and non-governmental organizations for women and child development; Community participation for education of the girl child; Constitutional provisions, policies, programmes for women.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the term 'gender and 'sex' (R); Differentiate between gender and sex (U); Write about the meaning of gender studies (R); Understand the need of gender studies (U); Illustrate the scope of gender education (U); Analyze the need of gender studies in the present context (An); Explain the importance of gender studies as an academic discipline (U); Understand

the role of gender in the field of economy and work (U); Find out the relationship between gender and globalization (Ap); Identify the role of gender and education (R); Critically analyze the role of gender in the system of education (An);

Module II

Explain the concept 'society', 'family' and 'school' in India (U); Understand the role of society, family and school (U); Identify the issues in school education (Ap); Analyze the problems of access, enrollment retention, stagnation, drop out and push out (An); Explain how gender influence the issues in education system. (U); Understand the system of higher education (U); State the problems of higher education in India (R); Summarize the role of gender in higher education (Cr); Analyze the role of gender in professional spaces (An)

Module III

Understand gender as the basis of inequality (U); Explain the issue of patriarchy (U); Analyze the problems like hierarchy, power, dominance and subjugation (An); Explain the concept of gender disparity (U); Find out the status of gender disparity in India (An); Understand how gender biasness takes place in school curriculum (U); Explain the concept of andro construction of knowledge (U).

Module IV

State the issues faced by Indian women (R); Understand family in relation with the issues of Indian women (U); Understand caste and class in relation with the issues of gender (U); Find out the influence of culture and religion in the gender issues (Ap); Write about women education (R); Explain the status of women education in India (U); Find out the problems of women education (An); State the meaning of co-education (R); Find out the relevance of non-formal education for women's development (Ap); Find out the present status of girl child and their education in India (Ap).

Module V

State the important women's movements taken place before independence (R); State the women movements taken place after the independence in India (R); Find out the current woman movements across the globe (Ap); Explain the role of the woman movements (U); List out the national commissions and committees for woman (Ap); Understand the role of community participation for education for girl child (U); State the constitutional provisions in India for gender equality and women (R); Describe about the policies and programmes for women in India (U)

Suggested Readings

1. Apple, Michael W. & Smith, Christian L. (ed.) The Politics of the Textbook, Routledge, New York.
2. Bhasin, Kamla. What is Patriarchy? Kali for Women, New Delhi
3. Bhog, Dipta. Gender and Curriculum, Review of Women Studies, Economic and Political Weekly, 37(17):1638-1642
4. Chakravarti, Uma. Rewriting History; The Life and Times of Pandita Ramabai. OUP; Delhi.
5. Geetha, V. Gender: Stree; Kolkata.
6. Giroux, H. Ideology, Culture and the Process of Schooling. Falmer Press, London
7. Kumar, Krishna. What is Worth Teaching, Orient Blackswan, Delhi
8. MHRD-Ramamurty Committee Report (1990)-Towards enlightened and humane society, Delhi
9. Narasaiah. M.L. Women, Children and Poverty. New Delhi: Discover Publishing House
10. NCERT-National Curriculum Framework 2005, N.C.E.R.T. New Delhi
11. NCERT-National Curriculum Framework 2005 Position Paper no. 3.1 by National Focus Group on Problems of Scheduled Caste and Scheduled Tribe Children, N.C.E.R.T. New Delhi

12. NCERT-National Curriculum Framework 2005 Position Paper no.3.2 by National Focus Group on Gender issues in Education, N.C.E.R.T. New Delhi
13. NCERT-National Curriculum Framework for School Education 2000, N.C.E.R.T. New Delhi
14. Parvin, M.R. Empowerment of Women: Strategies and Systems for Gender Justice. New Delhi: Dominant Publishers
15. Rao. D.B. Education for Women. New Delhi: Discover Publishing House
16. Rao. D.B. International Encyclopedia of Women. New Delhi: Discover Publishing House
17. Sindhuja, P. Economic Empowerment of Women through Self-Help Groups. New Delhi: Discover Publishing House
18. Skelton, C. The SAGE Handbook of Gender and Education. New Delhi: Sage

EDPB0107: PSYCHOLOGICAL BASES OF EDUCATION

(4 Credit-60 hours)

Objectives:

- *To create awareness about the psychological behaviour of individual.*
- *To understand the significance of psychology in the process of education.*
- *To make the students well aware of the nature of psychology as a discipline.*
- *To create some skills of handling some equipment and tests.*

Module I: Psychology as a Science of Behaviour (10 Hours)

Meaning of Psychology, Nature and fields of psychology, Educational Psychology-its meaning, nature and scope, Relationship between Education and psychology.

Module II: Psychology of Growth and Development (10 Hours)

Introduction to growth and development; principles and factors of development, stages of development, Theories of development: Erickson's theory of Psycho-social development

Module III: Learning and Theories of Learning (15 Hours)

Meaning, Nature of Learning, learning and maturation, types of learning, Laws of learning, theories of learning: Trial and Error learning, Classical Conditioning, Operant Conditioning; Factors affecting learning, Individual differences and its educational implications

Module IV: Intelligence and its theories (13 Hours)

Intelligence: Definition,, Natureand Theories: Two Factor Theory of Intelligence, Guildford structure of Intellect, Intelligent Quotient (IQ), Emotional Intelligence, Assessment of Intelligence.

Module V: Personality and its Theories (12 Hours)

Meaning and Nature, Theories of personality: Type and Trait Theory, Determinants of personality, Assessment of personality: projective techniques.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Write the meaning of psychology (R); Define the term Psychology (R); explain the nature and field of Psychology (U); State the definition of Educational Psychology (R), Analyse the meaning of Educational Psychology (An); Explain the meaning, Nature and Scope of Educational Psychology (U); Synthesis the Scope of Educational Psychology (S); Use the knowledge of Educational Psychology in Practice (Ap); Establish relationship between Education and Psychology (Cr)

Module II

State the meaning of Human Growth and Development (R); Differentiate between Human Growth and Development (U); Explain the Factors affecting the Human Growth and Development (U); State the principles of Human Growth and Development (R); Identify the Growth and Development in different Stages of Human being (A); Recall the different stages of Human Growth and Development (K); Analyse the theory of Psycho Social Development given by Erickson (An); Apply the Erickson's Theory in Growth and Development of Individuals (Ap)

Module III

State the meaning of Learning (R); Explain the Nature of Learning (U); Relate Learning with Maturation (U); Write the Meaning of Classical Conditioning (R); Illustrate the Operant Conditioning (U); State the Factors affecting Learning (K); Identify differences in some individuals (Ap)

Module IV

Define the term Intelligence (R); Explain Two Factor Theory of Intelligence (U); Analyse the Guilford Structure of Intellect (An); Write the meaning of Intelligence Quotient (R); find out the Intelligence Quotient of an Individual (Ap); Assess the intelligence of Individuals (E)

Module V

Write the definition of personality (R); state the nature of Personality (R); Explain the Meaning and Nature of Personality (U); Name the Theories of Personality (R); Write about the Type and Trait Theory (R); Use Type and Trait Theory to identify the types of Personalities (A); Explain the determinants of Personality (U); Name the Tests of Personality Assessment Tests (R); Use the Projective Techniques to assess the Personality (Ap); Test the personality (E)

Suggested Readings

1. Chauhan, S.S. (2004): Advanced Educational Psychology, Vikas Publishing House Pvt. Ltd, New Delhi.
2. Chatterjee, S.K. (2017): Advanced Educational Psychology, Books and allied Pvt. Ltd. Calcutta,
3. Dandapani, S.(2013): A textbook of Advanced Educational Psychology, Anmol Publications Pvt. Ltd
4. Kuppaswami, B.(Ed.)(1963): Advanced Educational Psychology, Jalandhar: University Publications
5. Mangal, S.K., Advanced Educational Psychology, Prentice hall of India, Pvt Ltd. New Delhi
6. Morgan, C.T (1961): Introduction to Psychology, New York: McGraw-Hill.

EDHR0108: HUMAN RIGHTS EDUCATION

(3 Credits -45 hours)

Objectives:

- To make the students well aware of the concepts of Human Rights and Human Rights Education
- To familiarize the students with the rights of children and their education
- To create awareness among the students about the issues of gender equity and human rights of girl education
- To acquaint with the approach of inculcating value education

Module I: Introduction to Human Rights Education (12 Hours)

Origin and historical account of Human Rights; Description of UN Charter and UDHR; Meaning of Human Rights and Human Right Education; Constitutional Provisions for Human Rights

Module II: International Covenants, Convention and Gender Equity (11 Hours)

International Covenants on Economics, Social and Cultural Rights; Convention of Rights of Child and role of ILO; Right to Education Act -2009

Module III: Human Rights and Duties (10 Hours)

Human Right Protection Act and role of NHRC, SHRCs, UN, UNESCO; Curriculum framework of Human Rights Education; Approaches of Teaching for Human Rights Education

Module IV: Value Education (12 Hours)

Concept of Value; Sources of Value: Biological, Psychological, Sociological and Spiritual; Meaning, nature and objectives of Value Education; Value clarification approach

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the origin and historical account of Human Rights Knowledge (R); Describe the UN Charter and UDHR (U); Define Human Rights (K); Explain the concept of Human Rights Education (U); Write about the Constitutional Provisions for Human Rights in India (K); Apply the Knowledge of Human Rights in life (Ap)

Module II

Define International Covenants (K); Describe Economic, Social and Cultural Covenants (U); State Conventions of Rights of Child (R); Explain the role of ILO (U); State the RTE Act 2009 (K); Relate the RTE Act 2009 to Quality Education (Cr)

Module III

Explain the Human Rights Protection Act (U); State the role of NHRC, SHRCs, UN, UNESCO (K); Explain the Curriculum Frame Work of Human Rights Education (U); Prepare the Curriculum of Human Rights Education (Cr); State the approaches of Teaching Human Rights Education (R); Explain the Approaches of Teaching of Human Rights Education (U); Use of Approaches to teach Human Rights Education in Classroom (Ap)

Module IV

Write about the concept of Values (R); State the Sources of Values (R); Explain Biological, Psychological, Sociological and Spiritual Values (U); Define the concept of Value Education (R); Describe the Nature and Objectives of Value Education (U); Use of Value Clarification Approach in the process of inculcating Values among the students (Ap)

Suggested Readings

1. Bhardwaj, T.R (2007). Education of Human Value. New Delhi: Mittal Pub.
2. Dhand, M. (2002). Teaching Human Rights- A Handbook for Teacher Educators. Bhopal: Asian Institute of Human Rights Education
3. Donnelly, J. (2003). Universal Human Rights in Theory and Practice. New Delhi: Sterling
4. NCERT. (1996). Human Rights: A Source Book. New Delhi: NCERT
5. Mohanty, J (2009). Human Rights Education. New Delhi: Deep and Deep Publications
6. Rama, J. M. (1997). Human Rights an Indian Values. New Delhi: NCTE

EDPE0109: POPULATION EDUCATION**(3 Credits - 45 hours)****Objectives:**

- *To make the students well aware of the growing population*

- *To make the students acquainted with the effects of over population*
- *To make them aware of the ways and means of controlling the growing population*
- *To sensitize the students about the quality of life*

Module I: Indian Population (11 Hours)

Trend of Indian Population since 1901; Population scenario in North East of India; Population explosion, optimum population, under population and over population, population scenario in the world; Quality of life

Module II: Introduction to Population Education (12 Hours)

Definition, nature, objectives and scope of population education; Curriculum of population education for school stages; Approaches for teaching population education and preparation of teachers

Module III: Population Education Policies and Programme in India (13 Hours)

Population Education and Five Year Plans of India; Population education policies and programmes in India with special reference to Family planning; Mass media and population education; Nature and need of family life education

Module IV: Evaluation in Population Education (9Hrs)

Concepts of evaluation and measurement; Schemes of Evaluation: Formative and summative; Evaluation in Population education; Evaluation of students and population education programmes

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Explain the trend of Indian Population since 1901 (U); State the Population Scenario in North East India (R); Define Population Explosion (R); Describe Optimum Population, Under Population, Over Population (U); Identify the Over populated Areas of India (R); Explain Population Scenario in the world (U); Relate Population with Quality of life (Cr)

Module II

Define Population Education (R); Explain the Nature of Population Education (U); State the objectives of Population Education (R); Find out the Scope of Population Education (Ap); Describe the preparation of Curriculum of Population Education (U); Develop the Curriculum of Population Education for Secondary School Stage Students (Cr); Explain the Approaches for Teaching Population Education (U)

Module III

Identify the status of Population education in Five years Plans of India (R); Explain Population Education Policies and Programmes in India (U); Write the Meaning of Family Planning (R); Describe the methods to be adopted for making family planning successful (U); Describe the role of Mass Media in popularizing Population education (U); Explain the nature and need of family life Education (U)

Module IV

State the meaning of Measurement (R); Write the definition of Evaluation (R); Explain the relationship between Measurement and Evaluation (U); State the meaning of Formative and Summative Evaluation (R); Evaluate the Performance of the Students in Population Education (E)

Suggested Readings

1. Aggarwal, J.C (2003): Population Education, Delhi: Shipra Publications

2. Dubey, S.N (2001): Population of India, 2001, Delhi: Authors Press, Laxminagar
3. Gupta, P.K (2005): Population Education: Meerut, R.Lall Book Depot
4. Kapoor, K.C & Kapoor, A. (2013): Population Education, Guwahati, EBH, Publications
5. Kapoor, K.C.(2005): Effectiveness of training Modalities in Population Education for Secondary School Teachers of Arunachal Pradesh and their Attitude towards Population Education,(Unpublished Report)
6. Mehta, T.S and Chandra, R. (1972): Population Education (Selected Readings).New Delhi: NCERT.
7. Nanda, S.K (2005): Population Education: Delhi House, Book Sellers and Publishers.
8. NCERT (1987): National Source Book on Population Education. New Delhi: NCERT
9. UNESCO (1986): Teaching Methodologies for Population Education. Bangkok: Regional Office, UNESCO

EDEI0110: DEVELOPMENT OF EDUCATION IN INDIA

(4 Credits-60 hours)

Objectives:

- *To acquaint the students with the Ancient and Medieval system of Education in India.*
- *To enable the students to understand the development of education during the British rule in India.*
- *To enable the students to know about the different educational policy adopted by British Rule.*
- *To acquaint the students with the development of Education in Independent India.*
- *To acquaint the students with the development of Education in Assam*
- *To make the students well aware of the contemporary concerns and issues of Indian Education.*
- *To familiarize the students with various initiatives of the Government of India like SSA, Mid Day Meal etc.*

Module I: Education in Ancient India (12 Hours)

Vedic system of Education-- Aims, Methods of Teaching, Curriculum, Teacher- pupil relationship, Discipline, Education of Women; Buddhist Period--Aims, Methods of Teaching, Curriculum, Teacher-Pupil Relationship, Discipline, Education of Women; Medieval Period--- Aims, Methods of Teaching, Curriculum, Teacher- Pupil Relationship, Discipline, Education of Women.

Module II: Education during the British Period in India (13 Hours)

A brief introduction to the Educational Activities of East India Company and Christian Missionary in India.

Educational Reforms and Recommendations of : Charter Act of 1813, Macaulay's Minute 1835, Wood's Despatch; Hunter Commission, 1882, Lord Curzon's Educational Policy, 1904, Sadler's Commission, 1917, Wardha Scheme of Education, 1937, Sargent Report, 1944.

Module III: Education in Post Independence Era (13 Hours)

Educational Reforms and Recommendations of: University Education Commission (1948-1949), Secondary Education Commission (1952-53), Kothari Commission (1964-1966), National Policy on Education (1968, 1986 and 1992), Development of Education in Assam-Primary, Secondary, University and Women Education

Module IV: Vocationalization of Education (10 Hours)

Concept, Scope and need of Vocational Education; Objectives of Vocational education at +2 stage;

Vocationalization and National Development, NPE-1986 and POA-1992 with reference to Vocational Education.

Module V: Issues and Challenges in Indian Education at School Stage (12 Hrs)

Concept of UEE and its problems, Physical, Social and Quality access in relation to UEE; Operation Blackboard (OBB), District Primary Education Programme (DPEP), Sarva Shiksha Abhiyan (SSA) and RTE- Act 2009; Quality of Education at Secondary School Stage and Rashtriya Madhyamik Shiksha Abhiyan (RMSA), Use of ICT.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the meaning of Vedic System of Education (R); Explain the aims, methods of teaching the curriculum during Vedic Period (U); State the relationship between teacher and students in Vedic Period (K); state the features of education during the Buddhist Period (R); Explain the system of Education during Medieval Period (U); Identify the values prevailing during Vedic, Buddhist and Medieval Periods among the teachers and students (Ap); Explain the role of Missionaries in the field of education (U); State the activities of East India Company relating to education in India (R)

Module II

Write the recommendations made in Charter Act of 1813 (R); Analyse the Macaulay's Minute 1835 (An); State the contributions of Wood's Despatch, Hunter Commission, Lord Curzon's Educational Policy and Sadler's Commission in the field of Indian Education (R); Explain the Wardha Scheme of Education (U); State Sargent Report in the India Context (R)

Module III

State the features of University Education Commission (1948-1949) (R); Explain Secondary Education Commission (U); Write the effectiveness of Kothari Commission (R); Analyse the features of NPE, 1986 and Programme of Action, 1992 (An); Explain the growth and development of Primary, Secondary, University and Women Education in Assam (U)

Module IV

Describe the nature and scope of Vocational Education (U); Define Vocational Education (R); State the Objectives of Vocational Education for +2 School stage (R); Synthesize the features of Vocational Education found in NPE, 1986 (Cr)

Module V

Write the meaning and purpose of UEE (R); State the problems of UEE in India (R); Explain the concept of Operational Black Board and DPEP in ensuring UEE (U); state the basic features of SSA and RTE, Act 2009 relating to quality education at Elementary Schools in India (R); Explain the features of RMSA (U)

Suggested Readings

1. Goswami,S. & Das Sarma , P (2012). Development of Education in India, Shanti Prakashan.
2. GOI (1964-1966):'Education and National Development". Ministry of Education, Government of India 1966.
3. Govt. of India, Ministry of Human Resource Development, Policy of Action, 1992, New Delhi
4. Mohanty, J., (1986). School Education in Emerging Society, Sterling Publishers
5. Mukerjee, S.N., (1966). History of Education in India, Acharya Book Depot.
6. NCERT (1986). School Education in India – Present Status and Future Needs, New Delhi.
7. Nurullah , S. & Naik, J.P.(1974) History of Education in India, Mc. Millan Company. India.
8. Rawat,PL (2006).: History of Indian Education, Ram Prasad & Sons, Bhopal.

EDET0111: EDUCATIONAL THINKERS**(3 Credits- 45 hours)****Objectives:**

- *To create awareness among the students about the different educational thinkers of the world and India.*
- *To familiarize the students about the different philosophies of some eminent educational philosophers.*
- *To create awareness among the students about the role of teachers and various methods of teaching in the field of education.*

Module I: A- Indian Thinkers (11 Hours)

Swami Dayanand (1825-1883): Philosophy, aims of Education and values; Swami Vivekananda (1863- 1902): Philosophy Principles, Character Building, Discipline and values; Rabindranath Tagore (1861- 1914): Tagore's Philosophy and its features, basic contributions in the field of Education.

Module II: B-Indian Thinkers (12 Hous)

M.K Gandhi (1869-1948) : Features of Gandhian Educational Philosophy, Objectives of Education and Gandhiji's view on Education , Concept of Basic Education and its relevance in 21st century.

Sri Aurobindo (1872-1950): Life Sketch , Philosophy of life, Views on Education , Teachers and teaching, Concept of Ashram School, International Centre of Education.

Module III: A- Western Thinkers (12 Hours)

Jean Jacques Rousseau: Life Sketch , Philosophy of Education , Self Education of Rousseau Idolizes Nature, Naturalism, Negative Education, The Emile-its importance , Basic Ideas of Rousseau's Philosophy.

John Dewey : Life Sketch, Philosophy of Life,Laboratory School,Methods of teaching.

Module IV: B – Western Thinkers (10 Hours)

Friedrich August Froebel (1782-1852): Philosophy and Principles,Concept of Kindergarten and its features and relevance in present context.

Maria Montessori (1870-1952): Life sketch , Educational Philosophy and Principles,Role of Teacher,Concept of Children's House

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Give the life sketch of Swami Dayanand, Vivekanand and Rabindranath Tagore (Ap); Explain the contributions made by Indian thinkers like of Swami Dayanand, Vivekanand and Rabindranath Tagore (U); Analyse the thoughts of Vivekananda in character building of the individuals (Ap); Apply the Philosophies of Swami Dayanand, Vivekanand and Rabindranath Tagore in making curriculum (An)

Module II

Explain the features of Gandhian Philosophy of Education (U); State the objectives of education according to Gandhiji (K); Explain the concept of Basic Education (U); Give the life sketch Sri Aurobindo (R); State the features of Education as per Sri Aurobindo (R); Explain the concept of Ashram School (U); State the features of International centre of education (R)

Module III

Explain the basic features of educational philosophy given by Rousseau (U); State the concept of Self education (R); State the educational Philosophy of Emile (R); Explain the contributions of John Dewey in the field of education (U)

Module IV

State the contributions of Froebel in the field of Education (R); Write the Principles and concept of Kindergarten (R); Identify the relevance of Kindergarten in 21st century (Ap); Explain the contributions of Maria Montessori in the field of Pre-primary education (U)

Suggested Readings

1. Aggarwal, J.C (2002): Psychological, Philosophical and Sociological Foundations of Education, Shipra Publications, Delhi
2. Goswami, M.K (2006) : Educational Thoughts and Essays, Asian Books Pvt Ltd, New Delhi
3. Kumar, T.P (2011) : Great Philosophers of Education, APH Publishing Corporation, Darya Ganj ,New Delhi
4. Rai, B.C (2000) : Principles of Education, Prakashan Kendra ,Lucknow.
5. Safaya S (2010): Modern Theory and Principles of Education, Dahnpat Rai Publishing Company Pvt Ltd, New Delhi
6. Singh, Y.K (2013) : Philosophical Foundations of Education, APH Publishing Corporation, New Delhi
7. Sur Roy, T. (2013): Educational Thinkers Oriental and Occidental, Ashok Publications, Guwahati
8. Taneja, V.R (2009) : Educational Thought and Practice, Sterling Publishers Pvt Ltd, New Delhi

EDEC0112: EARLY CHILDHOOD CARE AND EDUCATION (ECCE): A PERSPECTIVE

(3 Credits-45 Hours)

Objectives:

- To promote awareness about the need and significance of ECCE.
- To acquaint the trainees about the policies and programmes of ECCE in India.
- To make the trainees well aware of the different philosophers of some western and Indian educationist concerning to ECCE.
- To make the trainees well aware of some agencies involved in ECCE.

Module I: Nature of ECCE (12 Hours)

Meaning, Definitions and Significance of ECCE in the context of Universalization of Elementary Education Objectives and scope of ECCE; ECCE and Human Resource Development

Module II: Philosophies on ECCE (12 Hours)

John Dewey, Maria Montessori, Fredrick Froebel; Rabindra Nath Tagore and Tarabai Modak

Module III: Policies and Programmes on ECCE (11 Hours)

ECCE before independence and after independence of India; National Children's Policy 1974; NPE-1986 and POA-1992; Convention on Rights of child, 1989

Module IV: Initiatives and Interventions (10 Hours)

Government, Private and NGO's; ICDS and SSA; Preschool Education and training programmes; ECCE and National Curriculum Framework

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the definition of ECCE (R); Explain the significance of ECCE in the context of UEE (U); State the objectives of ECCE (R); Explain the scope of ECCE (U); Describe the role of ECCE in Human Resource Development (U)

Module II

Explain the philosophy of John Dewey in the context of ECCE (U); State the contributions made by Maria Montessori in the growth and development of ECCE (R); Describe the philosophy of Froebel to gear up the growth and development of ECCE (U); Explain the contributions made by Rabindranath Tagore and Tarabai Modak in the field of ECCE (U)

Module III

State the basic features of ECCE before Indian Independence and after independence (R); Explain the basic features of national children's policy 1974 (U); Find out the place and space of ECCE in NPE, 1986 (Ap); Describe the convention on rights of child 1989 (U)

Module IV

Explain the role of central and state governments in the growth and development of ECCE in India (U); State the contributions made by NGO's in the field of ECCE (R); Analyse the functions of ICDS in the context of ECCE (An); State the objectives of SSA in the context of Pre-school education (R); Describe the process of preparing the teachers for ECCE (U); Find out the relationship between National Curriculum Frame work and ECCE (Ap)

Suggested Readings

1. Braun, S.J & Edwards, E.P (1972): History and Theory of Early childhood Education, Ohio, Charles, A. ones Publishing Co.
2. Desai, K.G. (1976): Effectiveness of kindergarten Education : Allahabad, United Publishers.
3. Koul, V. (et.al) (1993): Early Childhood Care and Education: An Assessment, New Delhi, NCERT.
4. MHRD (1986): A Guide Book for Anganwadi Workers Dept. Of Women & Child Development, MHRD, Govt. of India
5. Montessori Maria (1969): The Montessori Method, New York, Shockan Book
6. Montessori Maria (1986): The child in the Family, New York, Avon Books
7. Thakur, Aruna (1972): Perspectives in Pre-School Education, Bombay, Poplr Pradhan Pvt Ltd
8. Upadhyay, G.C (1999): A study of Pre-school component and its perception and extend of Utilization by Community, New Dehi, NCERT
9. Viruru Radhika (2001): Early Childhood Education, New Delhi, Sage Publications

EDME0113: MEASUREMENT AND EVALUATION IN EDUCATION**(4 Credits-60 Hours)**

Objectives:

- *To create awareness among the students about the basics of educational measurement and evaluation*
- *To make the students well aware of the tools and techniques of educational measurement and evaluation*
- *To enable the students to prepare a good test/scale*
- *To enable the students to administer the tools and interpret the scores*

Module I: Nature of Measurement and Evaluation (12 Hours)

Concept of Measurement, Types of Measurement: Psychological and physical, Concept of educational measurement, Functions of educational measurement, Concept of assessment and evaluation, Principles and steps of Evaluation, Relationship between educational measurement and evaluation

Module II: Testing and Non-Testing Techniques in Educational Measurement and Evaluation (12 Hours)

Testing Technique: Achievement Test aptitude Test, Intelligence Test; Non-Testing technique: Interview, Observation, Questionnaire, Rating Scales, Check list attitude scale, cumulative record.

Module III: Concept of Reliability (10 Hours)

Meaning and Nature of reliability of the test scores; Methods of Computing Co efficient of reliability: test-retest, parallel form, split half, KR-20,21; Factors influencing reliability of test scores

Module IV: Concept of Validity (12 Hours)

Meaning and nature of Validity of the test scores;Types of Validity: face, content, construct, concurrent, predictive; Relationship between validity and reliability; Factors affecting validity

Module V: Test Items (14 Hours)

Concept and types of test items; Guidelines for writing objective types test items; Guidelines for writing essay type test items; Guidelines for interpretive exercises; Construction and standardization of test and attitude scale; Concept and types of norms

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to

Module I

Define the term 'Measurement' (R);Analyse the concept of Measurement (An);illustrate the meaning of Measurement (U);Name the types of Measurement (R);Find out the difference between the two types of Measurement (Ap);Explain the Psychological and Physical Measurement (U);To State the functions of educational Measurement (R);Differentiate between the concepts of assessment and evaluation (Ap); State the meaning of assessment and evaluation (R);Illustrate the principles of the process of evaluation (U);State the steps of evaluation (R);Illustrate the steps of Evaluation (U);Use the steps of evaluation for process of evaluation (Ap);Apply the process of measurement for effective process of evaluation(Ap)

Module II

State the meaning of testing technique (R);Explain the concept of testing (U);Use the testing technique for measuring the performance of students in different areas of studies (Ap);Name the different texts used under testing technique of measurement (R);Analyse the components of an achievement test (An);Summarise the performance of students (Cr);State the meaning of non-teaching technique of measurement (R);Name the tools of non-teaching techniques of measurement (R);Find out the difference between the testing and non-testing technique (Ap);Construct the questionnaire and scales (Ap);Use the non-testing techniques for the purposes of assessment (Ap)

Module III

Define the term 'Reliability' (R); analyse the nature of the concept of reliability (An); Explain the nature of 'reliability' (U); Synthesise the features of the concept of reliability (Cr); State the methods of computing reliability of test score (R); Explain the Test-Retest method for computing coefficient of reliability of the test scores (U); Use the test-retest method and find out the coefficient of reliability (Ap); Explain the parallel form method, Split-half method for

computing coefficient of reliability (U); Analyse and use K-R-20 formula for finding out the coefficient of reliability (Ap); State the factors influencing the coefficient of reliability of the test scores (R); Analyse and classify the factors affecting coefficient of reliability (An). Decide about the adequacy of reliability (E)

Module IV

State the meaning of 'validity' (R);Analyse the nature of 'validity' (An);Write the features of 'Validity' (R);Name the types of 'Validity' (R);Explain the concepts of face validity and content validity (U);Find out the content Validity of a text (Ap);Write the meaning of construct and concurrent validity (R);To find out the construct and concurrent validity (Ap);Explain the predictive validity (U);Test the hypothesis (Ap);State the factors affecting the validity of the test scores (R);Illustrate the factors affecting validity (U);Identify the factors of validity (Ap);Evaluate the validity of the test score (E).

Module V

State the meaning of test item (R); Explain the concept of test item (U); Name the types of test items (R); Formulate the different types of test items (AP); State the guidelines for writing objective type text items (K); Illustrate the guidelines of objective type test items (U); Define the essay type test item (K); State the features of essay type test item (R); Analyse the test items (An); Classify the test items (Ap); Evaluate the test items (E); Explain the procedure of construction and standardisation of test (U); Develop the test (Ap); Evaluate the final draft of the test (E); State the steps for construction and standardisation of the test (R); Develop an attitude scale (Ap); Interpret the test score and attitude scores (U).

Suggested Readings

1. Anastasi, A (1976): Psychological Testing, McMillan Publication Co. New York
2. Edwards,A.L (1966) : Techniques of Attitude Scale Construction, New York
3. Frank,S.Freeman (1990) : Theory and Practice of Psychological Testing,IH Publishing Co. Bombay
4. Granlund, N.E (1976): Measurement and Evaluation in Teaching, McMillan Publishing Co. New York
5. Linn,R.L&Miller,M.D (2008) : Measurement and Assessment in Teaching, Darling Kindersley,pvt.Ltd
6. Sharma,R.A (1998) : Essentials of Measurement in education and Psychology, R.Lall Book Depot, Meerut

EDTY0114: EDUCATIONAL TECHNOLOGY

(4 Credits-60 Hours)

Objectives:

- To familiarize the students with the conceptual framework of educational technology
- To create awareness among the students about the nature of instructional technology
- To make the students well aware of the different approaches in educational technology
- To familiarize the students with some innovations in the field of education for qualitative improvements.

Module I: Introduction to Educational Technology (13 Hours)

Emergence of educational technology, different views on educational technology, definition, meaning, nature and scope of educational technology, educational technology in formal and non-formal education, educational technology and quality education, problems of educational technology in the Indian context.

Module II: Teaching-Learning Process (12 Hours)

Nature of Teaching-learning process; variables and functions of teaching; levels and phases

of teaching; Instructional objectives relating to cognitive, affective and psycho-motor domains; writing of instructional objectives in behavioral forms.

Module III: Communication and Instruction (12 Hours)

Concept and need of communication; Forms of communication; Model of communication process; Classroom communication: Verbal and Non-verbal; Instructional Technology : Programmed Instruction (PI), Personalized system of Instruction (PSI), Computer Assisted Instruction (CAI), Modular Instruction (MI)

Module IV: Behavioural Technology (13 Hours)

Need and Nature of behavioral technology; Features of teaching behavior; Concept of teaching skills and their identification; Need, nature and steps of Micro-teaching; Interaction Analysis with special reference to Flanders; Simulated Social Skill Training (SSST)

Module V: Emerging Trends of Educational Technology (10 Hours)

Nature of Information Technology (IT); Mass Media in Education : Radio, TV, Internet and E-Learning; Multimedia Approach; EDUSAT, Blended Learning, MOOCs; Research in Educational Technology

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to

Module I

State the emergence of Educational Technology (R); State the different views on Educational Technology (R); Define the term 'Educational Technology' (R); Analyse the definition of educational technology (An); Synthesise the different definitions of educational technology (Cr); State the basic features of educational technology (R); Describe the scope of educational technology (U); To explain the use of educational technology in formal and non-formal systems of education (U); To define 'quality education' (R); To apply educational technology for achieving quality education (Ap); To state the problems of educational technology in Indian context (R)

Module II

Write the definition of the term 'Teaching' (R); Explain the different dimensions of teaching (U); Illustrate the teaching-learning process (U); State the variables of Teaching-learning process (R); Find out the relationship among the different variables (Ap); State the functions of Teaching (R); Identify the functions of teacher (AP); Illustrate the levels of the T-L Process (U); Teach at three levels of T-L Process (Ap); Name the three phases of T-L Process (R); Explain all the three phases of T-L Process (U); Identify the relationship among three phases of T-L process (AP); Analyse the interactive phase of T-L process (An); Write the meaning of cognitive, affective and Psychomotor objectives (R); Explain the taxonomies of cognitive, affective and psychomotor educational objectives (U); Put the objective in behavioural forms (Ap); Test the formulated objectives (E).

Module III

State the meaning of 'communication' (R); State the forms of communication (R); Illustrate the model of communication process (U); Identify the facilitators and barriers of the process of communication (Ap); Evaluate the process of communication (E); Write the meaning of instructional technology (K); Explain the concept and steps of programmed instruction (U); To develop the programmed learning material (Ap); Teach through the approach of programmed instruction (Ap); Evaluate the programmed instructional material (Ev); Explain the features of PSI, CAI, and MI (U); Prepare the instructional materials of PSI, CAI, and MI (Ap); Evaluate the PSI, CAI, and MI materials (E); Find out the basic differences in different approaches of teaching (Ap);

Module IV

Define the term 'Behavioural Technology' (R); State the features of Behavioural technology (R); Write the meaning of teaching skill (K); Identify the teaching skills (Ap); Write about the concept of micro-teaching (R); Explain the need of micro-teaching (U); State the steps of micro teaching (R); Explain the purpose of interaction analysis (U); State the 10 categories of instructional analysis categories given by Flander (R); Analyse the behaviour of a teacher in classroom by adopting FIACS (Ap); Explain the concept and need of simulated social skill training (SSST) (U); State the steps of SSST (R); Differentiate between micro teaching and SSST (Ap).

Module V

Explain the nature of Information Technology; Give the meaning of mass media (R); Explain the use of radio, T.V. internet as the tools of mass media (U); State the features of Multimedia approach (R); Use the multimedia approach in the classroom for the purpose of teaching (Ap); Write the utility of EDUSAT (R); State the meaning of blended learning (K); Explain the features of blended learning (U); Explain the concept and need of MOOCs (U); Explain the concept of research and its scope in educational technology(U)

Suggested Readings

1. Aggarwal,J.C (2014) : Essentials of Educational Technology,Vikash Publishing House PvtLtd,New Delhi
2. Bruner,J.S (1966) :Toward a Theory of instruction, New York
3. Flanders, Ned A (1972) : Analyzing Teacher Behaviour,California ,Addison Wesley
4. Mangal,S.K&Mangal,U (2014) : Essentials of Educational Technology PHI Learning Pvt.Ltd,Delhi
5. Mitra,S.K (1968) : Proceedings of symposium on educational Technology,IPAL,NCERT,New Delhi
6. Sharma,R.A (1988) : Technology of Teaching, Loyal Book Depot, Meerut

EDFC0115: FOUNDATIONS OF CURRICULUM DEVELOPMENT**(4 Credits-60 Hours)****Objectives:**

- *To acquaint the students with the conceptual framework of curriculum*
- *To create awareness among the students about the different dimensions and approaches of curriculum designing*
- *To make the students well aware of the developmental process and evaluation of the curriculum*
- *To acquaint the students with the curriculum implementation strategies*

Module I: Nature of Curriculum (12 hours)

Defining curriculum, Components of curriculum, Principles of curriculum, Goals and objectives for curriculum development, Characteristics of a good curriculum

Module II: Bases of curriculum construction (15 hours)

Philosophical bases: Naturalism, Idealism, Pragmatism, Sociological bases: Society, education and schooling, social change and curriculum, Psychological bases: Learning theories and curriculum, humanistic psychology

Module III: Approaches to curriculum development (18 hours)

Major approaches: subject-centred, broad fields/ life-centred, learner-centred approaches, Models of curriculum development: Technical/Scientific model- Tyler Model and Taba Model, Non-technical/ non-scientific model – Open class model, Wienstien and Fantini's Model

**Module IV: Process of curriculum development and the role of teachers in curriculum development
(15 hours)**

Process of curriculum development: Assessment of educational needs, Formulation of objectives Selection and organisation of content, Selection and organisation of learning experiences , Evaluation Role of teachers in curriculum development and some issues in curriculum development, Irrelevant curriculum, Emerging curriculum

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the meaning of curriculum (R);decide the dimensions of curriculum (E);identify the different components of curriculum (An);differentiate among curriculum, syllabus and course (An);assess the relationship between curriculum, and syllabus and curriculum and course (E);enumerate the components of curriculum (U);summarize the principles of curriculum development (Cr);state the goals and objectives of curriculum development (K);demonstrate the importance of goals and objectives in curriculum development (Ap);explain characteristics of a good curriculum (U) list down the characteristics of a good curriculum (R);generalize the characteristics of a good curriculum (Cr); apply the principles of curriculum development in the construction of a new curriculum (Ap);evaluate the existing curriculum (E)

Module II

Explain influence of idealism in curriculum development. (U); state the meaning of education according to idealism (R); demonstrate the curriculum according to idealism (Ap);compare the curriculum of idealism and that of Realism (An); summarize the curriculum of idealism (Cr); examine the curriculum according to idealism (E);evaluate the relationship between philosophy and curriculum (R); recall the meaning of education according to realism (R);interpret the meaning and purpose of education of realism. (U); criticize the curriculum of education according to realism. (An); use the philosophy of realism in the construction of curriculum (Ap); determine the relevance of curriculum of education according to realism (E); recognize influence of pragmatism in the curriculum development (R); interpret the philosophy of pragmatism in the context of curriculum development (U); apply the tenets of pragmatism in the construction and development of the curriculum (Ap); generalize the usefulness of philosophy of pragmatism in curriculum development (S); assess the shortcomings of the philosophy of pragmatism in the curriculum development (E); illustrate the influence of existentialism in the curriculum development (U); demonstrate the different viewpoints of existentialism on the curriculum (Ap); write the historical background of existentialism; summarize the role of the learners in the teaching-learning process according to existentialism (S); explain the psychological bases of curriculum (U); apply the principles of the learning theories in the curriculum development (Ap); judge the influence of humanistic psychology in the curriculum development (E)

Module III

State the major approaches of curriculum development (R); explain the subject-centred approach in the curriculum development (U); find out the goals and objectives of subject-centred approach in the curriculum development (Ap); identify the shortcomings of subject-centred approach in the curriculum development (An); summarize the benefits of subject-centred approach in the curriculum development (Cr); determine the different elements of the subject-centred approach in the curriculum development (E); interpret the meaning of life-centred approach in the curriculum development (U); name the individuals who promote the life-centred approach to curriculum development (R); construct the learning objectives according to the life-centred approach (Ap);point out the roles of teachers in the

implementation of the life-centred approach curriculum (An); generalize the usefulness of the life-centred approach in the curriculum development (Cr); determine the different factors to be keeping in mind for design a curriculum following a life-centred approach (E); define learner-centred approach in the curriculum development (R); explain the concept learner-centred approach in the curriculum development (U); demonstrate the relevance of learner-centred approach in the curriculum development (Ap); analyse the different elements in the learner-centred approach in the curriculum development (An); synthesize the meaning and implications of learner-centred approach in the development and implementation of the curriculum (S); assess the difficulties involve in the implementation of the curriculum development and implementation (E); recall the different models of curriculum development (R); classify different models of curriculum development (U); explain the models of curriculum development according to Tyler, Taba, Saylor and Alexander (U); apply any of the models in the construction or development of a curriculum (Ap); analyse the foci of different models of curriculum development (An); assembles the components of different models of curriculum development (S); evaluate the relevance and shortcomings of each model of curriculum development (E)

Module IV

Write the process of curriculum development (R); illustrate the different components of the process of curriculum development (U); demonstrate the ways to formulate the objectives of teaching-learning process. Ap); interrelate the different elements of the process of curriculum development (An); assess the methods and process of curriculum development (E); write the roles of teacher in the curriculum development (R); explain the limitations of teachers while implementing the curriculum (U); identify some issues related to curriculum development and implementation (An); differentiate between irrelevant and emerging curriculum (U); analyse the role of teachers in bringing about changes and modification in the curriculum (An); examine the relevance of the existing curriculum (E);

Suggested Readings

1. Beane, A. J., Topfer, Jr. and Alessi, S.J. (1986). Curriculum Planning and Development. London: Allyn and Bacon.
2. Dewey, J. (1966). The Child and the Curriculum- The School and Society. USA: Phoenix
3. Ovlivia, P. F. (1988). Developing the Curriculum. London: Scott Foreman and Company
4. Seethaeramu, A.S. (1989). Philosophies of Education. New Delhi: Ashish Publishing House
5. Sharpes, D.K. (1988). Curriculum Tradition and Practices. London: Routledge
6. Shivarndrappa. G. (1985). Philosophical Approaches to Education. New Delhi: Himalaya Publishing House.
7. Taneja, V.R. and Taneja. S. (1980). Educational Thinkers. New Delhi: Atlantic Publishers
8. Tyler. R. (1949). Basic Principles of Curriculum and Instruction. Chicago: University of Chicago Press.
9. Weinstein, G and Fantini, M. (1970). Towards Humanistic Education: A Curriculum of Affect. New York: Praeger.
10. Wheeler, D.K. (1976). Curriculum Process. London: University of London
11. Wiles, J and Bondi, J (1989). Curriculum Development. Ohio: Merrill Publishing Company.

EDGC0116:GUIDANCE AND COUNSELLING IN EDUCATION

(4 Credits-60 Hours)

Objectives:

- *The general objectives of the course are:*
- *To familiarise the students with various concepts of guidance and counselling*
- *To get the fundamental knowledge on guidance and counselling.*

- *To create awareness among the students about its significance in the field of education.*
- *To acquire the necessary skills need for guidance and counselling.*
- *To give guidance and counselling to the students with problems.*
- *To realise the role of guidance and counselling as a teacher.*
- *To understand the importance of guidance and counselling.*
- *To acquaint the students with the tools and techniques of guidance and counselling.*

Module I: Introduction to Guidance (16 Hours)

Meaning, Definition and Nature of Guidance, Historical background of the guidance in India, Need and Principles of Guidance, Bases of guidance, Teacher as a guide

Module II: Types of Guidance (13 Hours)

Educational Guidance, Vocational Guidance, Personal Guidance

Module III: Concept of Counselling (14 Hours)

Meaning, Definition and Nature of Counselling, Need for Counselling to educational institutions, Types of Counselling: Directive, Non-directive Counselling and Eclectic Counselling, Qualities of an effective counsellor

Module IV: Tools and Techniques of Guidance and Counselling (17 Hours)

Testing Technique to measure the different constructs of an individual: Intelligence, Creativity, Interest, Aptitude and Personality traits, Non-testing Techniques: Observation, Interview, Scales, Cumulative records, Organisation of guidance and Counselling services

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

Define the term 'guidance' (R); explain the definition of the term guidance (U); find out the important features of guidance (Ap); illustrate the nature of guidance (U); state the historical background of guidance services in India (R); explain the need of guidance in India (U); write the principles of guidance (K); name the bases of guidance (K); explain the philosophical bases of guidance (U); explain the psychological bases of guidance (U); narrate the sociological basis of guidance (U); use the bases of guidance in guidance services (Ap); state the qualities of a teacher as guidance worker (R).

Module II

State the types of guidance (R); write definition of educational guidance (R); analyse the components of educational guidance (An); state the need of educational guidance (R); write the definition of 'Vocational Guidance' (R); explain need and components of vocational guidance (U); explain the concept of personal guidance (U); perform the guidance activities (Ap);

Module III

Define the term 'Counselling' (R); analyse the definition of counselling (An); make their own definition their own definition of counselling (Ap); explain the concept of counselling (U); write about the need of counselling in educational institutions (K); name the types of counselling (R); explain the types of counselling (U); differentiate the types of counselling (Ap); practice the different types of counselling (Ap); state the qualities of a good counsellor (R); act like an effective counsellor (Cr)

Module IV

Write about the concept of testing technique of guidance (R); explain the features of testing technique in guidance (U); give the tests of intelligence, creativity, interest inventories, aptitude, personality tests (K); administer the different test (Ap); do the scoring works (Ap); interpret the scores (U); state the meaning of non-testing technique (R); name the tools of non-testing technique (R); use the different tools of non-testing technique (Ap); explain observation, interview and cumulative records as tools of non-testing technique (U); state the guidance and counselling devices (R); organise the guidance and counselling services (Ap); evaluate the guidance and counselling services (E);

Suggested Readings

1. Aggarwal, J. C. (1991). Educational, Vocational Guidance and Counseling. New Delhi: Doabai House.
2. Bengalee, M. D. (1985). Guidance & Counseling. Bombay: Sheth publishers.
3. Bhatagar, R.P. (2018). Guidance & Counseling in Education and Psychology Meerut: R-Lal Book Depot Educational Bookseller and Publishers.
4. Bhatnagar, R. P., & Seema, R. (2003). Guidance and Counselling in Education and Psychology. Meerut: R.Lal Book Depot.
5. Chauhan, S. (2009). Principles & Techniques of Guidance. N.Delhi: Vikas Publishing House Pvt Limited.
6. Gibson Robert & Mitchell Marianne (2005): Introduction to Guidance & Counseling, 6th edition, N. Delhi: Prentice Hall of India
7. Indu, D. (1983). The Basic Essentials of Counseling. New Delhi: Sterling Publishers Private Ltd.
8. Kochhar SK (1986). Guidance & Counseling in Colleges & Universities. N. Delhi: Sterling publishers.
9. Kochhar, S. K. (1981). Guidance in Indian education. N. Delhi: Sterling publishers.
10. Kochhar, S. K. (1984). Guidance and Counseling in Colleges and Universities. New Delhi: Sterling Publishing Pvt.Ltd.
11. Kochhar, S. K. (1987). Educational & Vocational Guidance in Secondary Schools. N. Delhi: Sterling Publishers.
12. Madhukar, Indira, (2005). Guidance & Counseling. N. Delhi: Authors Press.
13. Madhusudan, M. (1983). Educational and Vocational Guidance. Sambalpur: Saha Publishers & Distributors.
14. Narayan S. Rao (1991). Counseling and Guidance. New Delhi: TataMcGrawHill.
15. Raj, Singh. (1994). Educational & Vocational Guidance, N. Delhi: Commonwealth Publications.
16. Sharma, N. R. (1989). Educational and Vocational Guidance. Agra: Vinod PustakMandir. Sharma, R. N. (2008). Vocational Guidance and Counseling. Delhi: Surjeet Publications.
1. Singh, L.K. & Sudarshan, K. N. (1996): Vocational Education. N. Delhi: Discovery Publishing house.

EDSI0117: SPECIAL AND INCLUSIVE EDUCATION**(4 Credits-60 Hours)***Objectives:*

- *To acquire knowledge and understanding of Special education and Inclusion*
- *To understand of special education in broader social, political and educational context*
- *To recognize and describe strengths and needs of specially-abled children and their respective effect on child's performance in school and community.*

Module I: Introduction to Special Education (10 Hours)

Historical background of Special Education-Meaning, Definition, nature, objectives and scope of special education, Principles of special education

Module II: Introduction to Inclusive Education (10 Hours)

Concept and nature of Inclusive Education; Objectives and scope of Inclusive Education; Children with special needs (CWSN); Identification of disabilities; Types of disabilities

Module III: Impairments (15 Hours)

Visual Impairment- blindness and low vision, methods of teaching visually impaired students; Hearing Impairment- definition, causes and preventions, methods of teaching; Speech Impairment- definition, and method of teaching

Module IV: Policies and Legislations: (10 Hours)

International Legislation for Special Education; Role of UN; Persons with Disabilities Act, 1995; Rights of Persons with Disabilities Act, 2016; Rehabilitation Council of India- Acts, Objectives and functions

Module V: Mental Retardation and Learning Disability (15 Hours)

Mental retardation- Definition and Identification of Mental Retardation and Mental Illness; Causes and Prevention of mental retardation; Characteristics -Mild, Moderate, Severe, Profound; Types and Classification of Mental Retardation and Mental Illness; Intervention and Educational Programmes ; Learning Disability- Concept characteristics, and Types, Etiological Factors affecting learning, Issues and needs of children with Learning Disabilities; Autism- characteristics, medical intervention and role of education.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

Module I

State the historical background of special education (R); define the concept of special education (R); explain the nature of special education (U); explain the scope special education (U); state the objectives of special education (R); explain the principles of special education (U).

Module II

Define the term 'Inclusive Education' (R); analyse the definition of inclusive education (An); write feature of inclusive education (K); explain the process of inclusion (U); write the need and objectives of inclusive education (R); identify the children with special needs (CWSN) (Ap); name the types disabilities (R); identify the disabilities (Ap); use and apply new approaches of teaching (Ap); analyse the inclusive classroom (Ap); evaluate the performance of all categories of students (E).

Module III

State the meaning of visually impaired students (R); explain the methods to be adopted for teaching the visually impaired students (U); evaluate the academic performance of visually impaired students (E); explain the causes of visually impairments (U); write the meaning of hearing impairment (R); explain the causes of hearing impairment (U); state the measures for controlling of hearing impairment (R); explain the methods of teaching for hearing impaired students (U); write the meaning of speech impairment (R); identify and classify the speech impaired student (Ap); explain the methods of teaching for speech impaired students (U).

Module IV

State policies and programmes at international and national level (R); explain the role of UN relating to Persons with Disabilities (U); state the features of Persons with Disabilities Act, 1995 (R); identify and explain the rights of Persons with Disabilities Act – 2016 (Ap); state the formation of Rehabilitation council of India and its acts (R); explain the objectives and functions of Rehabilitation council (U).

Module V

Define the term 'mental retardation' (R); explain the features of mentally retarded individual (U); identify the mentally retarded individuals and classify (Ap); identify the causes of mental retardation (Ap); prevent the mental sickness (Ap); state the educational programmes for mentally retarded children (R); define the term 'Learning Disability' (R); identify the students of learning disabilities and classify (Ap); state the characteristics of the students with learning disabilities (R); state the etiological factors affecting learning of students.(R&U); identify the needs of students with learning disabilities (Ap); explain the concept of Autism (U); state the features of Autism (R); state the medical interventions for the persons with autism (R); explain the role of education in the context of autism (U).

Suggested Readings

1. Evans, P and Verma, V. (Eds.) (1990) Special Education. Past Present and Future. The Fairer Press.
2. Hearty and Alur, Mithu: Education for Children with Special Needs (From segregation to Inclusion) New Delhi, Sage Publication: 2009
3. Jangira, N.K., & Mani, M.N.G., Integrated Education of the visually Handicapped, Management Perspectives. Gurgaon Academic Press, 1991.
4. Judith, I. (2008). Learners, Learning and Educational Activity, London: Roulledge
5. Kumari, Meena: Education for Children with Special Needs, New Delhi, Centrum Press: 2009
6. Mani, M.N.G., Techniques of teaching blind children, New Delhi Sterling Publishers, 1992.
7. Myreddi, V. & Narayan, J. Educating Children, Secunderabad, NIMH
8. Narayan, & Kutty, A.T.T. (1989) Handbook for Trainers of the Mentally Retarded persons. Pre-primary level. NIMH, Secunderabad.
9. Overton, T. (1992). Assessment in Special Education An Applied Approach. New York McMillan.
10. Panda, K.C. (1997). Education of Exceptional Children. New Delhi Vikas Publications.
11. Report to UNESCO, Education for All-2000 Bulletin No.32, 1998
12. Smith, R: Children with Mental Retardation : A parent's Guide Edited by Romanye Smith, Bethasda, USA, Woodbine House, 1993
13. Subba Rao, T.A. (1992). Manual on Developing Communication Skills in Mentally Retarded Persons, NIMH, Secunderabad.
14. Zeki, S: The Visual images in Mind and Brain, Scientific American, 1992

EDTL0118: TEACHING LEARNING METHODS AND PEDAGOGY**(4 Credits- 60 Hours)****Objectives:**

- *To acquaint the students about the several components of teaching-learning process.*
- *To create interest among the students in teaching and teaching profession.*
- *To create awareness among the students about teaching skills, methods and approaches of teaching.*
- *To make the students competent in planning the lesson and teaching effectively.*

Module I: Concepts of teaching and learning (12 hours)

Meaning and definitions of the term teaching.

Teaching from descriptive point of view.

Teaching from success point of view.

Variables and functions of teaching, levels and phases of teaching.

Module II: Theories and Principles of Teaching (15 hours)

Nature of theory of teaching

Significance of theory of teaching

Formal, descriptive and normative theories of learning

Teaching skills and Microteaching

Module III: Instructional Objectives and Approaches of Teaching (18 hours)

Concept of instructional objectives and learning outcomes.

Taxonomy of instructional objectives with special reference to cognitive objectives

Methods of teaching: Lecture method, Discussion method, Demonstrative method

Approaches of teaching: Inquiry approach, Modular approach, Computer assisted instruction and Keller's plan

Module IV: Lesson Plan and Process of Evaluation (15 hours)

Meaning and significance of lesson plan

Approaches of lesson plan

Preparation of lesson plan

Concepts of measurement and evaluation in education

Principles of evaluation in education

Preparing a balanced question paper with its blue print

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

Module I

Write the meaning of teaching (R), analyse the concept of teaching (An), justify the hyphenated expression of teaching-learning process (Ap), explain the variables of teaching-learning process (U), write the functions of teaching-learning process (R), describe the phases of T-L process (K), establish the relationship among the different phases of teaching (Ap), evaluate the phases of teaching (E)

Module II

Give the meaning of theory of teaching (R), analyse the components of the theory of teaching (An), explain the significance of theories of teaching (U), name the theories of teaching (R), categorize the theories of teaching (Ap), illustrate the theories of different categories (U), state the different principles of teaching (R), describe the maxims of teaching (R), differentiate between principles and maxims of teaching (Ap), define the teaching skill (R), enlist the teaching skills from different sources (Ap), understand the concept of microteaching (U), explain the steps of microteaching (U), apply microteaching for imbibing the teaching skills (Ap)

Module III

Write the meaning of instructional objective (R), describe the concept of learning outcome (R), explain the Bloom's taxonomy of cognitive objectives (U), formulate the different categories of instructional objectives (Ap), formulate the learning outcomes in accordance with the different categories of formulated instructional objectives (Ap), differentiate between the method and approach (Ap), explain the methods like – lecture method, discussion method, demonstrative method, and project method (U), explain the basic features of approaches of teaching (U), illustrate the steps of Inquiry Approach, Modular Approach, Computer-Assisted

Instruction, and Keller Plan (U), use the different approaches in classroom situation for the purpose of teaching and learning (Ap)

Module IV

Know the meaning of lesson plan (R), state the significance of lesson plan (R), explain the different approaches of lesson plan (U), differentiate the different approaches of lesson plan (AP), explain the format of the lesson plan (U), draw the format for making lesson plan (Ap), develop a lesson plan (Ap), use the lesson plan in classroom for the purpose of teaching a lesson (Ap), write the meaning of measurement (R), define the term 'Evaluation' (R), differentiate between the educational measurement and evaluation (Ap), state the principles of evaluation (R), develop a balanced question paper with its blue print (Ap)

Suggested Readings

1. Aggarwal, J.C (2014): Essentials of Educational Technology, Innovation in Teaching-Learning, Vikas Publishing House Pvt. Ltd. New Delhi
2. Bloom, B.S (1956): Taxonomy of Educational Objectives, New York.
3. Freeberg, M.J & Drescoli, Amy (1992): Universal Teaching Strategies, Boston: Allyan and Bacon
4. Gage, N.S. (1968): "Theories of Teaching" in theories of learning and instruction, Chicago University Press.
5. Jangira, N.K. & Ajit Singh (1983):Core Teaching Skills: The Microteaching Approach, NCERT, New Delhi.
6. Kapoor, K.C et. al. (Ed) (2008): Teacher Education in the 21st Century, The Associated Publsiher, Ambala cantt.
7. Mangal, S.K & Mangal, U (2014): Essentials of Educational Technology, PHI Learning Pvt. Ltd, Delhi.
8. Mudranalaya
9. Passi, B.K. (1976): Becoming Better Teacher: Microteaching Approach, Ahmedabad: Sahitaya
10. Stone, Edgar & Morris, Sidney (1972): Teaching Practice: Problems and Perspectives, London

EDEM0119: EDUCATIONAL MANAGEMENT AND ADMINISTRATION

(4 Credits-60 hours)

Objectives:

- *To enable students to acquire knowledge and skills in the field of Educational Administration.*
- *To create awareness among the students about School Management.*
- *To enable the learners with leadership qualities.*
- *To make them understand institutional planning.*
- *To equip the students with Supervision and Management Skills.*

Module I: Introduction to Educational Administration (10 hours)

Meaning, Definition, Nature of EA, Scope of EA; Objectives of EA; Types of EA, Elements of EA, Characteristics of Administration; Functions of EA, Factors influencing EA.

Module II: School Management (12 hours)

Concept of School, Need of School, Meaning and Definitions of School management; Process of School Management, Qualities of a Headmaster/Principal; Role of teachers in school management; Essential Qualities of a Teachers, Professional ethics and attitude of the teachers, Autocratic and Democratic administration.

Module III: Institutional planning (12 hours)

Meaning of Planning, Concept of Institutional Planning, Importance of Institutional Planning, Aims of Institutional Planning, Steps and Preparation of Institutional planning, Approaches of Educational Planning – Man Power and Rate of return approach.

Module IV: Supervision (11 hours)

Meaning and Nature of Supervision, Concept of Inspection, Difference between Inspection and Supervision, Aims, Types, Scope of Supervision, Supervision Procedures, Principles of Supervision, Problems in Supervision, Suggestions for developing supervision, Effective supervision, Functional basis of supervision, Difference between supervision and administration.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

Module I

State the Meaning EA (R); Define EA (R); List out the Nature of EA (R); List out the scope of EA (R); State the Objectives of EA (R) ; Explain the types of EA (U), Analyze the Elements of EA (An), Spell out the characteristics of Administration (R); Criticize the functions of EA (E), Classify the factors influencing EA (An).

Module II

State the Concept of School (R); Explain the Need of School (U); State the meaning of school management (R); Define of School management (R); Explain the Process of School Management (U); Analyze the Qualities of a Headmaster/Principal (An); Identify the Role of teachers in school management (Ap); Evaluate the Essential Qualities of Teachers (Ev), Explain the Professional ethics and attitude of the teachers (U), Discuss Autocratic administration (An); Analyze Democratic administration (An); Compare and contrast Autocratic administration and Democratic administration (An).

Module III

Recall the meaning of Planning (R); State the concept of Institutional Planning (R); Explain the importance of Micro-Planning (U), List out the aims of Institutional Planning (R), Create an innovative institution plan for institution (Cr), Analyze the role of Administrator (An), Apply the concept of Time Management (AP); Prepare Time schedules of weekly, monthly, yearly plans for school activities (Cr); Apply the knowledge in the Management of Material Resources: School building, library, laboratory, hostels and playground (Ap).

Module IV

State the Meaning and Nature of Supervision (R); Explain the concept of Inspection (U), Difference between Inspection and Supervision (An), Spell out the aims Supervision (R); Explain the types Supervision (U); analyze the Scope of Supervision (An); Classify the Supervision Procedures (An); Apply the Principles of Supervision (Ap), Discuss Problems in Supervision (An); Make up suggestions for developing supervision (Cr); Explain Effective supervision (U); Discuss the functional basis of supervision (An); Differentiate supervision and administration (An).

Suggested Readings

1. Sindhu (2012). Educational Administration and Management, Noida: Dorling Kindersley.
2. Jain and Jain,. School Management, Ludhiana: Tandon Publications.
3. Adams,H.P & Duckey,F.G. Basic Principles of supervision.
4. Donahoo, S. & Hunter, R. Teaching Leaders to Lead Teachers: Educational Administration in the Era of Constant Crisis. Advances in Educational Administration, Volume 10, 1–4. Elsevier Ltd.
5. English, F. (ed.). Encyclopedia Educational leadership and Administration (Vol. 1). Sage Publication: Thousand Oaks.
6. Stanley, A. G. & Samier, E. A.Political Approaches to Educational Administration and Leadership. Routledge: New York.
7. Starratt, R. Centering Educational Administration: Cultivating Meaning, Community, and Responsibility. Lawrence Erlbaum Associates, Publishers: New Jersey.

EDSM0120: SCIENTIFIC METHODOLOGY**(4 Credits-60 Hours)****Objectives:**

- *To create scientific temper among the undergraduate students*
- *To create analytical and creative abilities among the undergraduate students*
- *To make the students well-aware of the scientific tools and techniques*
- *To develop self-decision making skill on the basis of scientific data*
- *To develop critical thinking ability among the learners*
- *To make the undergraduate students well-aware of the concept and process of research*

Module I: Introduction to the Nature of Science (15 Hours)

Meaning and definition of science, Functions of science, Aims of science, Science and technology in societal development, Qualities of a good science teacher

Module II: Contributions Of Eminent Scientists (10 Hours)

Sir J. C. Bose (1858-1937), Acharya Prafulla Chandra Ray (1861-1944), S. Ramanujan (1887-1920), Marie Curie (1867-1934), Louis Pasteur (1822-1895), Charles Darwin (1809-1882)

Module III: Scientific Methods and Approaches (20 Hours)

Methods of teaching science: Lecture, Observation, Demonstration, Discussion, Project method, Laboratory method, Inductive- Deductive method; Constructivist approach; Approaches: Problem-solving approach, Inquiry Approach, Constructivist Approach including 5E learning model; Scientific equipment and other teaching aids

Module IV: Research in Science (15 Hours)

Concept of research; Types of research- Fundamental, Applied & Action research; Scientific method of research; Process of research; Action research for science teachers

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

Module I

Write the meaning of science (R), give the definition of science (R), explain the functions of science (U), state the aims of science (R), illustrate the role of science and technology for the development of society (Ap), analyse the qualities of a science teacher (An), assess the influence of science and technology in the field of education (E)

Module II

Explain the contributions made by J. C. Bose (U), outline the life sketch of J. C. Bose (R), illustrate the contributions of Acharya P. C. Ray (U), state the contributions made by S. Ramanujan (R), illustrate the life sketch of S. Ramanujan (R), analyse the works of Marie Curie (An), synthesise the works of Louis Pasteur (Cr), state the contributions of Charles Darwin (R)

Module III

Differentiate between method and approach of teaching of science (Ap), name the important methods of teaching and learning science (R), explain lecture method with its merits and demerits (U), describe demonstration method with its advantages and disadvantages (U), demonstrate working models (Cr), analyse data collected through observation method (An), Understand significance of use of laboratory in science (U), Use laboratory for their learning purposes (Ap), use inquiry approach to solve problems (Ap), explain constructivist approach

with its merits and demerits (U), understand the concept of 5E model (U), create new body of knowledge by using constructivist approach (Cr), assess the quality of outcomes produced by new approaches (E), understand the importance of scientific equipment and teaching aids (U), state a few teaching aids required for teaching science (R)

Module IV

Describe the concept of research (R & U), name the types of research (R), differentiate between basic research and action research (Ap), explain the steps of scientific method of research (U), carry out a small piece of research work (Ap & Cr), use action research for solving the problem faced by students in class (Ap), explain the process of research (U),

Suggested Readings

1. Pedagogy of Science- Physical Science, Part I & II (2013) Textbook for B. Ed., NCERT; ISBN 978-93-5007-224-0 & 978-93-5007-225-7 respectively
2. Soni, A. Teaching of Science. Tandon Publications.
3. Rajasekar, S. (2011). Methods of Teaching Physical Science. Neelkamal Publications Pvt. Ltd. ISBN 81-8316-031-X
4. Shankat, T. (2018). Methods of Teaching Life Science, Crescent Publishing Corporation. ISBN 81-8342-062-1
5. Malhotra, V. (2018). Methods of Teaching Physics. Crescent Publishing Corporation. ISBN 81-8342-025-7
6. Vanaja, M. (2012). Methods of Teaching Physical Science. Neelkamal Publications Pvt. Ltd. ISBN 978-81-8316-329-3
7. Mohan, R. (2013). Innovative Science Teaching- for Physical Science teachers. PHI Learning Pvt. Ltd. ISBN 978-81-203-3157-0
8. Malhotra, V. (2018). Methods of Teaching Mathematics. Crescent Publishing Corporation. ISBN 81-8342-029-X
9. Llewellyn, D. (2005). Teaching High School Science through Inquiry: A case study approach. SAGE Publications India Pvt. Ltd. ISBN 978-81-321-1601-1 (PB)
10. Koul, L. (2009). Methodology of Educational Research, Vikas Publishing House Pvt. Ltd. ISBN 978-81-259-2796-9
11. Kerlinger, F. N. (2004). Foundations of Behavioral Research. Surjeet Publications.

EDTE0121: TEACHER EDUCATION

(3 Credits- 45 Hours)

Objectives:

- *To create awareness about Teacher Education programmes*
- *To make them aware of the structure and curriculum of the Teacher education Programme*
- *To create understanding among the students about the concepts of Pre-service & In-service Teacher Education Programmes*
- *To provide the students some of the current trends in the field of Teacher Education*
- *To make the students competent for conducting research in the field of Teacher Education*

Module I: Introduction to Teacher Education (10 hours)

Meaning, nature and scope of Teacher Education

Historical background of Teacher Education in India

Objectives of Teacher Education

Paradigm shifts in education and preparation of teachers

Module II: Structure and Curriculum of Teacher Education (12 hours)

Salient Features of the Teacher Education Curriculum

Structure of Teacher Education curriculum at Pre-primary and Primary level

Structure of Teacher Education curriculum at Secondary stage

Curriculum for Teacher Educators.

Module III: Pre-service and In-service Teacher Education (12 hours)

Concept of Pre-service & In-service Teacher Education

Features of Pre-service & In-service Teacher Education

Terms and conditions for Pre-service & In-service Teacher Education Programs as per NCTE

Modes of Transaction

Micro Teaching and SSST

Team Teaching

Module IV: Current Trends and Research in Teacher Education (11 hours)

Practice Teaching and Internship

Flander's Interaction Analysis Category System (FIACS)

Integrated Teacher Education Programme

Research in Teacher Education

Process of Action Research

Technology in Teacher Education

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

Module I

Define Teaching (R); Find out the difference between Teacher and Educator (Remembering); Who are Teacher Educators (R); What are the qualities of a Teacher (Remembering); Identify the necessity of efficient teaching (Ap); Explain the meaning of Teacher Education (U); Summarize the nature of Teacher Education (U); Compare between teachers of the past and present (An); Discuss the scope of Teacher Education (Cr); Explain the historical background of teacher education in India (Ev); Elaborate on the aims of Teacher Education (Cr); List the objectives of Teacher Education (An). Analyze the paradigm shifts in education and its role in preparing teachers (An)

Module II

Define Curriculum (R); Why is curriculum required (R); Explain and illustrate the salient features of Teacher Education Curriculum (U); Apply curriculum for effective teaching learning (Ap); Contrast between pre-primary and primary level of education (An); Importance of curriculum in Teacher Education programme (Ev); Develop a structure of Teacher Education curriculum at Pre-primary level (Cr); Elaborate the structure of Teacher Education curriculum at Primary level (Cr); What is secondary education (Re); Analyze the need of curriculum at secondary stage (An); Importance of curriculum for Teacher Educators (Ev).

Module III

Explain the concept of Pre-service Teacher education (U); Discuss the concept of In-service Teacher education (Cr); Distinguish between Pre-service and In-service Teacher education program (An); Analyze the components of Pre-service and In-service Teacher education (An); Summarize the features of In-service and Pre-service Teacher Education (Un);

What is the importance of pre-service and in-service teacher education program(R);Find out the full form of NCTE(R);Discuss and elaborate the terms and conditions required for Pre-service and In-service Programme as per NCTE (Cr);Assess the modes of transaction in Teacher Education programme(Ev);Explain Micro teaching(Ev);Formulate the steps of Micro teaching(Cr);Evaluate and justify the meaning of SSST (Ev);Define Team Teaching (R);Explain the steps of Micro teaching(U)Apply the steps of Micro teaching in classroom setting(Ap);Recommend and propose on the improvement of Micro teaching (Ev & Cr).

Module IV

Define Practice Teaching(R); Outline the objectives of Practice teaching(U); Importance of Internship(Ev);Explain the objectives of School Internship(U);Justify the process of school internship (Ev);Analyze the components of School Internship(An);Solve the issues faced in implementing internship successfully (Cr); Explain Flander’s Interaction Analysis Category System (FIACS) in details(U); Analyze the behavior of the teachers by using FIACS(An); Summarize the features of FIACS(U);Explain the concept of Integrated Teacher Education Programme(U) ;Analyze the elements of Integrated Teacher Education Programme (An);Evaluate Integrated Teacher Education Programme in an institution(Ev); Propose for improving Integrated Teacher Education Programme(Cr); Elaborate on Research in Teacher Education (Cr) Recommend on Research in Teacher Education (Ev);Define Action Research (R);Analyze the features of Action Research (An);Explain the features of Action Research (U);Formulate the steps of Action Research (Cr);Discuss and solve the problems in Action Research (Cr); Make use of Technology in Teacher Education programme(Ap);Utilize technology in Teacher Education programs(Ap);Examine the use of ICT in Teacher education programme(An);Importance of ICT in Teacher Education Program (Ev).

Suggested Readings

1. Aggarwal.J.C (2010): Teacher Education, Theory and Practices, New Delhi, Daoba Home
2. Harvilas, S. and Naik, J.P (2016): A History of Education in India, Bombay, McMillan & Co.
3. Jangaiah, C(2016): Teacher Education, APH Publishing Corporation
4. Jangira, N.K (2002): Teacher Training and Teacher Effectiveness –An experience in Teaching, New Delhi, National Publishing House
5. Kumar, T.P (2010): Teacher Education, APH Publishing Corporation
6. NCERT (1968): The Third Indian Year Book on Education, New Delhi, NCERT
7. NCTE (1978): Teacher Education Curriculum-A Framework, New Delhi, NCERT
8. Mohanty, R.K (2012) : Teacher Education, R.Lal Book Depot, Raj Printers
9. Shirmali, K.L: Better Teacher Education, New Delhi, Ministry of Education, Govt. of India

EDDA0122: DISTANCE AND ADULT EDUCATION

(3 Credits-45 Hours)

Objectives:

- *To develop their knowledge and understanding of various aspects of theory and practice of Distance education and adult education.*
- *To enable them to critically analyse, appreciate and promote the role of distance and adult education in the emerging social, political, cultural, economic, developmental, environmental and educational situations for effecting transformation at the national and international levels.*
- *To realize the importance of policies and programmes of adult education and distance education towards achieving the goal of ‘Education for All’.*
- *To develop the knowledge of existing issues and policy initiatives with regard to adult education and distance education.*

Module I: Understanding Adult Education (10 hours)

Adult Education- Meaning, definition, nature, objectives, characteristics, scope, target group, characteristics of adult learners, importance of adult education in India.

Module II: Trends in Adult Education (13 hours)

National Literacy Mission (NLM) - Objectives, Management Structure, role and function, supporting agencies for adult education programmes and bodies such as State Resource Centre, Directorate of Adult Education. Total Literacy Campaigns (TLC), Post – Literacy Campaigns (PLC), Teaching methods for adults, Role of NGOs, Universities and other Government agencies in support of the NLM UNESCO's efforts; Hamburg Declaration on Adult Education, 1997;

Module III: Understanding Distance Education (12 hours)

Distance Education- Meaning, nature, scope, characteristics, significance, merits and demerits; Types of interaction in distance learning; Use of technology in distance learning; Historical Context; Distance Education in India; Models of Distance Education- Systems Model, Transactional Model;

Module IV: Commissions and Agencies of Distance Education (10 hours)

Report of Indian Commissions and Committees on Distance Education- NPE, 1986; Open University- Concept, Status in India; IGNOU; Commonwealth of Learning; International Council for Distance Education (ICDE); Asian Association of Open University (AAOU)

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

Module I

Write the meaning of adult education (R); Define adult education (R); Elaborate the nature of adult education (E); Enumerate the objectives of adult education (U); State the characteristics of adult education (R); Explain the scope of adult education (An); Identify the target group learners and their characteristics (R); Locate the importance of adult education in India (Cr)

Module II

Define National Literacy Mission (R); Enlist the Objectives of NLM (R); Illustrate the management structure (U); State the functions of NLM (R); Elaborate the concept of State Resource Centre (Cr); Discuss about the DIET and its functions (An); Find out the functions of Directorate of Adult Education (An); Analyse the scheme of Total Literacy Campaign (An); Practice teaching methods for adults (Cr); Analyse monitoring and evaluation of TLC, PLC and other programs of the NLM (An); Explain the role of NGOs, Universities and other Government agencies in support of the NLM UNESCO's efforts (E); Describe Dakar Framework (U); Elaborate Hamburg Declaration on Adult Education, 1997 (Ev); State the objectives of NPE 1986 on Adult Education (R)

Module III

Write the meaning of distance education (R); Define distance education (R); Elaborate the nature of distance education (Ev); Explain the scope of distance education (An); State the characteristics of distance education (R); Discuss the importance of distance education (Cr); Locate the merits and demerits of distance education (Ap); Classify the types of interaction in distance learning (E); Outline the historical context of distance education (An); Explain the concept of distance education in India (U); Describe the models of Distance Education- Systems Model, Transactional Model (Cr); Discuss the training modalities for teacher educators (E)

Module IV

Illustrate the Report of NPE, 1986 on Distance Education (U); Define open university (R); Discuss the concept of open university (U); Explain the status of open university in India (An);

Illustrate the objectives and functions of IGNOU (U); Describe Commonwealth of Learning (U); Elaborate the role of International Council for Distance Education (Ap); Analyse the role of Asian Association of Open University (An)

Suggested Readings

1. Mohanty. S. (2002). Adult and Non-Formal Education, Second Edition, *Deep & Deep Publications Pvt. Ltd.*
2. Reddy. V. (2012). Adult and Lifelong Education, *APH Publishing Corporation, Darya Ganj, New Delhi.*
3. Mohanty. S. (2012). Lifelong Education and Adult, *APH Publishing Corporation, Darya Ganj, New Delhi.*
4. Attri. A. (2012). Adult Education, *APH Publishing Corporation, Darya Ganj, New Delhi.*
5. Singh. M. (2012). Adult Education in India: Some Reflections, *Kanishka Publishers, New Delhi.*
6. Reddy, P. A. (2007). Post-Literacy & Continuing Education. *Discovery Publishing House.* ISBN 81-7141-433-8.
7. Kumar, P. J. & Rao, D. B. (2011). Effectiveness of Distance Education System. *Discovery Publishing House.* ISBN 81-7141-437-0.
8. Ramanujam, P. R. (2009). Globalisation, Education and Open Distance Learning. *Shipra Publications.* ISBN 987-81-7541-273-6.

EDES0123: ELEMENTARY STATISTICS IN EDUCATION

(3 Credits: 45 hours)

Objectives:

- To create awareness among the students about the utility of statistics in Education.
- To acquaint the students about the nature of data and its organization.
- To make the students well aware of the Central tendency and variability of the collected data.
- To provide skills of computation and interpretation of the computed results.

Module I: Introduction to Statistics (10 hours)

Meaning, definition and functions of Statistics

Need of Statistics in Education

Concept of data, methods of organizing data

Graphical representation of data: Frequency Polygon, Histogram, Cumulative Frequency curve, Cumulative Frequency Percentage curve or ogives.

Module II: Measures of Central Tendency (10 hours)

Meaning and significance of Measures of Central Tendency

Computation of Mean from Ungrouped and Grouped data

Computation of Median from Grouped and Ungrouped data

Computation of Mode from Grouped and Ungrouped data.

Module III: Measures of Variability (13 hours)

Meaning and significance of Measures of Variability

Concepts, Uses and Computation of Range, AD, SD and QD

Percentile and Percentile Ranks

Module IV: Linear Correlation (12 hours)

Meaning of Correlation

Degrees of Correlation ship

Computation of Correlation by using –Product Moment Method and rank Difference Method
Interpretations of Computed Co-efficient of Correlation.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to:

Module I

Define the term 'Statistics' (R), explain the 'Statistics' as singular and plural (U), illustrate the functions of statistics (U), define the term 'data' (R), create the data (Cr), organize and use the data (Ap), analyze the data (An), draw the Frequency Polygon and histogram by using the data (Ap)

Module II

State the meaning of Measures of Central Tendency (R), write the significance of Measures of Central Tendency (R), define the terms-Mean, Median and Mode (U), compute the Mean from Ungrouped and Grouped data (Ap), compute the Median from Ungrouped and Grouped data (Ap), find out the value of mode from Ungrouped and Grouped data (Ap), apply the Mean, Median and Mode in different situations (Ap)

Module III

Explain the concept of Variability (U), write the significance of Measures of Variability (R), state the concept of Range (R), compute the Average Deviation (Ap), use SD and QD in different situations (Ap), analyze the concepts of SD and QD (An), find out the values of Percentiles and Percentile Rank (Ap)

Module IV

Write the meaning of Linear Correlation (R), explain the concept of correlations (U), give the degrees of relationship (R), find out the Co-efficient of Correlation by adopting Product Moment Method (Ap), interpret the Computed Correlation Value (U), explain the concept of Rank Difference Method of finding out the Co-efficient of Correlation (U), compute the correlation value of two variables by using Rank Difference Method (Cr)

Suggested Readings

1. Garrett, H.E (1971): Statistics in Psychology and Education, Vakuls, Feffera and Sumon, Bombay
2. Guilford, J.P (1967): Fundamentals Statistics in Psychology and Education, McGraw-Mill, New York
3. Gupta, B.N (1993): Statistics, Theory and Practice, Sahitya Bhawan, Agra.
4. Koul, L. (2009): Methodology of Educational Research, Vikash Publishing House, Pvt Ltd, New Delhi
5. Mangal, S.K. (2018): Statistics in Psychology and Education, PHI Pvt. Ltd, Delhi

EDJG6002: JOURNALING - A TECHNIQUE FOR PERSONAL AND ACADEMIC GROWTH

(3 Credits)

Journaling is a strategy for making sense of experiences. The objective of journaling is to develop in students a reflection that can be described as an inner dialogue with oneself whereby a person calls forth his or her own experiences, beliefs, and perceptions about an idea; informing and transforming functions of knowledge; and a conscious and systematic mode of thought. This is to nurture in future educational leaders a sense of reflective practice.

Each student is required to maintain a reflective journal, using the Visible Thinking Routine (Harvard), as a critical structure for guiding their journal writing. The students are to submit the journal on every Friday. Journaling have to be done six days of the week. At the end of the semester, the student will be awarded a grade/marks after assessing the learning.

During the semester, students have to visit a school in pairs at least ten times and conduct an audit.

The audit reports need to be submitted in scientific format at the end of the semester after the presentation. Marks will be awarded after assessing the work.

Suggested Readings

1. Davies, M. (2011). Concept mapping, mind mapping and argument mapping: what are the differences and do they matter?. Higher education, 62(3), 279-301. Retrieved from <http://download.springer.com> on 19th July 2016
2. Dhankar, Rohit (2013). Can reflective practice be taught? Teacher Plus 2013. (<http://www.teacherplus.org/cover-story/can-reflective-practice-be-taught>)
3. Hubbs, D. L., and Brand, C. F. (2005). The paper mirror: Understanding reflective journaling. Journal of Experiential Education, 28(1), 60-71.
4. Liulienė, A., and Metiūnienė, R. (2009). Students' Learning Through Reflective Journaling. Coactivity / Santalka, 17(4), 32-37. doi:10.3846/1822-430X.2009.17.4.32-37
5. Lowe, G. M., Prout, P., and Murcia, K. (2013). I See, I Think I Wonder: An Evaluation of Journaling as a Critical Reflective Practice Tool for Aiding Teachers in Challenging or Confronting Contexts. Australian Journal Of Teacher Edu

EDES6003 : EDUCATIONAL SEMINAR I EDES6009 : EDUCATIONAL SEMINAR II (2 Credits)

During the course of the programme, students are expected to present a series of seminars which will address fundamental intellectual, conceptual and practical issues in current educational philosophy and application. They may also deal with other relevant topics such as use of ICT in education, design of new and innovative curricula, methodological issues in education, etc. Students will be assisted through guest lectures, discussions, field work in education related institutions and active engagement with faculty members. During these interactions students will be provided with an opportunity to explore how best to bring new interdisciplinary scholarship, technology and critical thinking into the development of the chosen seminar area. They will also consider alternative pedagogic strategies, teaching techniques and technologies. Students will prepare and present a final paper based on these seminars. The course will be evaluated on the basis of the seminars and the final paper.

EDSV6004: SCHOOL VISITS

(2 Credits)

Objective:

School visits provide an opportunity to the students, to experience the ground reality of the schools. During their visit to the schools, the students can experience a new environment, meet new people, and also offer their services to the schools. It is also helpful for the students to clarify, establish, co-relate and co-ordinate accurate concepts regarding the various schools that they plan to visit - interpretations and appreciations and enable them to make their learning about the schools more concrete, effective, interesting, inspirational, meaningful and vivid. Through school visits, the understanding on schools - concepts and phenomena may be easily clarified and assimilated. They can get to know about the proper functioning and management of schools, along with the teaching-learning process. The students are required to maintain a journal and submit a written periodical report. They are also expected to make a presentation of his/her experiences during the school visits. Students will be required to produce a certificate from the Head of the Institution regarding his/her performance in the Institutions they have visited. The focus of school visits would be mostly on

- Enabling resources of school: availability, adequacy and usability
- Teaching-learning and Assessment
- Productive community participation.

- Analysis of school syllabus and textbooks.
- Inclusion, health and safety
- School leadership and management.

Assessment of School visits

- Mentors will be allotted for each student. It will be the responsibility of the respective mentors to allot marks for the student's individual reflective journals.
- A presentation will be made by all the students for updating their review progress and for adequate feedback from the faculty members.
- Marks shall be allotted to each students in accordance with the performance of the tasks mentioned above. Students shall also be required to prepare a report, analysing the experiences of the school visits.

Basis of Assessment	Marks
Reflective journals	20
Presentation made on the basis of review progress for faculty feedback.	20
Objective assessment based on the tasks (Presentation)	60
Total	100

EDDI6005: DISSERTATION PHASE I

(2 Credits)

Every student shall undertake a research project work under the supervision and guidance of a faculty member. The students are expected to complete the literature review and present a research proposal during the first phase. The dates, mode and components of evaluation and the weightages attached to them shall be published by the department at the beginning of the semester.

EDDI6007: DISSERTATION PHASE II

The students of final semester will have to compile their research study in the form of dissertation. Each dissertation has to be systematically structured following proper methodology of educational research. To set the dissertations in a standardized pattern the supervisor should ensure that it follows proper sequence containing following aspects:

- A. Preliminary section
 1. Title page
 2. Approval sheet
 3. Acknowledgments
 4. Table of contents
 5. List of tables (if any)
 6. List of figures (if any)
- B. Main body
 1. Introduction
 - Conceptual framework of the theme
 - Some relevant studies
 - Rationale/Justification of the study
 - Statement of the problems

- Operational terms
- Statement of the study
- Objectives of the study
- Hypotheses
- Delimitation of the study
- 2. Review of related literature
- 3. Method and Procedure of the study
 - Procedures used
 - Methods of gathering data
 - Description of data gathering tools
- 4. Presentation and Analysis of Data
 - Texts
 - Tables
 - Figures
 - Statistical treatment
 - Analysis of data gathered and interpretations
- 5. Conclusion
 - Brief restatement of problems and procedures
 - Major findings and conclusion
 - Educational implications
 - Recommendations for further research
- C. Reference section
 - 1. References (APA sixth edition)
 - 2. Appendix

The supervisor will help students to understand the detailed steps of writing a dissertation. He/she will ensure that the dissertation is prepared keeping in view Of Intellectual Property Rights, maintenance of research ethics and avoidance of plagiarism. Phase I of the course is carried out in the 3rd semester where the students will work on research proposal, literature review and first part of the data collection. In the 4th semester they will complete data collection, analysis, preparation of research report (Phase II). Students are required to make a presentation of the dissertation submitted to the department on the date set in the academic calendar for the same.

EDIN6008: INTERNSHIP

The sustained engagement with the school over a period of time is known as ‘school internship’ which equips the prospective practitioners to build a repertoire of professional understandings, competencies and skills, and positive attitude to schooling, administration and teaching. (School internship: framework and guidelines, NCTE, 2016)

Following suggestions are made to make internship a meaningful learning experience.

- Students to maintain reflective journal through-out internship. The emphasis should be on analysis and reflection.
- Following are the tasks to be completed by the students: (school internship: framework and guidelines, NCTE, 2016)

- a) Understanding the Internship School and the community around.
- b) Observing the classroom teaching of regular teachers.
- c) Preparation of case study of the internship school and the innovative activities that the school undertakes.
- d) Preparation of Teaching Plans and Unit Plans.
- e) Teaching the units of the prescribed syllabus in any two subjects currently being taught in the school along with sessions for teachers/ community members/students on aspects of leadership: decision making, all of us are leaders, motivation, visioning, strategizing, problem solving and so on.
- f) Mobilization and development of teaching-learning resources.
- g) Preparation of question papers and other assessment tools.
- h) Undertake action research project on at least one problem area of schooling.
- i) Assist Head of the school/administrators.

Assessment of Internship: 100 Marks

Marks will be divided as per the tasks mentioned above. Each of the tasks will be assessed.

EDTP6010: TEACHING PRACTICE

(2 Credits)

Objectives:

- *To acquaint the students with the concept and purpose of teaching practice.*
- *To provide the skill of preparing lesson plan*
- *To make the students will aware of the various teaching skills and their use in classroom situations.*

Module I: Introduction to Teaching Practice

Introduction to Teaching Practice,

Concept of teaching practice

Objectives of teaching practice

Concept of Lesson Plan, significance of lesson plan

Approaches for preparing lesson plan

Format of lesson plan

Teaching skills and Micro Teaching

Module II: Preparing Lesson Plans

Preparation of Lesson Plan and Presenting lesson plans

Preparing 10 lesson plans for Secondary / Senior Secondary / UG students

Delivering 4 Lesson Plans in Secondary / Senior Secondary / UG Classes

One lesson plan for final practice teaching

Evaluation Scheme:

1. Internal Assessment : 40 Marks (Based on Test)
2. External Assessment : 60 Marks
 - Record : 20 Marks
 - Final Teaching practice : 20 Marks
 - Viva : 20 Marks

COURSE/ LEARNING OUTCOMES

At the end of this module, the students are able to :

Module I

Realise the meaning of teaching practice (R); write the objectives of teaching practice (R); explain the significance of teaching practice (U); identify the important approaches of lesson (AP); develop the lesson plan (AP); draw the appropriate format for any lesson plan (AP); identify the important teaching skills (AP); practice the teaching skills through the process of Micro Teaching (Cr)

Module II

Have encouragement and confidence in the process of teaching and creating learning among the students (Cr); evaluate the presentation of lesson plan (E); deliver the lesson plans effectively in classroom situation (AP); synthesise the delivered content in the classroom; use the different teaching skills, methods, teaching aids in their teaching-learning process (AP). have the skill of writing specific / learning objectives (Cr) analyze course content to be taught (An)

Suggested Readings

1. Bloom, B.S (1956): Taxonomy of Educational Objectives, New York.
2. Passi, B.K. (1976): Becoming Better Teacher: Microteaching Approach, Ahmedabad: Sahitaya
3. Mudranalaya
4. Gage, N.S. (1968): "Theories of Teaching" in theories of learning and instruction, Chicago University Press.
5. Jangira, N.K. & Ajit Singh (1983): Core Teaching Skills: The Microteaching Approach, NCERT, New Delhi.
6. Kapoor, K.C. et.al (Ed.) (2008): Teacher Education in 21st century. Ambala Cantt.:The Associate Publisher.
7. Mangal, S.K & Mangal, U (2014): Essentials of Educational Technology, PHI Learning Pvt. Ltd, Delhi.
8. Aggarwal, J.C (2014): Essentials of Educational Technology, Innovation in Teaching-Learning, Vikas Publishing House Pvt. Ltd. New Delhi
9. Freeberg, M.J & Drescoli, Amy (1992): Universal Teaching Strategies, Boston: Allyan and Bacon
10. Stone, Edgar & Morris, Sidney (1972): Teaching Practice: Problems and Perspectives, London.

EDPT6101: PSYCHOLOGICAL TESTING

(4 Credits)

Objectives: The objectives of this course are

- *To acquaint students with the steps and procedures for administering a psychological test*
- *To enable students to learn the art of scoring and interpreting psychological test*
- *To enable students to correlate theoretical and practical aspect of psychology with respect to individuals' behaviour.*
- *To acquaint the students with psychological experiments with the help of apparatuses.*

a) **Psychological Experiment with apparatus:** Any two from the following:

1. Maze Learning
2. Bilateral Transfer -Mirror learning
3. Division of Attention (Tachistoscope)
4. Reaction Time

b) **Test Administration** : Any two from the following

1. Adjustment Inventory by V. K. Mittal
2. Rorschach Ink blot test
3. Thematic Apperception Test (TAT)
4. Differential Aptitude Test (DAT)

Scheme of Evaluation:

- Psychological Experiment with apparatus : 30 Marks
 - Psychological Experiment without apparatus : 20 Marks
 - Practical book : 10 Marks
 - Viva Voce : 40 Marks
- Total : 100 Marks**

EDPW6102: PROJECT WORK

(3 Credits = 45 Hours)

(EDUCATIONAL TOUR)

Objectives:

- To provide the general exposure about an educational organization.
- To create awareness about the functioning of educational institution at a glance.

Educational Tour as a project for UG 6th semester students aims at providing of some practical experience about an eminent educational institution/institutions. This educational tour will be of two /three day's duration. Educational institutions of some eminence will be identified and the tour will be organized by having the following specific objectives:

1. To study the goals of the identified institutions
2. To look into the plans and policies of the institutions
3. To observe and assess the physical infrastructure
4. To study the profiles of the teachers
5. To observe the functioning of the institutions and observing some classes and laboratory works
6. To analyze the academic performance of final year class/classes
7. To find out the unique features of the institution and if some problems prevail.

On the basis of all the observations, the students need to prepare the complete report of the project stepwise. Each student needs to make the presentation of this project report indicating their experiences. The constituted group of members will assess the project report presented by the students.

Evaluation:

Internal Assessment = 40 % (Presentation)

External Assessment = 60 % (Report + Viva)

DEPARTMENT OF LANGUAGE STUDIES

DETAILED SYLLABUS

LSCE0001: COMMUNICATIVE ENGLISH I

(2 Credits – 30 hours)

Objective: *The objective of this course is to equip the learners with the basic skills of effective communication in English language in all real life contexts, with a reasonable fluency and clarity.*

The course is intensely practice oriented and it specifically attempts to:

- *Familiarize the students with the basic tools of oral communication.*
- *Teach the students to use grammar in meaningful contexts.*
- *To enable the students to communicate in English confidently.*

Module I: Essential grammar of English: An Introduction (10 hours)

Parts of speech; Basic sentence structures; Articles; Prepositions; Person and number; Tenses and their uses; Subject –verb agreement; Vocabulary building; Common idioms and phrases

Module II: Basic tools of oral communication in English (4 hours)

- a) Syllables, stress –pattern and intonation
- b) Consonants, vowels and diphthongs
- c) Differences between spoken and written English

Module III: Functional English: Situational Conversation Practice (7 hours)

- a) At the post office, bank, hotel
- b) At the doctors', At the chemists, In the library
- c) At the market, Tailors', At the garage
- d) In the kitchen, With a close friend , At a wedding
- e) Greetings, small talk, congratulations, condolences, offers, invitations

Module IV: Functional English: Structural Conversation Practice (6 hours)

Telephone conversation, Interviewing a film star; At a travel agent's, An interview; Buying, Hiring a taxi, buying a motor cycle; Agreement, disagreement; Hypothetical conditions, likelihood; Public speaking: Speeches of great men; Interjection, exclamation, emotion emphasis; Expressions of hope, disappointment, surprise, concern, worry; Willingness, wish, intention; Commands, requests, advice, promise, threat.

Module V: Non-Detailed Study: Reading and comprehension (3 hours) Short stories and poems

1. The Blind Dog - RK Narayan
2. The Gift of the Magi - O Henry
3. The End of the Party - Graham Greene
4. Civility is all that Counts - SJ Duncan
5. The Herb Seller - Yengkhom Indira
6. Nothing Gold Can Stay - Robert Frost
7. Night of the Scorpion - Nissim Ezekiel

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

CO1: List out the different parts of speech in English grammar. (Remembering)

CO2: Classify the different vowel and consonant sounds in English phonetics. (Understanding)

- CO3:** Identify the basic sentence structures in English. (Applying)
CO4: Distinguish between common idioms and phrases in English. (Analyzing)
CO5: Determine the different hypothetical conditions in language. (Evaluating)
CO6: Discuss the dominant themes in a short story or poetry. (Creating)

Suggested Readings

1. Leech, Geoffrey and Jan Svartvik, A Communicative Grammar of English, Third edition, Pearson Education, 2002.
2. Sasikumar,V and Dhamija, P.V, Spoken English, Tata McGraw Hill, New Delhi.
3. Taylor, Grant, English Conversation Practice, Tata McGraw Hill, 1975.
4. Dixon, Robert J., Everyday Dialogues in English, Prentice Hall India, 2006.
5. Apte, Madhabi, A Course in English Communication, Prentice Hall India, 2007.
6. Seely, John, The Oxford Guide to Writing and Speaking, Oxford.
7. Plathottam, George, Public Speaking: Resource Book for Effective Communication, Don Bosco Publications, Guwahati, 2007.
8. An Anthology of Short Stories, prepared by Department of Humanities and Social Sciences, Assam Don Bosco University, for private circulation, 2014.

LSCE0002: COMMUNICATIVE ENGLISH II

(2 Credits – 30 hours)

Objectives:

- To develop an awareness in the students about writing as an exact and formal skill
- To equip them with the components of different forms of writing
- To enable the students to study academic subjects with greater facility through the theoretical and practical components of their text books.
- To develop the study skills and communication skills necessary in formal and informal situations.
- To prepare them to face interviews and group discussions

Module I: Basics of Business Communication (6 hours)

Effective communications—benefits, methods, barriers, flow Speaking, listening, non-verbal, telephonic communications

Use of English language in business—grammatical terms, subject-verb agreement, punctuation, some basic grammatical rules

Module II: Business Letters (5 hours)

- a) Introduction—layout, structure, categories of business letter
- b) Rules of good writing
- c) Recruitment correspondence—application, CV, interview, offer, acceptance, etc.
- d) Technical report writing

Module III: Telecommunication (3 hours)

- a) Fax and e-mail
- b) Internet, intranet, extranet

Module IV: Internal communication (5 hours)

- a) Memos - structure, tone
- b) Reports - formal, informal
- c) Proposals
- d) Meetings, minutes, agenda

Module V: Persuasive communication (4 hours)

- a) Circulars, sales letters
- b) Publicity materials - Public relations, news release, news letters c) Notice, advertisements, leaflets

Module VI: Visual and oral communications (4 hours)

- a) Forms and questionnaires
- b) Visual presentation—methods, charts, diagrams c) Writing summaries
- d) Oral presentation—reading and giving speech

Module VII: Non-Detailed Study: Reading and comprehension (3 hours) Short stories and poems

1. Engine Trouble - RK Narayan
2. The Mouse - HH Munro
3. The Rocking-Horse Winner - DH Lawrence
4. Travel the Road - Mamang Dai
5. Haflong Hills - Kallol Choudhury
6. Self-Portrait – A.K. Ramanujan
7. The Solitary Reaper – William Wordsworth

COURSE / LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** List out the different parts of a business letter. (Remembering)
- CO2:** Summarise the different aspects of non-verbal communication. (Understanding)
- CO3:** Identify the different barriers of effective communication. (Applying)
- CO4:** Distinguish between circular letters and sales letters. (Analyzing)
- CO5:** Explain the main themes and motifs in a short story. (Evaluating)
- CO6:** Design an attractive notice or a proposal. (Creating)

Suggested Readings

1. Taylor Shirely, Communication for Business: A Practical Approach, Fourth edition, Pearson Education, 2005.
2. Rutherford, Andrea J., Basic Communication Skills for Technology, Pearson Education, 2001.
3. Mitra, Barun K, Effective Technical Communication, OUP, 2006.
4. Sen, Leena, Communication Skills, Prentice Hall India, 2007.
5. Brian, M.H. Robinson, et al, Communicative Competence in Business English, Orient Longman, 1988.
6. Kaul, Asha, Effective Technical Communication, Prentice Hall, 2006.
7. The Oxford Anthology of Writings from North -East India (Fiction) edited by Tilottoma Misra, OUP, 2011

LSGE0004: GENERAL ENGLISH I

(4 Credits – 60 hours)

Objective: *The objective of this course is to introduce students to a body of literature that includes three different genres—fiction, drama and poetry—from English literature. This course expects them to examine the implication of ideas and explore the different themes and motifs in relation to the socio-cultural contexts in which the mentioned texts were written. This course also aims at equipping the learners with the basic skills of effective communication in English language by introducing a module on basic concepts in English grammar.*

Module I: Selected novel (15 hours)

- a. Jane Austen – Sense and Sensibility

Module II: Selected Dramas (18 hours)

- a. A Doll's House – Henrik Ibsen
- b. The Birthday Party – Harold Pinter

Module III: Selected Poems (12 hours)

- a. My Mother at Sixty-six – Kamala Das
- b. Death Be Not Proud – John Donne
- c. The World is Too Much with Us – William Wordsworth
- d. The Blessed Damozel – D G Rossetti

Module IV: Basic English Grammar (15 hours)

Parts of Speech, Time, Tense, Aspect, Determiners, Phrases and Clauses, Active and Passive Voice, Direct and Indirect Speech, Basic Sentence Structures, Subject-Verb Agreement, Punctuation.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define various genres of literature, viz. novels, drama and poetry and they are able to write about the selected writers and their important literary works. (Remembering)
- CO2:** Interpret the selected literary works and they are able to explain the plot, theme and character of the novels and dramas. (Understanding)
- CO3:** Make use of the correct form of grammar while using the English language and they are able to identify and solve grammatical problems. (Applying)
- CO4:** Take part in critical interpretation or criticism of the literary texts, critically analyse the themes and compare and contrast the different characters of the selected novels and dramas. (Analysing)
- CO5:** Assess and evaluate the selected novels, dramas and poems vis-à-vis their context and socio- political and cultural background. (Evaluating)
- CO6:** Discuss and critically appreciate the selected poems and other literary texts. (Creating)

LSGE0005: GENERAL ENGLISH II**(4 Credits – 60 hours)**

Objective: *This course introduces students to the literary form of short stories and essays through a selection of representative texts from different eras of English literature. This course aims at developing the language skills of the learners by teaching them the different forms of writing and helping them improve their vocabulary in English language.*

Module I: Selected Short Stories (20 hours)

- a. The Happy Prince – Oscar Wilde
- b. Engine Trouble – R K Narayan
- c. The Open Window – Hector Hugh Munro
- d. The Last Leaf – O' Henry

Module II: Selected Essays (20 hours)

- a. Science and Human Life - Bertrand Russell
- b. Meditation Upon a Broomstick - Jonathan Swift

- c. Homage to Gandhi – Jawaharlal Nehru
- d. Of Friendship – Francis Bacon

Module III: Language and Composition (20 hours)

Vocabulary building, Synonyms and Antonyms, Common Idioms and Phrases, One-Word Substitution, Confusing Word Pairs, Letter writing, Application writing, Precis writing, Paragraph writing, C V writing, Memo writing, Notice, Advertisement, Dialogue writing, Letter to the editor, Poster writing.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define various genres of literature, viz. short stories and essays and they are able to write about the selected writers and their important literary works. (Remembering)
- CO2:** Interpret the selected literary works and they are able to explain the themes and characters of the essays and short stories. (Understanding)
- CO3:** Make use of the correct form of language and composition in English and they are able to identify and solve grammatical problems. (Applying)
- CO4:** Take part in critical interpretation or criticism of the literary texts, critically analyse and compare the themes of the selected texts. (Analysing)
- CO5:** Assess and evaluate the selected short stories and essays vis-à-vis their socio-political and cultural context. (Evaluating)
- CO6:** Discuss, summarize and critically appreciate the selected short stories and essays. (Creating)

LSAE0007: ALTERNATIVE ENGLISH I

(4 Credits – 60 hours)

Objective: *This paper is designed to present students with the opportunity to study key concepts and terms associated with three different genres of literature – poetry, novel and drama. The students are expected to examine the implication of ideas and relate these terms and concepts to the prescribed texts in this paper. This paper brings to the students a selection of poems, novels and dramas that are representative of important trends and formal experimentation.*

Module I: Introduction to Poetry: key terms and concepts (8 hours)

Verse, meter, rhyme, stress, accent, alliteration, assonance, consonance, antithesis, blank verse, conceit, iambic pentameter, heroic couplet, quatrain, stanza, foot, syllable, hyperbole, litotes, simile, metaphor, metonymy, verse libre, lyric, narrative, epic, haiku, sonnet, ode, elegy, dramatic monologue, idyll, pastoral, quatrain, refrain, onomatopoeia, apostrophe, personification, epithalamion, carpe diem, ballad.

Module II: Selected Poems (12 hours)

- a. Ode to the West Wind – P B Shelley
- b. The Professor – Nissim Ezekiel
- c. The Second Coming – W B Yeats
- d. Dover Beach – Matthew Arnold

Module III: Selected Dramas (12 hours)

- a. Candida – G B Shaw
- b. She Stoops To Conquer – Oliver Goldsmith

Module V: Introduction to Novel: Key Terms (8 hours)

Novelette; novel; novel of incident, character, manners, formation/education; gothic novel; epistolary novel; picaresque novel; realistic novel; magic realism; documentary fiction; historical novel; social novel; anti novel; prose romances, bildungsroman, stream of consciousness, flat and round character, plot, theme and motifs

Module VI: Selected Novels (12 hours)

- a. Animal Farm- George Orwell
- b. Old Man and the Sea- Earnest Hemingway

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define various genres of literature, viz. novels, drama and poetry and they are able to write about the selected writers and their important literary works. (Remembering)
- CO2:** List the important works of the mentioned writers. (Remembering)
- CO3:** Explain the themes in the selected poems and other literary texts. (Understanding)
- CO4:** Make use of the key terms of the genres of literature in meaningful contexts. (Applying)
- CO5:** Analyse critically the themes and compare and contrast the different characters of the selected novels and dramas. (Analysing)
- CO6:** Interpret the selected literary works and they are able to explain the plot, theme and character of the novels and dramas. (Evaluating)
- CO7:** Assess and evaluate the selected novels, dramas and poems vis-à-vis their context and socio- political and cultural background. (Evaluating)
- CO8:** Construct a new reading of the texts. (Creating)

Suggested Readings

1. M H Abrams, A Glossary of Literary Terms, MacMillan Publishers
2. Peter Brooker, A Glossary of Cultural Theory, Hodder Education
3. Selected Texts (mentioned in the detailed course)

LSAT0009: ALTERNATIVE ENGLISH II**(4 Credits – 60 hours)**

Objective: This course introduces students to the literary forms of short fiction and essays taken from different periods of English literature. The learners are expected to analyse the texts and explore the different themes and motifs in relation to the socio-cultural context in which the prescribed texts are placed. This paper also seeks to introduce students to Linguistics as the scientific study of language and to familiarize them with the key concepts at different levels of language organisation.

Module I: Selected Short Stories (20 hours)

- a. The Purloined Letter – Edgar Allan Poe
- b. The Doll's House – Katherine Mansfield
- c. The Rocking Horse Winner – D H Lawrence
- d. The Home-coming – Rabindranath Tagore

Module II: Selected Essays (20 hours)

- a. A Room of One's Own – Virginia Woolf
- b. The Chimney Sweeper – Charles Lamb

- c. Introduction: The absurdity of the Absurd – Martin Esslin
- d. Imaginary Homeland - Salman Rushdie

Module III: Language and Linguistics: Key concepts (20 hours)

Language and linguistics; langue and parole; synchrony and diachrony; competence and performance; signifier and signified; phonology, morphology, syntax and semantics; organs of speech; vowel and consonant sounds; syllable; stress and intonation; morphs, morphemes and allomorphs; word-formation; idiolect, dialect and register; prefixes and suffixes; syntactic structures.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the genres of literature, viz. fiction and poetry and to write about the selected writers and their important literary works. (Remembering)
- CO2:** Interpret the selected literary works and they are able to explain the plot, theme and character of the fictions and dramas. (Understanding)
- CO3:** Make use of the themes of the literary works in creative writing in various contexts. (Applying)
- CO4:** Take part in critical interpretation or criticism of the literary texts, critically analyse the themes and compare and contrast the different characters of the selected fiction and poetry. (Analysing)
- CO5:** Assess and evaluate the selected fiction and poetry vis-à-vis their context and socio-political and cultural background. (Evaluating)
- CO6:** Discuss, summarize and critically appreciate the selected poems and other literary texts. (Creating)

Suggested Readings

- 1. John Lyons, Language and Linguistics: An Introduction, Cambridge University Press
- 2. David Crystal, Linguistics, Pelican
- 3. RK Bansal and JB Harrison, Spoken English – A Manual of Speech and Phonetics, Orient Blackswan

LSHE0010: HISTORY OF ENGLISH LITERATURE I: ELIZABETHAN TO ROMANTIC PERIOD

(4 Credits-60 hours)

Objective: *The objective of this course is to introduce students to selected texts of literature that includes three different genres – Poetry, Drama and Fiction – from the Elizabethan to the Romantic Period in English Literature. This course expects them to examine the implication of ideas and explore the different themes and texts in the context of the social and political history. This course also provides an overview of the literary and historical context of the mentioned period, in order to help the students to understand the texts better.*

Module I: The Literary History and its Context (20 hours)

Spanish Armada, Shakespeare's greatest tragedies and tragi-comedies, Prose writings of Bacon, Metaphysical poetry (John Donne and others), English Civil War, Puritan Interregnum, Restoration of Stuart Monarchy, Dissolution of the Commonwealth, Closure of Public Theatres, Restoration Comedies (Congreve and others, Heroic Drama (Dryden and others), Age of Sensibility (Pope and Johnson), Enlightenment, Rise of great novelists (Richardson, Fielding, and others...), Shift from sensibility to romanticism in Gray and other poets, Lyrical Ballads, Romantic Poetry (Wordsworth, Coleridge, Keats, and others), Gothic Romances (Anne Radcliffe and others...)

Module II: Selected English Poetry (10 hours)

- a) 'A Valediction: Forbidding Mourning' by John Donne
- b) 'Frost at Midnight' by S.T. Coleridge
- c) 'La Belle Dame Sans Merci' by John Keats
- d) 'The Indian Serenade' by P.B. Shelley
- e) 'To a Butterfly' by William Wordsworth

Module III: Selected English Drama (15 hours)

- a) A Midsummer Night's Dream by William Shakespeare
- b) The Duchess of Malfi by John Webster

Module IV: Selected English Fiction (15 hours)

- a) Frankenstein by Mary Shelley
- b) Pride and Prejudice by Jane Austen

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the various genres of prominent from Elizabethan to Romantic Period. (Remembering)
- CO2:** Choose an important aspect relevant to the text while interpreting it. (Remembering)
- CO3:** Summarize the themes reflected in the reading to the poems and the dramas. (Understanding)
- CO4:** Apply the historical background in reading the texts. (Applying)
- CO5:** Analyse the shifts in terms of texts belonging to different ages. (Analysing)
- CO6:** Assess, combine and organize the various elements in a given literary text in the form of writing and evaluate it as a work of literary art. (Evaluating)
- CO7:** Estimate the characteristic features of metaphysical poetry. (Evaluating)
- CO8:** Discuss the representative styles of various writers as evident in their works and interpret the texts based on their understanding. (Creating)
- CO9:** Develop a better understanding of the history of England from early 15th to late 18th century (Creating)

Suggested Readings

1. Ferguson, Margaret. et al. Eds. The Norton Anthology of Poetry. New York: London
2. Drabble, Margaret. ed. The Oxford Companion to English Literature. Oxford: OUP
3. Sanders, Andrew. The Short Oxford History of English Literature. Oxford: OUP
4. Wells, Stanley W. & Margaret De Grazia. The Cambridge Companion to Shakespeare. Cambridge: CUP
5. M.H. Abrams, Geoffrey Galt Harpham, A Glossary of Literary Terms, Cengage Learning

LSHL0011: HISTORY OF ENGLISH LITERATURE II: VICTORIAN TO CONTEMPORARY PERIOD (4 Credits - 60 hours)

Objective: The objective of this course is to introduce students to selected texts of literature that includes three different genres – Poetry, Drama and Fiction – from the Victorian Age to the Contemporary Period in English Literature. The learners are expected to analyse the texts and explore the different themes and motifs in relation to the literary and socio-cultural context in which the prescribed texts are placed.

Module I: The Literary History and its Context (16 hours)

The Oxford Movement, Crisis in Religion in 19th Century, Pre-Raphaelites, Aestheticism, Consolidation of the British Empire, 'Scrutiny' and its Influence, The New Theatre - Expressionism, Absurdism, New Criticism, Globalisation, Impact of the two World Wars, Popular Culture

Module II: Selected English Poetry (12 hours)

- a) The Charge of the Light Brigade by Lord Alfred Tennyson
- b) The Windhover by Gerard Manley Hopkins
- c) 'The Journey of the Magi' by T.S. Eliot
- d) Fern Hill by Dylan Thomas
- e) 'My Last Duchess' by Robert Browning

Module III: Selected English Drama (16 hours)

- a) Arms and the Man by G. B. Shaw
- b) The Hairy Ape by Eugene O'Neill

Module IV: Selected English Fiction (16 hours)

- a) Great Expectations by Charles Dickens
- b) And The Mountains Echoed by Khalid Hosseini

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** List the different genres of Poetry, Drama and Fiction and state about the Literary History of English Literature and its context from the Victorian to Contemporary period. (Remembering)
- CO2:** Explain, Analyse and criticize these literary genres in terms of critical elements and literary devices found in the given texts, the meaning, linguistic aspects and the themes in the context of the social and political history. (Understanding)
- CO3:** Organize the various elements in a given literary text in the form of writing and evaluate it as a work of literary art. (Applying)
- CO4:** Examine the literary text in the context of its socio-cultural background, theme, plot and the use of the various literary devices. (Analysing)
- CO5:** Discuss and summarise the poetry, drama and fiction from the Elizabethan to the Romantic Period in English literature. (Creating)

Suggested Readings

1. Theatre of the Absurd by Martin Esslin
2. Palgrave's Golden Treasury.
3. David Green (ed.) The Winged Word.
4. David, Deidre. The Cambridge Companion to the Victorian Novel. Cambridge, CUP
5. Sanders, Andrew. The Short Oxford History of English Literature. Oxford: OUP
6. Eagleton, Terry. The English Novel. Oxford: Blackwell
7. M.H. Abrams, Geoffrey Galt Harpham, A Glossary of Literary Terms, Cengage Learning

LSFN0012: FUNCTIONAL ENGLISH

(3 Credits - 45 hours)

Objective: This open elective course will enable the learners to use language effectively in a wide range of situations. This course aims to help the learners develop the skills of language learning, namely Listening, Speaking, reading and writing. It also aims to develop students' proficiency in English through meaningful communicative activities.

Module I: Grammar in Communication (11 hours)

Nouns and noun groups; Phrasal verbs; Tense and temporal adjuncts; Speech Acts and mood; Modal auxiliaries; Simple, complex and compound sentences; Common mistakes in English grammar; Degrees of Comparison; Phrases, Clauses and Idioms in English; Tense, Voice and Narration; Differences between traditional grammar and functional grammar

Module II: Introduction to Phonetics (10 hours)

Speech Sounds; Classification and Description of Vowels and Consonants; Phonetic Symbols; Minimal Pairs; Syllable and Consonant Clusters; Word Accent and Sentence Intonation; Pronunciation drill and practice

Module III: Writing Skills (12 hours)

Grammar for writing; Vocabulary building; Tips for improving English writing skills ; Introduction to paragraph format and content; Types of writing; Friendly and formal letters; Essay writing; Narrative writing; Academic writing vs. Journalism; Blog writing; Editing and Revising

Module IV: Conversational Skills (12 hours)

Greetings; Introducing others; Welcoming; Bidding farewell; Appearing in an Interview; Talking about oneself: strengths, weaknesses, likes, dislikes, future plans, describing one's family; Face-to-face interaction in formal and informal situations; telephonic interactions; public speaking; presentation skills; Role play; Class presentations; Powerpoint presentations; Speaking with Confidence; Ways to overcome speech anxiety; Building credibility as a speaker

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define various grammatical items and they are able to recognize the accurate phonetic symbols to represent the sound of different words. (Remembering)
- CO2:** Classify the grammatical rules related to the basic grammatical items and they are able to explain the difference between traditional and functional grammar. (Understanding)
- CO3:** Make use of the correct form of grammar while using the English language and they are able to use the correct pronunciation and other conversational and writing skills while speaking and writing in English. (Applying)
- CO4:** Analyse different sentence structures and types of writing and ways of delivering speech by using formal language. (Analysing)
- CO5:** Assess and examine the selected topics of their writing. (Evaluating)
- CO6:** Discuss and summarize the rules of grammar and phonetic transcription and draw inference or conclusions of their analytical writing. (Creating)

Suggested Readings

1. Leech, G. and J. Svartvik, A Communicative Grammar of English. Pearson, India. Pandey J. H., Complete Grammar, Shree Book Centre, Mumbai, India.
2. Murphy, R., Intermediate English Grammar. Cambridge Univ. Press, India.
3. Hewings, M., Advanced English Grammar. Cambridge Univ. Press, India.
4. Wren, P. C. and H. Martin, High School English Grammar and Composition, S. Chand and Co, New Delhi.
5. Balasubramanian, T., A Textbook of English Phonetics for Indian Students, Macmillan, New Delhi.
6. Sethi, J. and P. V. Dhamija, A Course in Phonetics and Spoken English, Ed., Prentice Hall, New Delhi.
7. Oxford Advanced Learner's Dictionary

LSCW0013: CREATIVE WRITING IN ENGLISH

(3 Credits - 45 hours)

Objective: *This course aims to provide the students across all disciplines, the required skills and professional knowledge about the art of writing. This course also helps in developing the creative ability of the learners who are interested in a professional career as a freelance writer.*

Module I: Creative Writing and its Significance (12 hours)

Introduction; Objectives of Creative writing; History of Creative Writing as an academic pursuit, Different types of Creative Writing; Scope and Area of Creative Writing; Analysing a Creative composition; Origin of Thought and Birth of an Idea: Inspiration, Imagination and Creativity, Incubation, Implementation and Interpretation; Strategies of a Writer

Module II: General Principles of Writing (15 hours)

Mechanics of Writing: Cohesion, Coherence, Style, Context, Register, Content; Aesthetic function of Writing; Rules for good writing; Things that must be avoided by a Writer; Literal and Figurative Use of Language; Active and Passive style of writing; Direct and Indirect Speech Styles; Personal and impersonal styles of writing; Formal and informal use of language

Module III: Forms of Creative Writing (18 hours)

Writing a film / book review; Narrative or discursive essay / article; Personal and business letters; Writing a Business proposal; Report writing; Poetry writing; Short story writing; Dramatic dialogue writing; Designing a Website; Writing for the New Media; Poster writing; Advertisement; CV writing; Newspaper article and editorial; Emails and Blogs; Writing for Radio and Television

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the different creative techniques adopted by different writers in their work. (Remembering)
- CO2:** Interpret the emerging techniques of creativity inherent in different branches of literature- poetry, fiction, essays and Drama. (Understanding)
- CO3:** Apply different tropes and figures of speech to enhance creativity in literary and non-literary texts. (Applying)
- CO4:** Examine the most significant topics like creativity in Drama, novels, poems, speeches, writing for radio, television as well as psychological testing of creativity. (Analysing)
- CO5:** Evaluate different literary and non-literary texts with reference to different seminal texts as well as existing paradigms of creativity tests. (Evaluating)
- CO6:** Elaborate and develop literary and non-literary texts as well as performances by adopting different skills and techniques of creative writing. (Creating)

Suggested Readings

1. Seely, John, The Oxford Guide to Writing and Speaking Oxford: Oxford University Press
2. Jones, Leo, Cambridge Advanced English: Student's Book New Delhi: Cambridge University Press
3. Everett, Nick, "Creative Writing and English." The Cambridge Quarterly. 34 (3)
4. Palmer, A.J., "Writing and Imagery - How to Deepen Your Creativity and Improve Your Writing." [Aber Books].

LSPD0014: POETRY, PROSE AND DRAMA: ELIZABETHAN TO RESTORATION PERIOD**(3 Credits-45 hours)**

Objective: *The objective of this course is to acquaint the students with representative selected texts from different genres from the Elizabethan to the Restoration Period in English Literature. The students are also expected to read the selected texts within this literary period with the understanding the circumstances that influenced and shaped literary production.*

Module I: Prose and Metaphysical Poetry (5 hours)

- a) Francis Bacon's 'Of Youth and Age'
- b) Andrew Marvell's 'To His Coy Mistress'

Module II: Tragedy and Tragi-comedy (20 hours)

- a) Christopher Marlowe's The Tragical History of the Life and Death of Doctor Faustus
- b) William Shakespeare's Measure for Measure

Module III: Restoration Comedy and Heroic Drama (20 hours)

- a) The Way of the World by William Congreve
- b) Absalom and Achitophel by John Dryden

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Relate the various genres of Prose and Metaphysical Poetry, Drama in the form of Tragedy, Tragi-comedy, Restoration Comedy and Heroic Drama. (Remembering)
- CO2:** Explain the various elements that constitute an Essay and a Metaphysical Poetry and the Drama in the forms as mentioned above. (Understanding)
- CO3:** Summarize the Romantic prose, transitional poetry and Gothic Romance. (Understanding)
- CO4:** Analyse and criticize the representative selected texts from these different genres from the Elizabethan Period to the Restoration Period in English Literature. (Analysing)
- CO5:** Combine, organize and write the various literary aspects of the respective texts and examine them as a literary work of art. (Creating)

Suggested Readings

1. Sanders, Andrew. *The Short Oxford History of English Literature*. Oxford: OUP
2. Willey, Basil. *The Seventeenth Century Background*.
3. Bredvold, L I. *The Intellectual Milieu of John Dryden*.
4. Bradbrook, M C. *Themes and Conventions of Elizabethan Tragedy*. Cambridge: CUP
5. Braunmuller, A R and Michael Hattaway. *The Cambridge Companion to English Renaissance Drama*. Cambridge: CUP
6. Gurr, Andrew. *The Shakespearean Stage*. Cambridge: CUP
7. M.H. Abrams, Geoffrey Galt Harpham, *A Glossary of Literary Terms*, Cengage Learning

LSPF0015: POETRY, PROSE AND FICTION: AUGUSTAN TO ROMANTIC PERIOD**(3 Credits-45 hours)**

Objective: *The objective of this course is to acquaint the students with representative selected texts from different genres from the Augustan to the Romantic Period in English Literature. The students are also expected to read the selected texts within this literary period with the understanding the circumstances that influenced and shaped literary production.*

Module I: Romantic Prose(15 hours)

- a) Dream Children: A Reverie by Charles Lamb
- b) The South-Sea House by Charles Lamb
- c) On Going A Journey by William Hazlitt

Module II: Transitional Poetry and Romantic Poetry (15 hours)

- a) 'Elegy Written In A Country Churchyard' by Thomas Gray
- b) 'God Moves In A Mysterious Way'by William Cowper
- c) Robert Burns' 'A Red, Red Rose'
- d) Samuel Taylor Coleridge's 'Christabel'

Module III: Sentimental novel and Gothic Romance (15 hours)

- a) Pamela by Samuel Richardson
- b) Northanger Abbey by Jane Austen

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Choose the different genres of Transitional and Romantic age. (Remembering)
- CO2:** Define Romantic prose, transitional poetry, sentimental novel and gothic parody. (Remembering)
- CO3:** Interpret the critical elements and the literary devices used in the text. (Understanding)
- CO4:** Apply the socio political context in reading the texts. (Applying)
- CO5:** Analyse the representative selected texts from the Augustan to the Romantic Period, in terms of the literary devices used in the text, meaning and linguistic aspects. (Analysing)
- CO6:** Examine the themes and motifs of the texts. (Evaluating)
- CO7:** Explain the biographical details of the writers. (Evaluating)
- CO8:** Construct a literary, thematic and political interpretation of the texts. (Creating)

Suggested Readings

1. F W Hilles and Harold Bloom. Eds. *From Sensibility to Romanticism*.
2. Alexander, Michael. *A History of English Literature*. Basingstoke Hampshire: Palgrave Macmillan.
3. W J Bate. *From Classic to Romantic*.
4. Bachelor, John. *The Art of Literary Biography*. Oxford: OUP
5. M.H. Abrams, Geoffrey Galt Harpham, *A Glossary of Literary Terms*, Cengage Learning
6. "Hazlitt's Selected Essays" by George Sampson, Kindle Edition, Gibb press
7. "The Essays Of Elia" by Charls Lamb, Classic reprint series

LSCS0016: COMMUNICATION SKILLS

(Audit Course)

Objective: *The objective of this audit course is to prepare students to be effective in their career in the corporate world where they will put to use their professional expertise. This course enables students*

- *To understand the difference between hard skills and soft skills*
- *To learn the importance of communication skills as part of the soft skills,*
- *To be familiar with the various features of effective communication, which includes verbal, non-verbal, written communication and body language.*

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recognise the difference between hard and soft skills
- CO2:** Understand the importance of communication skills
- CO3:** Analyse features of effective communication
- CO4:** Apply the soft skills in the corporate world

LSEH0017: ENGLISH

(2 Credits- 30 hours) (L-T-P: 2-0-0)

Objective: *The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.*

Module I: Vocabulary Building (6 hours)

The concept of Word Formation

Root words from foreign languages and their use in English

Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.

Synonyms, antonyms, and standard abbreviations.

Module II: Basic Writing Skills (6 hours)

a) Sentence Structures

b) Use of phrases and clauses in sentences c) Importance of proper punctuation

d) Creating coherence

e) Organizing principles of paragraphs in documents f) Techniques for writing precisely

Module III: Identifying Common Errors in Writing (5 hours)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

Module IV: Nature and Style of sensible Writing (6 hours)

Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

Module V: Writing Practices (7 hours)

Comprehension, Précis Writing, Essay Writing

Suggested Readings

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.

LSEC0018: ENGLISH COMMUNICATION

(2 Credits- 30 Hours)

Objective: *The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. The present course hopes to address some of these aspects through an interactive mode of teaching-learning process and by focusing on various dimensions of communication skills.*

Module I: Introduction

Theory of Communication, Types and modes of Communication

Module II: Language of Communication:

Verbal and Non-verbal (Spoken and Written)

Personal, Social and Business

Barriers and Strategies

Intra-personal, Inter-personal and Group communication

Module III: Speaking Skills

Monologue, Dialogue, Group Discussion

Effective Communication/ Mis- Communication

Interview, Public Speech

Module IV: Reading and Understanding

Close Reading, Comprehension, Summary, Paraphrasing

Analysis and Interpretation

Translation (from Indian language to English and vice-versa)

Literary/Knowledge Texts

Module V: Writing Skills

Documenting, Report Writing, Making notes, Letter writing

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

CO1: Define the theories of Communication, its types and modes

CO2: Explain various dimensions of communication skills

CO3: Use the correct and suitable art of communication in today's world of complexities, multiplicities and competition

CO4: Analyse the difference in personal and professional interactions

CO5: Summarize various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments

CO6: Evaluate different documents and reports, prepared or presented

Suggested Readings

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

LSET0019: ENGLISH LANGUAGE TEACHING

(3 Credits: 45 Hours)

Objective: *The objective of this course is to introduce the students to the basic concepts of language learning and teaching. The course would expect the learner to familiarise with the principles and practice of ELT Pedagogy, Teaching methodology, Material development, Testing and Evaluation as key components of ELT.*

Module I: Introduction to English Language Teaching (10 hours)

Introduction, Fundamental concepts of Language Teaching, Historical Perspective of ELT, Language Pedagogy. Elements of the Structure of English Language.

Module II: Methods and Approaches of Teaching English (20 hours)

Theoretical aspects of Language Acquisition and Learning. Language Skills assessment. Psychological approach to language teaching in a bilingual/ multilingual context. Use of Technology in Language Teaching. Educational Technology. Testing and Evaluation.

Module III: Grammar and Practical Language Skills (10 hours)

Parts of Speech, Articles and Prepositions, Degrees of Comparison, Direct and Indirect Speech, Sentence patterns, Letter Writing, Report Writing, Reading Comprehension, Listening and Speaking, English Speech Sounds – Vowels and Consonants, Stress and Intonation patterns, Language Games, Vocabulary Expansion, Telephonic Conversation. Teaching English for Academic, Business Purpose.

Module IV: Language through Literature (5 hours)

Role of Literature in Language Learning. Teaching of Literature. Use of Language Model.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the vast body of Language teaching methodologies. (Remembering)
- CO2:** Demonstrate the different approaches to teaching of English as a second language. (Understanding)
- CO3:** Interpret the emerging techniques and theories of second language teaching. (Understanding)
- CO4:** Apply theoretical assumption as well as practical language teaching skills while dealing with second language learners in the classroom. (Applying)
- CO5:** Analyse the specific issues such as the First and Second Language acquisition, Mother tongue interference in learning a foreign language, TG Grammar, Psychological and Sociological perspectives in Language learning, Role of technology in language learning. (Analysing)
- CO6:** Compare and estimate the utility and feasibility of different language teaching methodologies and techniques in different language teaching- learning situations with proper forms of testing. (Evaluating)
- CO7:** Design as well as adapt on the syllabuses of second language teaching and constructing lesson plans for dealing with language learners of different linguistic backgrounds. (Creating)

Suggested Readings

1. Ray Mackay, A Basic Introduction to English Language Teaching; Oxford.
2. Penny Ur, A Course in English language Teaching, CUP.

LSNE0020: NORTH-EAST INDIAN LITERATURE IN ENGLISH**(3 Credits: 45 Hours)**

Objective: *The objective of this course is to expose students to the vast body of writings in English from India's North-east. The course is designed to introduce to student the emerging genres of North-east Indian literature- poetry, fiction and non-fictional prose writing. The course will help the students to explore and understand the specific issues such as the double challenge of truth and liberty, of identity and unity, of cultural loss and recovery, of ethnic specificity and aesthetic universality in the literature from the north- east India in English.*

Module I: Selected Poetry (15 hours)

- a) Easterine Kire's 'Riddu Riddu' & 'Narcissus'
- b) Robin Ngangom's "My Invented Land"
- c) Ilabunta Yumnam's "Barak River You Are Beautiful"

Module II: Selected Fiction/Non-Fiction Writers (30 hours)

- a) Mamang Dai's "The Legends of Pensam"
- b) Mitra Phukan's "The Collector's Wife"

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the vast body of writings in English from Northeast of India. (Remembering)
- CO2:** Interpret the emerging trends of literature from northeast of India in its different genres- poetry, fiction and translation (Understanding)
- CO3:** Apply theoretical assumption as well as critical reading skills to the study of vibrant area of Northeast literature. (Applying)
- CO4:** Examine the most significant topics like colonialism, identity and unity, cultural loss, ethnic conflicts, universality in the literature of Northeast region before and after British Colonial Period (Analysing)
- CO5:** Explain different literary themes and recurrent issues reflected in the vast body Northeast writings in English. (Evaluating)
- CO6:** Evaluate different literary texts with reference to different seminal texts of mainstream Postcolonial and Postmodern literature. (Evaluating)
- CO7:** Elaborate on the existing critical views on Northeast India literary texts with reference to the Modern and Postmodern Theories on Literature. (Creating)

Suggested Readings

- 1. Selected Texts (mentioned in the detailed course)
- 2. Misra, Tillotama. The Oxford Anthology of Writings From North East India: Poetry and Essays. OUP
- 3. Zama, Magarat Ch. Emerging Literatures From NorthEast India: The Dynamics of Culture, Society and Identity, SAGE publications
- 4. Ngangom, Robin S. & Nongkynrih, Kynpham Singh. Dancing Earth: An Anthology of Poetry from North-east India.
- 5. Swami, Indu. Exploring North-East Indian Writings in English: 2 volumes

LSEP0021: CHAUCER TO ELIZABETHAN PERIOD - POETRY, DRAMA AND ROMANCE

(4 Credits: 60 hours)

Objective: *The objective of this course is to introduce students to the selected texts of the three literary genres of Poetry, Drama and Romance from the age of Chaucer to Elizabethan Period. The learners of this course are expected to explore the themes and motifs in the prescribed texts in its historical and literary context.*

Module I: Selected Poetry (25 hours)

- a) Geoffrey Chaucer's Prologue to The Canterbury Tales
- b) Edmund Spenser's 'The Faerie Queen' (Book III)
- c) William Shakespeare's Sonnets No. 34, 18, 29
- d) Philip Sidney's 'Astrophel and Stella'

Module II: Selected Drama (20 hours)

- a) Christopher Marlowe's The Jew of Malta
- b) Ben Jonson's The Alchemist

Module III: Selected Romance (15 hours)

- a) Sir Thomas More's Utopia

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the fundamental concepts of the three genres of Poetry, Drama and Romance from the age of Chaucer to Elizabethan period. (Remembering)
- CO2:** List the representative writers and their texts of the fourteenth century. (Remembering)
- CO3:** Outline the characteristic features and forms of Poetry, Drama and Romance from the age of Chaucer to Elizabethan period. (Understanding)
- CO4:** Identify the socio-political background and factors that influenced and shaped the literary texts of the period. (Applying)
- CO5:** Analyse the given text critically in its literary context, use of various literary devices, thematic and symbolic significance and the use of Language and style. (Analysing)
- CO6:** Assess the ideas derived after critical analysis of the given texts. (Evaluating)
- CO7:** Evaluate the given text as a literary work of art. (Evaluating)

Suggested Readings

1. Texts of Selected Poetry, Drama and Romance.
2. Ferguson, Margaret. et al. Eds. The Norton Anthology of Poetry. New York: London.
3. Drabble, Margaret. ed. The Oxford Companion to English Literature. Oxford: OUP.
4. Shakespeare, William. William Shakespeare Sonnets, Rupa Publishers;

LSLS0022: LITERARY AND SOCIAL HISTORY OF ENGLAND - CHAUCER TO ELIZABETHAN PERIOD**(3 Credits: 45 Hours)**

Objective: *The objective of this course is to familiarise the students to the social and literary tradition of England from the Medieval age to the coming up of the Elizabethan theatre. The aim of this course is to enable the students understand the socio-political events and developments that influenced and shaped the literary production during this period.*

Module I (15 hours)

- a) The Church and Medieval Life
- b) Towns and Villages in Medieval England
- c) Feudalism
- d) The English Manorial System and Medieval Agriculture

Module II (15 hours)

- a) The Black Death and its Aftermath
- b) Medieval English Theatre
- c) Medieval Romance
- d) Fabliau, Lyric, Dream Allegory and Ballad

Module III (15 hours)

- a) Caxton and the Printing Press
- b) Renaissance and the Literature: The University Wits, the Elizabethan Prose, the Metaphysical Poetry, etc.
- c) Reformation
- d) The Elizabethan Theatre

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the different Periods involved in the Literary and Social History of England from the Medieval to Elizabethan age. (Remembering)
- CO2:** List the chronological changes that intervened in the history of England during fourteenth and early fifteenth century. (Remembering)
- CO3:** Interpret the characteristic features, significant changes, development and modes indicating transition from the Medieval life, The Black Death to the Elizabethan theatre. (Understanding)
- CO4:** Identify the various socio-political factors responsible for these developments and their influences in the shaping of the Literature of the period. (Applying)
- CO5:** Analyse and differentiate the various genres of literature on the basis of the historical changes and developments from the Medieval life to the Elizabethan age. (Analysing)
- CO6:** Explain the various literary and socio-political influences for the literature production at the various stages from the Medieval age to the coming of Elizabethan theatre. (Evaluating)
- CO7:** Evaluate the contextual background involved in the shaping up of various literary works. (Evaluating)

Suggested Readings

1. Sanders, Andrew. The Short Oxford History of English Literature. Oxford:OUP.
2. Abrams, M.H. A Glossary of Literary Terms. Prism India.
3. Peck, John and Martin Coyle. A Brief History of English Literature. Palgrave.
4. Ashok, Padmaja. The Social History of England. Orient Black Swan.

LSSD0023: SHAKESPEAREAN DRAMA I - COMEDY AND HISTORY PLAYS

(4 Credits: 60 Hours)

Objective: The aim of this course is to introduce the students to the richness of the Elizabethan Drama through the works of William Shakespeare. The learners are expected to explore the magnanimity of the Shakespearean text and its relevance in the contemporary period, through his representative Comedies and Historical plays.

Module I: Comedies (30 hours)

- a) Shakespeare's The Tempest
- b) Shakespeare's The Midsummer Night's Dream

Module II: History Plays (30 hours)

- a) Shakespeare's Henry V
- b) Shakespeare's Julius Caesar

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define a Shakespearean Drama as a literary genre. (Remembering)
- CO2:** Explain the significant stages in the texts of Shakespearean Comedy and a Historical play. (Understanding)
- CO3:** Identify and differentiate a given text as a work of Shakespearean Comedy or a Historical play. (Applying)
- CO4:** Analyse the theme, plot and characterization, use of literary devices and settings in a given Shakespearean text as a work of Comedy or History. (Analysing)
- CO5:** Evaluate the characteristic features and creative energy of Shakespeare through the study of a Comedy and a Historical play. (Evaluating)
- CO6:** Compile the content, style and the literary aspects of the given Shakespearean text as a work of Comedy or History. (Creating)

Suggested Readings

1. Texts of Selected Drama prescribed in the Course.
2. Bloom, Harold, Elizabethan Drama. Infobase Publishing, New York.
3. Legatt, Alexander. Shakespeare's Political Drama. Routledge, London.
4. Dutton, Richard and Howard, Jean. A Companion to Shakespeare's Works, Vol.II.Blackwell, Oxford.

LSRP0024: RHETORIC AND PROSODY

(2 Credits: 30 Hours)

Objective: *The aim of this course is to enable the students develop a critical awareness of Rhetoric and Prosody and its applications in literature. This course is expected to introduce the learners the key words and concepts, use of figures of speech, grammar, rhyme and metre applied to the language and verse of a given literary text.*

Module I: Introduction to Rhetoric (10 hours)

Rhetoric; Difference between Grammar and Rhetoric; Relation between Rhetoric and Emotion; Rhetoric and Oratory; Prosody; Difference between Poetry and Prose; Syllable, Foot, Accent, Pitch; Primary and Secondary accent; Rules governing Accent; Rhythm, Rhyme, Metre; Scansion

Module II: Figures of Speech (10 hours)

Contribution of Figures of Speech to Literary Expression, Classification of Figures of Speech, Figures based on Similarity or Resemblance, Association, Contrast or Difference, Imagination, Indirectness, Sound, Construction; Miscellaneous Figures of Speech

Module III: Prosody: Different kinds of Metre and Poetry (10 hours)

Types of Metre; Special Metres; Types of Poetry

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the different figures of speech based on Comparison. (Remembering)
- CO2:** Classify the differences between Metonymy and Synecdoche. (Understanding)
- CO3:** Apply the rules of prosody in scanning a piece of poetry. (Applying)
- CO4:** Distinguish between Irony and Sarcasm. (Analysing)
- CO5:** Explain the different figures of speech used in a passage. (Evaluating)
- CO6:** Discuss the dominant types of meters used in English versification. (Creating)

Suggested Readings

1. Bhattacharya, Arunodoy. Studies in English Rhetoric and Prosody. Books Way.
2. Lanham, Richard A. A Handlist of Rhetorical Terms, University of California Press.
3. Corbett, Edward P.J. and Connors, Robert J. Classical Rhetoric for the Modern Student. OUP.
4. Chakraborti, M. Principles of English Rhetoric and Prosody. Kolkatta: The World Press Pvt. Ltd.

LSTS0025: T.S. ELIOT

(3 Credits: 45 Hours)

Objective: *The objective of this course is to present the nuances of poetry through of the major works of the modernist poet T.S. Eliot. The learner is expected to explore the unique characteristics and the temperamental propensities of the individual poet as well as the age he belonged to.*

Module I: Introduction to T.S. Eliot. (10 hours)

Modern English Poetry. Life and Career of T.S. Eliot. Formative influences on the poet. Characteristics of the poet's mind and art. Themes, Techniques and features found in his poetry. T.S Eliot's Contribution to poetry, society and life.

Module II: Prescribed Texts of T.S. Eliot. (35 hours)

- a) The Waste Land
- b) The Murder in the Cathedral

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define Modern poetry as a literary genre and T.S. Eliot as a Modernist poet. (Remembering)
- CO2:** Outline the style and characteristic features of T.S Eliot poetry. (Understanding)
- CO3:** Identify the salient features of Modern poetry through the works of T.S.Eliot. (Applying)
- CO4:** Analyse T.S. Eliot's works in terms of theme, technique, prosody, approach, focus, vision and influences. (Analysing)
- CO5:** Evaluate the influences, impact and effectiveness of the works of T.S. Eliot. (Evaluating)
- CO6:** Discuss and summarize the various literary and poetic aspects of his works against the individual and socio- political propensities. (Creating)

Suggested Readings

1. Moody, David. A. The Cambridge Companion to T.S. Eliot. CUP.
2. Behr, Cardene. T.S. Eliot: A Chronology of His Life and Works. Macmillan.

LSTH0026: THOMAS HARDY

(3 Credits: 45 Hours)

Objective: *The aim of this course is to present a detailed study on the great Victorian novelist Thomas Hardy and his representative works. The learner is expected to explore the transitional element in the novelist from being a late Victorian to an early modernist and the themes of Realism and Universality by way of the critical study of his prescribed texts.*

Module I: Introduction to Thomas Hardy (10 hours)

English Victorian Novel. Life and Career of Thomas Hardy. Formative influences on the writer. Characteristic features of the individual novelist. Themes, setting and Techniques used in his novels. Writer's contribution to the art of Novel writing and society.

Module II: Prescribed Texts of Thomas Hardy (35 hours)

- a) Tess of D' Urbervilles
- b) Far From the Madding Crowd

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define English Victorian novel and Thomas Hardy as a Victorian novelist. (Remembering)
- CO2:** Demonstrate the characteristic features of Thomas Hardy's fiction. (Understanding)
- CO3:** Identify the Victorian elements and modernistic features in the works of Thomas Hardy. (Applying)
- CO4:** Analyse critically Hardy's style through the theme, plot, characterization and settings found in the prescribed texts. (Analysing)
- CO5:** Evaluate Hardy's works in terms of the philosophical content, Historical perspective, literary aspect and language and style. (Evaluating)
- CO6:** Discuss and summarize the thematic content, approach, literary aspects, and socio-political background of the period in Hardy's fiction. (Creating)

Suggested Readings

1. Allen, Walter E. The English Novel: A Short Critical History. London: Phoenix.
2. Bayley, J. An Essay on Thomas Hardy. Cambridge.
3. Drabble, M. The Genius of Thomas Hardy. London

LSRR0027: RESTORATION TO ROMANTIC PERIOD – POETRY AND DRAMA**(4 Credits: 60 Hours)**

Objective: The objective of this course is to acquaint the students with representative selected texts from the genres of poetry and drama from Restoration to the Romantic period in English literature. The students are also expected to read the selected texts within this literary period by understanding the circumstances that influenced and shaped literary production during that period.

Module I: Selected Poetry (25 hours)

- a) John Dryden's "Mac Flecknoe"
- b) Lord Byron's "Love's Last Adieu"
- c) William Wordsworth's "Composed on Westminster Bridge"
- d) John Keats' "Ode to a Nightingale"
- e) P. B. Shelley's "To a Skylark"

Module II: Selected Drama (35 hours)

- a) George Etherege's The Man of Mode
- b) William Congreve's The Double Dealer
- c) John Dryden's All for Love

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define various genres of literature, viz. poetry and drama and they are able to write about the selected writers and their important literary works. (Remembering)
- CO2:** Find the recurrent themes of the Restoration and Romantic era. (Remembering)
- CO3:** Apply the historical onset while reading the texts. (Applying)
- CO4:** Analyse the themes critically and compare as well as contrast the different characters of the selected dramas. (Analysing)

- CO5:** Interpret the selected literary works and they are able to explain the plot, theme and character of the dramas and the theme and figures of speech in the poems. (Evaluating)
- CO6:** Evaluate critically and appreciate the selected poems. (Evaluating)
- CO7:** Assess and evaluate the selected dramas and poems vis-à-vis their context and socio-political and cultural background. (Evaluating)
- CO8:** Formulate a critical interpretation or criticism of the literary texts. (Creating)
- CO9:** Invent a new interpretation of the texts. (Creating)

Suggested Readings

1. Dryden, John. MacFlecknoe and Other Poems.
2. Appelbaum, Stanley. English Romantic Poetry: An Anthology.
3. Selected Critical Texts (mentioned in the detailed course)
4. Fisk, Deborah Payne. The Cambridge Companion to English Restoration Theatre.
5. Perry, Henry Ten Eyck. The Comic Spirit in Restoration Drama: Studies in the Comedy of Etherege, Wycherley, Congreve, VanBrugh and Farquhar.

LSLC0028: LITERARY CRITICISM: PLATO TO F.R. LEAVIS

(4 Credits: 60 Hours)

Objective: *This paper acquaints the students with important ideas of Western literary criticism from the time of Plato to the Modern period and expects them to examine the implications of those key ideas (on poetry, drama etc.) that have marked the history of Literary Criticism. This course has been designed to present the students with the opportunity to study the key concepts associated with the names of significant literary thinkers and critics in the history of English Literature.*

Module I: Literary Criticism: Key Ideas and Concepts – Plato to Sidney (12 hours)

Plato: Views on Poetry, Theory of Mimesis; **Aristotle:** Observations on Poetry and Imitation, Concept of Tragedy (plot, catharsis, hamartia, peripetia, anagnorisis, hubris); **Horace:** Observations on drama; **Longinus:** Ideas On the Sublime, Sources of Sublimity in Literature; **Philip Sidney:** Ideas on Apology for Poetry

Module II: Literary Criticism: Key Ideas and Concepts – Johnson to F. R. Leavis (18 hours)

Samuel Johnson: Views on Shakespeare, Concept of the Three Unities; **William Wordsworth:** Views on Poetry, Poetic Diction; **S.T. Coleridge:** Difference between Fancy and Imagination, Views on Organic Form; **John Keats:** Negative Capability; **Matthew Arnold:** The Touchstone Method, High Seriousness, Grand Style; **T.S. Eliot:** Views on Poetry (Impersonality), Objective Correlative, Dissociation of Sensibility; **I. A. Richards:** The Referential and Emotive Uses of Language, Statement and Pseudo-Statement; Tenor and Vehicle, Stock Response; **F.R. Leavis:** Enactment, Literary Criticism and Philosophy

Module III: Selected Critical Texts (30 hours)

- a) 'Poetics' by Aristotle
- b) 'Biographia Literaria' (Chapter 13) by Samuel Taylor Coleridge
- c) "Tradition and the Individual Talent" by T. S. Eliot

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** List out the characteristics of a tragic hero according to Aristotle. (Remembering)
- CO2:** Compare between Plato and Aristotle's theory of mimesis. (Understanding)
- CO3:** Identify Longinus' five principal sources of Sublimity. (Applying)

- CO4:** Analyse critically a selected text in the field of Literary Criticism. (Analysing)
CO5: Explain Coleridge's theory of Imagination. (Evaluating)
CO6: Discuss the contributions of I A Richards in the field of Literary Criticism. (Creating)

Suggested Readings

1. Selected Critical Texts (mentioned in the detailed course)
2. Culler, Jonathan. Literary Theory: A Very Short Introduction.
3. Abrams, M.H. A Glossary of Literary Terms.
4. Cuddon, J.A. The Penguin Dictionary of Literary Terms and Literary Theory.
5. Habib, M.A.R. A History of Literary Criticism: From Plato to the Present.

LSSH0029: SHAKESPEAREAN DRAMA II - TRAGEDY AND TRAGI-COMEDY

(4 Credits: 60 Hours)

Objective: This course introduces students to the literary form of drama, especially Shakespearean tragedy and tragi-comedy. This course aims at developing the critical reading and analytical skill of the learners by teaching them two very distinct forms of Shakespeare's drama. The course will require in-depth study and analysis of the selected texts for a better understanding of the genius of William Shakespeare.

Module I: Tragedy (30 hours)

- a) William Shakespeare's Hamlet
- b) William Shakespeare's King Lear

Module II: Tragi-Comedy (30 hours)

- a) William Shakespeare's The Merchant of Venice
- b) William Shakespeare's The Winter's Tale

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the literary form of drama, especially tragedy and tragi-comedy. (Remembering)
CO2: Interpret the selected literary works, i.e. the Shakespearean tragedy and tragi-comedy and they are able to explain the plot, theme and character of the dramas. (Understanding)
CO3: Apply critical reading skills to the two very distinct forms of Shakespeare's drama. (Applying)
CO4: Analyse selected texts for a better understanding of the genius of William Shakespeare. (Analysing)
CO5: Assess and critically appreciate the selected dramas. (Evaluating)
CO6: Evaluate the plot, theme and character of the selected dramas. (Evaluating)

Suggested Readings

1. Selected Texts (mentioned in the detailed course)
2. Bradley, A.C. Shakespearean Tragedy: Lectures on Hamlet, Othello, King Lear and Macbeth
3. Wells, Stanley and others. The Oxford Shakespeare: The Complete Works
4. Grazia, Margreta De. The New Cambridge Companion to Shakespeare
5. Hunter, G.K. English Drama 1586 – 1642: The Age of Shakespeare

LSAL0030: APPROACHES TO LANGUAGE AND LITERARY RESEARCH

(3 Credits - 45 Hours)

Objective: *This course introduces students to some basic concepts of research and its methodologies. The course aims at enabling students to identify research topics and select and define appropriate research problem and parameters. The course will provide the students knowledge of research with special focus on research in the field of language and literature so that they can organize and conduct research in an appropriate manner and write better research reports and papers.*

Module I: Introduction (10 hours)

Meaning of Research; Objectives of Research; Motivation in Research; Different types of Research Methods; Research Methods Vs Research Methodology; Difference between Methods and Techniques; Ethics in Research; Review of Literature

Module II: Hypothesis and Data Collection (10 hours)

Formulation of Hypothesis; Types of Hypothesis; Methods of Testing Hypothesis; Determining Sample design; Methods of Sampling; Methods of Collection of Data (Primary Data and Secondary Data); Processing and Analysis of Data; Types of Analysis

Module III: Critical Approaches to Literature (15 hours)

Formalist, Feminism and Gay and Lesbian Studies, Psychoanalysis, Narratology, Race Ethnicity and Postcolonial Studies, Structuralism, Post-structuralism, Postmodernism and Deconstruction, Ecocriticism

Module IV: Analysis and Report-Writing (10 hours)

Testing of Hypothesis; Interpretation; Different techniques of Interpretation; Citation and Bibliography; Writing and Presentation of Report

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain basic concepts of research and its methodologies. (Understanding)
- CO2:** Identify research topics and select and define appropriate research problem and parameters. (Applying)
- CO3:** Organize and conduct research in an appropriate manner. (Applying)
- CO4:** Analyse literary works from various genres by applying various theories and approaches. (Analysing)
- CO5:** Assess and evaluate the various works of literature to write research reports and papers. (Evaluating)
- CO6:** Discuss, summarize and critically appreciate the various approaches to language and literary research. (Creating)

Suggested Readings

1. Altick, Richard D. & Fenstermaker, John J. The Art of Literary Research
2. Correa, Delia Da Souza & Owens, W.R. The Handbook to Literary Research
3. Eagleton, Terry. Literary Theory.
4. Kothari, C. R. & Gaurav Garg. Research Methodology: Methods and Techniques
5. MLA Handbook for Writers of Research Papers

LSTR0031: CLASSICS IN TRANSLATION**(3 Credits: 45 Hours)**

Objective: *The objective of this course is to introduce students to the history, theories, methodologies and knowledge to address fundamental questions in Translation Studies. This course is designed to present to students the opportunity to study in a more intensive and sustained fashion the work of some of the major poets of classical literatures of Roman, Greek and Sanskrit. The authors studied have been chosen both for their high intrinsic quality and for their fundamental importance in shaping ancient literary standards and cultural ideals.*

Module I: Introduction to Translation Studies (20 hours)

Introducing Translation; History of Translation Theories; Significance of Translation in a Multi-Linguistic and Multi-Cultural Society/World; Different Types/Modes of Translation (Semantic, Literal, Literary, Functional, Communicative, Technical); Understanding the dynamics and challenges in Translation.

Module II: Selected Texts (25 hours)

- a) Horace's ArsPoetica
- b) Homer's Odyssey
- c) Kalidasa's Abhijanana Shakuntalam

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the history, theories, and methodologies in Translation Studies. (Remembering)
- CO2:** Illustrate fundamental questions related to translation of the major poets of classical literatures of Roman, Greek and Sanskrit. (Understanding)
- CO3:** Apply various theories and methods of translation. (Applying)
- CO4:** Examine critically the translated literary texts, critically analyse the themes and the style of literary expression in the selected texts. (Analysing)
- CO5:** Evaluate the high intrinsic quality of the classics and their fundamental importance in shaping ancient literary standards and cultural ideals. (Evaluating)
- CO6:** Discuss, summarize and critically appreciate the selected classics in translation. (Creating)
 1. Selected Texts (mentioned in the detailed course)
 2. Bassnett, Susan. Translation Studies.
 3. Nida, E. The Theory and Practice of Translation.
 4. Munday, Jeremy. Introducing Translation Studies.
 5. Jones, Peter V. Classics in Translation: from Homer to Juvenal.

LSIW0032: INDIAN WOMEN WRITERS**(3 Credits: 45 Hours)**

Objective: *This course introduces literature by women in India in English to the students. The course covers poetry, drama, short stories and novels produced in different historical periods. The objective of the course is to acquaint students with the contribution of women writers to the Indian English literary tradition and enable students to investigate the nature of this contribution. The course not only helps the students to understand the essence of women's literature but also exposes them to the gamut of women's lives and concerns as represented in literature.*

Module I: Selected Poets (12 hours)

- a) Toru Dutt's "Sita"
- b) Sarojini Naidu's "The Gift of India"
- c) Kamala Das' "The Old Playhouse"

Module II: Selected Playwrights and Short Story Writers (15 hours)

- a) Manjula Padmanabhan's Harvest
- b) Mahasweta Devi's 'Draupadi'

Module III: Selected Novelists (18 hours)

- a) Nayantara Sahgal's Rich Like Us
- b) Kiran Desai's The Inheritance of Loss

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the literature by women in India in English. (Remembering)
- CO2:** List the representative women writers in Indian literature. (Remembering)
- CO3:** Summarize and critically appreciate the selected literary works and find out the commonalities in terms of themes and issues. (Understanding)
- CO4:** Apply feminist theories and feminist reading techniques to critically interpret and assess the selected texts. (Applying)
- CO5:** Analyse the contribution of women writers to the Indian English literary tradition. (Analysing)
- CO6:** Judge the essence of women's literature and appreciate the gamut of women's lives and concerns as represented in literature. (Evaluating)
- CO7:** Construct a critical reading of the poetry, drama, short stories and novels produced by women of India in different historical periods. (Creating)

Suggested Readings

- 1. Selected Texts (mentioned in the detailed course)
- 2. Butler, Judith. Undoing Gender.
- 3. Goodman, L. Literature and Gender.
- 4. Mohanty, S.K. Indian Women Writers in English
- 5. Zaidi, Annie (ed.). Unbound: 2,000 years of Indian Women's Writing.

LSAD0033: ENGLISH ESSAYS I - ADDISON TO DICKENS

(4 Credits – 60 hours)

Objective: This paper acquaints the students with the development of English Essays as a literary genre by providing a clear picture of the socio-cultural context of the mentioned period, i.e., from Addison to Dickens in English literature. They are also familiarised with the representative literary essays of this period.

Module I: Introducing Essays (15 hours)

Definition; Major English Essayists; Development of Essay as a genre; Different types or styles of writing essays; the Socio-Political Context of English Essays.

Module II: Selected English Essays (45 hours)

- a. "The Fairy Way of Writing" by Joseph Addison.
- b. "Fashionable Affectations" by Richard Steele

- c. “In Praise of Chimney Sweeper” by Charles Lamb
- d. “The Indian Jugglers” by William Hazlitt
- e. Washington The Legislature and the President’s House by Charles Dickens

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define Essays as a literary genre (Remembering)
- CO2:** Label the important essayists in the field of English literature. (Remembering)
- CO3:** Compare between narrative and descriptive essays (Understanding)
- CO4:** Make use of expository and persuasive essays in practical real-life situations (Applying)
- CO5:** Analyse the themes reflected in the texts. (Analysing)
- CO6:** Assess the socio-political context of the time. (Evaluating)
- CO7:** Evaluate the recurrent themes in the essays from Addison to Dickens (Evaluating)
- CO8:** Discuss the representative styles of the prominent essayists. (Creating)
- CO9:** Construct a better understanding of socio-political contexts of the age through the essays. (Creating)

Suggested Readings

- 1. Winchester, C.T. A Group of English Essayists of the Early Nineteenth Century.
- 2. Dawson, William J. The Great English Essayists: With Introductory Essays and Notes.
- 3. Davis, William H. English Essayists: A Reader’s Handbook.
- 4. Walker, Hugh. The English Essay and Essayists.

LSPR0034: POETRY: RESTORATION TO ROMANTIC PERIOD

(3 Credits – 45 hours)

Objective: *This Course is an attempt to familiarise the learners with the socio-cultural context of England between the Restoration Period and the Romantic Period in English Literature. The students are also acquainted with the major poetic sub-genres and poetic styles dominant during this period along with few representative poetry pieces between Restoration and Romantic Period.*

Module I: Socio-Cultural Context and Poetic Styles (15 hours)

Socio-Cultural Context of Restoration to Romantic Period ; Major Sub-genres of Poetry in the Restoration and Romantic Period (Mock-heroic Poetry, Satire, English Transitional Poetry, Romantic Poetry); Dominant poetic styles during this period (heroic couplet, ode, elegy, and sonnet)

Module II: Selected Poetry (30 hours)

- a. “The Rape of the Lock” (Canto 1 & 2) by Alexander Pope
- b. “The Chimney Sweeper” (Songs of Innocence and Songs of Experience) by William Blake
- c. “Lines Written a Few Miles Above Tintern Abbey” by William Wordsworth
- d. “Ozymandias” by P. B. Shelley
- e. “Ode on a Grecian Urn” by John Keats

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the different poetic styles, such as, ode, elegy and sonnet (Remembering)
- CO2:** List the representative works of the age. (Remembering)
- CO3:** Illustrate the different types of poetry written during this period (Understanding)
- CO4:** Identify the differences between Satire and Mock-heroic poetry (Applying)

- CO4:** Analyse a poetic piece critically. (Analysing)
- CO5:** Assess a representative poetic text. (Evaluating)
- CO6:** Determine the different poetic styles used during the mentioned period. (Evaluating)
- CO7:** Formulate an innovative interpretation of the texts. (Creating)
- CO8:** Elaborate the literary concepts prevalent in the age. (Creating)

Suggested Readings

1. Carter, K. Duane. New Beginnings: Poetry of Restoration.
2. Nayar, Pramod K. English Poetry From the Elizabethans to the Restoration.
3. Appelbaum, Stanley. English Romantic Poetry: An Anthology
4. Wordsworth, Jonathan. The Penguin Book of Romantic Poetry.
5. Green, David. The Winged Word.

LSCO0035: COMMUNICATION SKILLS

(3 Credits – 45 hours)

Objective: *The objective of this Course is to equip the learners across different disciplines with the basic skills of effective communication in English language in all real life contexts, with a reasonable fluency and clarity. This course has been designed in such a manner that it is intensely practice oriented and attempts to enable the learners to communicate in English language confidently.*

Module I: Basic Communication - Part I (20 hours)

Aspects of Effective Communication Skills; Barriers of Effective Communication Skills; Listening, Speaking, Reading and Writing techniques; Telephonic Etiquettes

Module II: Basic Communication - Part II (25 hours)

Non-Verbal Communication; Public Speaking Skills; Compering Skills; Self-Confidence; Personality Development; Group Discussions; Personal Interview; Secrets of Good Communication

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the importance of effective communication in English. (Remembering)
- CO2:** Illustrate the distinguishing aspects of verbal and non- verbal communication. (Understanding)
- CO3:** Apply theoretical as well as practical norms and skills for effective communication during group discussion and personal interviews. (Applying)
- CO4:** Analyse a creative composition in terms of the theoretical and practical paradigms of effective communication. (Analysing)
- CO5:** Explain different literary themes and recurrent issues reflected in the vast body essays written during the period. (Evaluating)
- CO6:** Assess and interpret the secrets of effective communication. (Evaluating)
- CO7:** Elaborate and design parameters for effective use of the four basic language skills LSRW in terms of R.P. variety as well as changing trends of communication at the behest of development of science and technology. (Creating)

Suggested Readings

1. Simon, Peter. Communication Skills.
2. Kumar, Sanjay & PushpaLata. Communication Skills.
3. Taylor, Grand. English Conversation Practice.
4. Sen, Leena. Communication Skills.

LSLW0036: LIFE WRITING: BIOGRAPHIES, MEMOIRS AND LETTERS**(4 Credits – 60 hours)**

Objective: *The objective of this course is to introduce students to the various forms of life-writing: biographies, memoirs and letters, through a selection of some of the important representative texts in English Literature. The students are expected to acquaint themselves with the emergence of this literary form as a genre as well as the different types and styles of life-writing in literature.*

Module I: Introducing Life-Writing (15 hours)

Life-Writing, emergence of biography as a literary genre, difference between biography, autobiography and memoir, different types of biography; memoirs and letters; fictional autobiographies in English literature.

Module II: Selected Texts (45 hours)

- a. Life of Milton by Samuel Johnson
- b. “Florence Nightingale” from Eminent Victorians by Lytton Strachey
- c. Prelude by William Wordsworth- Book I
- d. Nehru’s Letter to Priyadarshini: from The Glimpses of World History, Letter No. 1 & 2

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define life writing. (Remembering)
- CO2:** Find out the differences between memoirs and letters. (Remembering)
- CO3:** Illustrate the different types of life writing (Understanding)
- CO4:** Apply the narrative techniques while reading a piece of life writing. (Applying)
- CO5:** Analyse the life of an author/writer critically. (Analysing)
- CO6:** Evaluate a representative biographical text using the literary techniques. (Evaluating)
- CO7:** Discuss the different styles of writing a biography. (Creating)

Suggested Readings

1. Texts of selected Biographies, Memoirs and Letters (mentioned in the course-structure)
2. Batchelor, John. The Art of Literary Biography.
3. Lee, Hermione. Biography: A Very Short Introduction.
4. Strachey, Lytton. Eminent Victorians.

LSLC0037: LITERARY CRITICISM: ARISTOTLE TO I. A. RICHARDS**(3 Credits – 45 hours)**

Objective: *This paper acquaints the students with important ideas of Western literary criticism from the time of Aristotle to the Modern period and expects them to examine the implications of those key ideas (on poetry, drama, etc.) that have marked the history of Literary Criticism. This course has been designed to present the students with the opportunity to study the key concepts associated with the names of significant literary thinkers and critics in the history of English Literature.*

Module I: Literary Criticism: Key Ideas and Concepts I (10 hours)

Plato: Views on Poetry, Theory of Mimesis; Longinus: Ideas On the Sublime, Sources of Sublimity in Literature; Philip Sidney: Ideas on Apology for Poetry;

Module II: Literary Criticism : Key Ideas and Concepts II (10 hours)

Matthew Arnold: The Touchstone Method, Grand Style, High Seriousness; I. A. Richards: The Referential and Emotive Uses of Language, Statement and Pseudo-Statement, Tenor and Vehicle, Stock Response; F.R. Leavis: Enactment, Literary Criticism and Philosophy

Module II: Selected Critical Texts (25 hours)

- a. Poetics by Aristotle
- b. Biographia Literaria (Chapter 13) by Samuel Taylor Coleridge
- c. Tradition and the Individual Talent by T. S. Eliot

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define key critical terms and concepts. (Remembering)
- CO2:** Find out the implications of the key ideas on the prose, poetry, drama and fiction in literature (Remembering)
- CO3:** Distinguish between the various ideas of western literary criticism from the time of Aristotle to the Modern Period. (Understanding)
- CO4:** Analyse a representative critical text in literature. (Analysing)
- CO5:** Assess the works of the significant literary thinkers in the history of English literature. (Evaluating)
- CO6:** Discuss and summarise the key concepts of the various critical text. (Creating)

Suggested Readings

1. Selected Critical Texts (mentioned in the course structure)
2. Culler, Jonathan. Literary Theory: A Very Short Introduction.
3. Abrams, M. H. A Glossary of Literary Terms.
4. Cuddon, J.A. The Penguin Dictionary of Literary Terms and Literary Theory.
5. Wimsatt, W. K. & Cleanth Brooks. Literary Criticism: A Short History.
6. Habib, M. A. R. A History of Literary Criticism: From Plato to the Present.

LSSK0038: SOFT SKILLS

(3 Credits – 45 hours)

Objective: *The objective of this Open Elective Course is to train the students of different departments by imparting the various aspects of soft-skills like communication skills, leadership skills, social skills, to name a few, through lecture and training method. The Course aims to make the students realise the importance of soft skills as an integral part of personal and professional success.*

Module I: Soft Skills - Part I (20 hours)

Introduction to Soft Skills, People and Social skills, Communication skills- Writing skills and Speaking skills, Telephonic conversation skills, Negotiation skills, Team building, Leadership skills, Social and Emotional Intelligence

Module II: Soft Skills - Part II (25 hours)

Character Traits and Attitudes, Personality Types, Career Attributes, Presentation and Interaction, Time Management, Motivation and Persuasion, Professional ethics, Grooming and Etiquette

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define soft-skills. (Remembering)
- CO2:** Explain the importance of soft-skills in personal and professional life. (Understanding)
- CO3:** Distinguish between social and emotional intelligence. (Understanding)
- CO4:** Apply soft-skills at a work-place. (Applying)
- CO5:** Examine the different aspects of soft-skills. (Analysing)
- CO6:** Determine the do's and don'ts of grooming and etiquette. (Evaluating)

CO7: Discuss and summarise the different character traits and attitudes of an individual.
(Creating)

Suggested Readings

1. Mitra, Barun. Personality Development and Soft Skills.
2. Sharma, Prashant. Soft Skills: Personality Development for Life Success.
3. Butterfield, Jeff. Soft Skills for Everyone.
4. K., Alex. Soft Skills.
5. Chauhan, Gajendra S. Soft Skills: An Integrated Approach to Maximise Personality.

LSBC0039:BUSINESS COMMUNICATION

(2 Credits - 30 hours)(L-T-P:2-0-0)

Objective: To equip students effectively to acquire skills in reading, writing, comprehension and communication, as also to use electronic media for business communication.

Module I : Introduction (6 hours)

Nature of Communication, Process of Communication, Types of Communication (verbal & Non Verbal), Importance of Communication, Different forms of Communication Barriers to Communication Causes, Linguistic Barriers, Psychological Barriers, Interpersonal Barriers, Cultural Barriers, Physical Barriers, Organizational Barriers

Module II : Business Correspondence (6 hours)

Letter Writing, presentation, Inviting quotations, Sending quotations, Placing orders, Inviting tenders, Sales letters, claim & adjustment letters and social correspondence, Memorandum, Inter-office Memo, Notices, Agenda, Minutes, Job application letter, preparing the Resume.

Module III: Report Writing (6 hours)

Business Reports: Types, Characteristics, Importance, Elements of structure, Process of writing, Order of writing, the final draft, check lists for reports.

Module IV: Vocabulary (6 hours)

Words often confused, Words often mis spelt, Common errors in English.

Module V: Oral Presentation (6 hours)

Importance, Characteristics, Presentation Plan, Power point presentation, Visual aids.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** List out the different parts of speech in English grammar (Remembering)
- CO2:** Illustrate the basic sentence structures in English (Understanding)
- CO3:** Identify the barriers of effective communication (Applying)
- CO4:** Categories the different types of business letters (Analysing)
- CO5:** Compare between greetings and small talks (Evaluating)
- CO6:** Discuss the important themes/motifs in a short story (Creating)

Suggested Readings

1. Bovee, and Thill, Business Communication Essentials, Pearson Education
2. Shirley Taylor, *Communication for Business*, Pearson Education
3. Locker and Kaczmarek, *Business Communication: Building Critical Skills*, McGraw Hill Education
4. Herta A Murphy, Herbert W Hildebrandt, Jane P. Thomas, *Effective Business Communication (SIE)*, McGraw Hill Education

5. *Dona Young, Foundations of Business Communication: An Integrative Approach, McGraw Hill Education*
6. *Raymond V. Lesikar, Marie E. Flatley, Kathryn Rentz, Paula Lentz, and Neerja Pande, Business Communication: Connecting in a Digital World (SIE), McGraw Hill Education*

Note: Latest edition of text books may be used.

LSET0040: EFFECTIVE TECHNICAL COMMUNICATION

(3 Credits- 45 Hours)(L-T-P:3-0-0)

Module I: Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

Module II: Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Human factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

Module III: Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

Module IV: Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development.

Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

Module V: Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

COURSE /LEARNING OUTCOMES

After the completion of this course the students will be able to:

- CO1:** List out the different kinds of technical documents.
- CO2:** Compare different forms of technical writing.
- CO3:** Develop self-assessment and awareness.
- CO4:** Examine various forms of communication.
- CO5:** Apply ethics in various business environment

Suggested Readings

1. David F. Beer and David McMurrey, *Guide to writing as an Engineer*, John Willey. New York, 2004
 2. Diane Hacker, *Pocket Style Manual*, Bedford Publication, New York, 2003. (ISBN 0312406843)
 3. Shiv Khera, *You Can Win*, Macmillan Books, New York, 2003.
- AICTE Model Curriculum for Undergraduate degree in Civil Engineering (Engineering & Technology)*
4. Raman Sharma, *Technical Communications*, Oxford Publication, London, 2004.
 5. Dale Jungk, *Applied Writing for Technicians*, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
 6. Sharma, R. and Mohan, K. *Business Correspondence and Report Writing*, TMH New Delhi 2002.
 7. Xebec, *Presentation Book*, TMH New Delhi, 2000. (ISBN 0402213)

LSRW0041: ENGLISH FOR RESEARCH PAPER WRITING**(Audit Course)**

Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission.

Module I (4 hours)

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Module II (4 hours)

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Module III (4 hours)

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Module IV (4 hours)

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module V (4 hours)

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Module VI (4 hours)

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Readings

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London

LSVP0042: VICTORIAN TO POST-MODERN PERIOD-POETRY, DRAMA & FICTION**(4 Credits-60 hours)**

Objective: This course intends to acquaint the students with the popular and representative texts of the ages from Victorian to Post-Modern Period. In the process of familiarizing the texts it will further enable the students to understand the recent trends in the post-modern context. It will help the students have a comprehensive idea about the literary techniques used in reading the text prescribed.

Module I: Victorian Period: Poetry, Fiction, and Drama (20 hours)

- a. Ulysses: Alfred Lord Tennyson
- b. *Wuthering Heights*: Emile Bronte.
- c. *A Playboy of the Western World*: J.M. Synge

Module II: Modern Period: Poetry, Fiction, And Drama (20 hours)

- a. Wreck of the Deutschland: G. M. Hopkins

- b. Heart of Darkness: Joseph Conrad
- c. Saint Joan/ Pygmalion: G. B. Shaw

Module III: Post-Modern Period: Poetry, Fiction, And Drama (20 hours)

- a. Digging: Seamus Heaney
- b. The French Lieutenant's Women: John Fowles
- c. Waiting for Godot: Samuel Beckett

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the socio-cultural set up of England from Victorian to Post-Modern era. (Remembering)
- CO2:** Illustrate the Victorian, Modern and Post-modern elements prominent in the prescribed texts. (Understanding)
- CO3:** Summarise and interpret the various themes prominent from Victorian era to Post-Modern English texts. (Understanding)
- CO4:** Apply critical theories in reading the texts. (Applying)
- CO5:** Develop a theoretical interpretation of the prescribed texts. (Applying)
- CO6:** Analyse the background and critical readings undertaken by previous critics. (Analysing)
- CO7:** Analyse the various genres prominent in the eras. (Analysing)
- CO8:** Assess and evaluate the plot, theme, characters and context of the texts under study. (Evaluating)
- CO9:** Construct a critical reading based on its historic aspects evident in the texts. (Creating)

Suggested Readings

1. David, Deirdre. *The Victorian Novel*. Cambridge University Press, 2012.
2. Bradbury, Malcolm., McFarlane, James. *Modernism: A Guide to European Literature*. Penguin Publication, 1978.
3. Hutcheon, Linda. *The Poetics of Postmodernism*. Routledge Publication, 1988.
4. Waugh, Patricia. *Metafiction: The Theory and Practice of Self- Conscious Fiction*. Routledge Publication, 1988.

LSPC0043: POST-COLONIAL LITERATURE-POETRY, DRAMA & FICTION

(3 Credits- 45 hours)

Objective: *The objective of this course is to acquaint the students with the cardinal concepts of Postcolonial Studies. The students are required to read the selected texts from a postcolonial perspective. They are required to interpret the phenomenon of colonisation along with the flow of racist undertones in it.*

Module I: Introduction to Postcolonial studies.(10hours)

Historical background of Post-colonial Studies, Post-colonial theory, Decolonization, Globalization, Hybridization, identity, culture, philosophy of Othering,.

Module II: Selected Texts (10 hours)

- a. Orientalism- Edward Said (Selections)
- b. Nation and Narration- Homi.K. Bhabha

Module III: Selected Novels (20 hours)

- a. My Son's Father- Dom Moraes
- b. Foe-J.M. Coetzee

Module IV: Selected Drama & Poetry (15 hours)

- a. A Dance of the Forests- Derek Walcott
- b. Vultures- Chinua Achebe
- c. An African Elegy- Ben Okri

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the various critical elements in adherence to the Postcolonial literature. (Remembering)
- CO2:** Illustrate the Historical context of the Postcolonial literature and the use of racist and colonial undertones in the texts under study. (Understanding)
- CO3:** Identify the texts on the basis of the Historical background, socio-political conditions of the respective time period and establish a connectedness across the commonalities of the theme and structure of the texts under study. (Applying)
- CO4:** Analyse the various postcolonial theories and literary concepts from texts written in corresponding time frames and by authors coming from varied socio- linguistic milieu. (Analysing)
- CO5:** Evaluate the significance of the Post-colonial literature from the historical, socio-political and literary perspective and its evolution within a relevant theoretical framework along with the writer's psyche and contribution towards it. (Evaluating)

Suggested Readings

1. Eugene Benson and L. Conolly (eds). *Encyclopaedia of Postcolonial Literatures in English*. (2nd ed.)
2. B. M. Gilbert. *Postcolonial Theory: Contexts, Practices, Politics*.
3. Padmini Mongia. *Postcolonial theory*. Oxford.
4. Meenakshi Mukherjee and Harish Trivedi (eds.) *Interrogating Postcolonialism*.
5. Ashcroft, Griffiths and Tiffin. *The Empire Writes Back*.
6. Pramod K.Nayar. *Postcolonial Literature: An Introduction*.
7. Robert J.C. Young. *Postcolonialism: A Very Short Introduction*. New York: OUP,2003

LSAL0044: AMERICAN LITERATURE – POETRY, DRAMA & FICTION**(3 Credits- 45 Hours)**

Objective: *The aim of this course is to introduce the student to the American participation in literature. Students are expected to be aware of the early colonial experience, the Puritanical setup, the struggle for survival and later for political and cultural independence, the search for an American voice, the increasingly multi-ethnic setup and the faith in an American mythology of origins. This Course will be covered through both historical study and textual analysis.*

Module I: Introduction (10 hours)

The Colonial Period (Declaration of American Independence, 1776) American Nationalism, Romanticism, Transcendentalism (Selections from Emerson).

Module II: Drama (10 hours)

- a. Who is afraid of Virginia Woolf- Edward Albee.
- b. Death of a Salesman- Arthur Miller.

Module III: Novels (15 hours)

- a. Moby Dick- Herman Melville.
- b. The Scarlet Letter- Nathaniel Hawthorne.

Module IV: Poems (10 hours)

- a. Walt Whitman: "When Lilacs Last in the Dooryard Bloom'd".
- b. Edgar Allen Poe: "The Raven".

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define intricacies of American literature. (Remembering)
- CO2:** Explain diversified range of subjects portrayed in American literature. (Understanding)
- CO3:** Organize a comparative study between literature from the conventional European colonial powers and a colonised yet culturally and politically dominant nation like America. (Applying)
- CO4:** Analyse the texts from the point of the Native Americans which would be an unbiased view. (Analysing)
- CO5:** Evaluate the indigenous culture of the American society. (Evaluating)
- CO6:** Discuss, critically appreciate and summarise the selected texts. (Creating)

Suggested Readings

1. Ellmann, Richard, editor. (2001). *The New Oxford Book of American Verse*. Oxford University Press, New York.
2. Horton, R W and H E Edwards, editors. (1974). *Backgrounds of American Literary Thought*. Prentice Hall, Englewood Cliffs, NJ.
3. Spiller, Robert E. (1961). *The Cycle of American Literature*. Macmillan, New York.
4. Gray, Richard. (2008). *History of American Literature*. Blackwell, Oxford.
5. Chase, Richard. (1990). *The American Novel and its Tradition*. Johns Hopkins Press, Baltimore.
6. Krasner, David. editor. (2005). *A Companion to Twentieth Century American Drama*. Blackwell, Oxford.

LSLC0045: LITERARY AND CRITICAL THEORY

(4 Credits-60 Hours)

Objective: *The course would acquaint the students with the works of significant critics. The course would familiarise the students with important critical movements and enable them to apply principles of criticism to literary text. The course would encourage them to undertake further reading in critical movements and critical theory.*

Module I: Canonical literary theories and theorists (20 hours)

- a. Jacques Derrida Deconstruction with reference to "Structure, Sign and Play" in the Discourse of the Human Sciences
- b. Roland Barthes Post- modernism with reference to "The Death of the Author"
- c. Louis Althusser Marxist literary theory with reference to Ideology and the State Apparatuses (extract)
- d. Mitchel Foucault Post- structuralism with reference to The Order of Discourse (extract).

Module II: Important literary texts (20 hours)

- a. Northop Frye: Myth, Fiction and Displacement.
- b. William Empson: Seven types of ambiguity.
- c. T.E. Hulme- Romanticism and Classicism.

Module III: Critical essays and lectures (20 hours)

- a. Hélène Cixous : ‘Castration or Decapitation?’
- b. Michel Foucault : ‘What is an Author’?
- c. Victor Shklovsky : From Art as Technique
- d. M. M. Bakhtin : ‘Discourse in the Novel’ from The Dialogic Imagination.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define these modern theories. (Remembering)
- CO2:** Explain genesis and growth of the modern critical theories in the context of literary texts. (Understanding)
- CO3:** Utilize the contemporary theories in the critical analysis of various literary texts. (Applying)
- CO4:** Apply the theories in their subjects and generate a new approach of looking at literary texts. (Applying)
- CO5:** Evaluate the texts in terms of their political, social, psychoanalytical, feministic and economic implications. (Evaluating)
- CO6:** Develop a more profound critical approach after the study of these theories. (Creating)

Suggested Readings

1. Cuddon. *A Dictionary of Literary terms and Theories* ,Penguin
2. Wimsatt and Brooks eds. *Literary Criticism: A Short History* Indian ed., Oxford Book Company
3. Selden, Widdowson and Brookereds, *A Reader’s Guide to Contemporary Literary Theory*, 5th Edition ,Indian ed. Cambridge University Press

LSLL0046: GENDER AND LITERATURE**(2 Credits-30 Hours)**

Objective: *This paper is designed to present students with the opportunity to study key concepts and terms associated with gender and literature. The students are expected to examine the implication of ideas and relate these terms and concepts to the prescribed texts in this paper. This paper brings to students poems, novels and theories that are representative of important trends.*

Module I : Selected Feminist Writings (10 hours)

- a. The Laugh of the Medusa – Helene Cixous
- b. The Second Sex – Simone de Beauvoir (Selections)
- c. The Gender Trouble – Judith Butler (Selections)

Module II: Selected Fiction (10 hours)

- a. A Thousand Splendid Sons – Khalid Hosseini

Module III: Selected Poetry (10 Hours)

- a. ‘The Wife’s Letter ‘– Rabindranath Tagore
- b. ‘Purdah I ‘– Imtiaz Dharker
- c. ‘Sunlight On a Broken Column’ – Attia Hossain

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the various thoughts and theories pertaining to feminist writings and feminism. (Remembering)

- CO2:** Explain the themes and topics and relate it to real life situations. (Understanding)
- CO3:** Develop new ideas by connecting the various topics taught. (Applying)
- CO4:** Analyse the various movements related to gender and the progress in gender and literature. (Analysing)
- CO5:** Evaluate the interdisciplinary aspect in the various texts. (Evaluating)
- CO6:** Discuss and summarise the meanings, ideas and thoughts regarding gender and its connection with literature. (Creating)

Suggested Readings

1. *Nine Indian Woman Poets*, ed. Eunice de Souza , New Delhi: Oxford University Press, 1997
2. *Feminism and Subversion of Identity* , London: Roudedge, 1990
3. Rabindanath Tagore; *Selected Short Stories*, ed. Sukanta Chaudari, New Delhi: Oxford,2000

LSLS0047: LINGUISTICS AND STYLISTICS I

(3 Credits- 45 hours)

Objective: *The objective of this course is to introduce the learners to the two related disciplines – Linguistics and Stylistics – by introducing them with the key concepts related to these disciplines. This course will enable the students to have a scientific perspective in the areas of language and style in literature.*

Module I: Introduction to Linguistics (30 hours)

Definition of Language and its characteristics, Definition, Scope and Goal of Linguistics, Linguistics and Traditional Grammar, Langue and Parole, Competence and Performance, Synchrony and Diachrony, Syntagmatic and Paradigmatic, Sign, Signifier and Signified, Language and Society, Dialect and Idiolect, Standard Language, Register and Style, Bilingualism and Multi-lingualism, Code-Switching and Code-Mixing, Language Shift and Language Death

Module II: Introduction to Stylistics (15 hours)

Definition, Nature and Scope of Stylistics, Stylistics, Linguistics and Literary Criticism, Major Thinkers in Stylistics, Objectives of this discipline, Stylistics and levels of language, Stylistics and Style, Different branches of Stylistics, Stylistics as an inter-disciplinary field

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the key concepts of Linguistics. (Remembering)
- CO2:** Illustrate the differences between Stylistics and Linguistics. (Understanding)
- CO3:** Identify and explain the different levels of language. (Applying)
- CO4:** Analyse Linguistics and Traditional Grammar. (Analysing)
- CO5:** Recommend Stylistics as an interdisciplinary field of study. (Evaluating)
- CO6:** Discuss the different branches of Stylistics. (Creating)

Suggested Readings

1. Toolan, Michael. *Language in Literature: An Introduction to Stylistics*. Oxford University Press.
2. Simpson, Paul. *Stylistics*. Routledge.
3. Lyons, John. *Language and Linguistics*. Cambridge University Press.
4. Bradford, Richard. *Stylistics*. Routledge.
5. Carter, Ronald and Paul Simpson. *Language, Discourse and Literature: An Introductory Reader in Discourse Stylistics*. Routledge.

LSCE0048: INTRODUCTION TO MODERN EUROPEAN LITERATURE I**(3 Credits- 45 Hours)**

Objective: *The objective of this course is to expose students to the vast body of European Literature with its changing trends and forms. The course is chiefly designed to introduce to student the major themes and concerns central for acquainting themselves to 20th century European Literature through the genres of poetry, drama and fiction. The course will help the students to explore and understand the specific issues such as the socio-political strife, introspections, conflicts between individual versus society, hardships of life caused by the two Wars as represented in the literature of Modern Europe.*

Module I: Major Aesthetic Developments (10 hours)

Constructivism, Realism, Symbolism, Naturalism, Aestheticism, Futurism, Vorticism, Imagism, Expressionism, Dadaism, Surrealism, Cynicism, Skepticism, Resistance, Despair and Alienation

Module II: Selected Modern European Poetry (15 hours)

Charles Baudelaire: The Albatross

Rainer Maria Rilke: "The apple Orchard"

Module III: Modern European Fiction (20 Hours)

a) Fyodor Dostoevsky: Crime and Punishment

b) Franz Kafka: The Castle

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Recall the vast body of writings of the great European Literature. (Remembering)
- CO2:** Interpret the emerging trends of European Literature through the genres of poetry and fiction. (Understanding)
- CO3:** Apply critical reading skills to study the emerging and vibrant areas of literature at a wider range. (Applying)
- CO4:** Analyse the specific issues such as the double challenge of truth and liberty, of identity and unity, of cultural loss and recovery, of ethnic specificity and aesthetic universality in the writings of the great writers of world-wide repute. (Analysing)
- CO5:** Evaluate the core issues as depicted in the literature of Modern Europe. (Evaluating)
- CO6:** Discuss and summarise the critical analysis of the various texts. (Creating)

Suggested Readings

1. Abrams, M.H. & Harpham, Geoffrey Galt . A Glossary of Literary Terms. Cengage Learning, New Delhi,2015
2. Bloom, Harold: *The Western Canon: The Books and school of the ages*, New York:Harcourt,1994
3. Bradbury, Malcolm and Mac Farlane, James(eds) *Modernism : A Guide to European Literature,1890-1930* London, Penguin,1976
4. Cohen, Walter. *A History of European Literature*, Oxford University Press, New Delhi,2017
5. Cohen, J.M.: *A History of Western Literature* :New York, Transaction Publishing,2007
6. Hamburger, Michael. *The Truth of Poetry: Modernist Poetry since Baudelaire*. London: Anvil Press Poetry,2004
7. Moretti, Franco. ed.: *The Novel*, 2 Vols., Priceton UP, 2006
8. Nicoll, Allardyce: *British Drama*. New York: Barnes & Noble,1961
9. All the Selected Texts

LSCP0049: COLONIAL AND POST-COLONIAL AFRICAN LITERATURE I

(3 Credits- 45 Hours)

Objective: The objective of this course is to expose the students to the vast body of African English Writing during colonial and post-colonial period. The course is designed to introduce to student the themes and concerns central for acquainting themselves to the colonial experiences and literature of Africa during the Colonial and Postcolonial period through the genres of poetry, and fiction writing. The course will help the students to explore and understand the specific issues such as the reactions and resistance to colonialism, race relations, apartheid, identity crisis, cultural conflicts and negritude.

Module I: Selected Poetry (10 hours)

- a. Derek Walcott: Koenig of the River
- b. Gabriel Okara: The Fisherman's Invocation

Module II: Fiction (20 hours)

- a. Chinua Achebe: *No Longer at Ease*
- b. Chimamanda Ngozi Adichie: *Purple Hibiscus*

Module III: Drama (15 hours)

- a. Wole Soyinka: *The Lion And The Jewel*
- b. Ama Ata Aidoo: *The Dilemma Of Ghost*

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Illustrate the vast body of writings in English from Africa. (Understanding)
- CO2:** Interpret different genres of African literature- poetry, fiction and Drama (Understanding)
- CO3:** Apply critical reading skills to interpret the vibrant area of literature. (Applying)
- CO4:** Analyse the specific issues such as the colonialism, of identity and unity, of cultural loss, of ethnic specificity of universality in the literature of Africa during and after Colonial Period. (Analysing)
- CO5:** Evaluate the specific issues pertaining to the colonial experience and literature of Africa. (Evaluating)
- CO6:** Discuss and summarise the critical analysis of the various literary texts. (Creating)

Suggested Readings

1. Achebe, Chinua. *Arrow of God*, William Heinemann Ltd, Oxford, 1958
2. Adichie, Chimamanda Ngozi. *Purple Hibiscus*, Algonquin Books, 2003
3. Aidoo, Ama Ata. *The Dilemma Of Ghost*, Longman: USA, 1995
4. Bell, Bernard W. *The Afro-American Novel and Its Tradition*, University of Massachusetts Press, 1989
5. Dathorne, O.R. *The Black Mind: A History Of African Literature*. University of Minnesota Press, 1974
6. King, Lovalerie. et al. *Contemporary African American Literature: The Living Canon*, Indiana university Press, 2013
7. Ngugi, Mukoma Wa. *The Rise of the African Novel*, University of Michigan Press: USA, 2018
8. Soyinka, Wole: *The Lion And The Jewel*, OUP: London, 1962

LSIW0050: INDIAN WRITING IN ENGLISH – POETRY, DRAMA & FICTION**(4 Credits-60 hours)**

Objective: The course will introduce students to a kaleidoscopic pattern of literature produced in India. The students are expected to study the selected texts from the genres of poetry, fiction, drama and short-stories. The study will entail from a historical, political and cultural perspective instrumental in the production of literature.

Module I: Selected Poetry (10 hours)

- a. Philosophy- Nissim Ezekiel.
- b. The Looking Glass- Kamala Das
- c. A River- A.K. Ramanujan.
- d. APoem for Mother- Robin Ngangom.
- e. Indian Summer- Jayanta Mohapatra

Module II: Selected Drama & Short Story (15 hours)

- a. The Morning Raga- Mahesh Dattani
- b. The Road to Salvation- Munshi Premchand

Module III: Selected Fiction (20 hours)

- a. The Coolie- Mulk Raj Anand
- b. Fasting and Feasting- Anita Desai

Module IV: Travel Writing (15 hours)

An Antique Land- Amitav Ghosh

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the literature produced in India in English. (Remembering)
- CO2:** Illustrate and comment on poetry, drama, short stories and novels produced in India in their various socio-cultural context. (Understanding)
- CO3:** Identify and explain the various critical theories involved in the production of various indigenous texts. (Applying)
- CO4:** Analyse the techniques, style of writing and contribution of various writers to the Indian English literary tradition. (Analysing)
- CO5:** Evaluate the Indian writings in English and their representation of the Indian ethos on a global forum. (Evaluating)
- CO6:** Discuss, summarize and critically appreciate the selected literary works and find out the commonalities in terms of themes and issues. (Creating)

Suggested Readings

1. George, K.M(ed), *Contemporary Indian Short Stories in English and Modern Indian Literature*.
2. Deshpande, G.P.(ed.) *Modern Indian Drama: An Anthology*, Goodreads. 2000
3. Naik, M.K. *A History of English Literature*, Paperback, 1982
4. Selected Texts

LSSA0051: SOUTH ASIAN LITERATURE

(4 Credits- 60 Hours)

Objectives: *The course aims to acquaint the students with the seminal texts from the southern part of Asia which is an important geo-political cluster in the modern context. The oriental writings would enable the students to decode the world from a heterogenic and non-European viewpoint.*

Module I: Introduction (20 Hours)

Geo-political conditions, Historical background of South Asian Literature, Imperialism, Colonialism, Nationalism, Orientalism, De-colonization, Specific issues with reference to history, politics and linguistic inventiveness in the literature of South-Asian countries.

Module II: Selected Poetry(10 Hours)

- a. The Prophet by Khalil Gibran ('Love', 'Marriage', 'Children', 'Work', 'Joy and Sorrow' and 'Houses')
- b. Masnavi by Rumi

Module III: Selected Fiction (30 Hours)

- a. Ice Candy Man by Bapsi Sidwa
- b. The Kite Runner by Khaled Hosseini
- c. The Bones of Grace by Tahmima Anam.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the South Asian literary milieu. (Remembering)
- CO2:** Outline the literary, social, political and cultural dynamics of these texts. (Understanding)
- CO3:** Apply the knowledge from these texts to assess the socio cultural aspect of these areas. (Applying)
- CO4:** Examine the texts with reference to the classic literary texts that they have studied earlier. (Analysing)
- CO5:** Evaluate the overall political and social implications of the area as suggestive in their texts. (Evaluating)
- CO6:** Discuss, ascertain and summarise the emotions and aspirations of the writers from these areas reflected in their writings. (Creating)

Suggested Readings

1. Mukherjee, Surjit. *Translation as Recovery*. Orient Longman
2. Sahitya Academy. *East & West Poetics at Work*.
3. Walsh,W. *Commonwealth Literature*. Oxford University Press 1973
4. Ashcroft, Bill et al.eds. *The Empire Writes Back*.

LSLT0052: LINGUISTICS AND STYLISTICS II

(3 Credits-45 hours)

Objective: *This course intends to acquaint the students with the basic branches of linguistics. It will prepare the students to understand the recent developments in the field of linguistics and stylistics and approach language from a theoretical as well as practical perspective.*

Module I: Phonology, Morphology, Syntax and Semantics: Basic Concepts (30 hours)

Organs of Speech, Vowel and Consonant Sounds, Syllable and Word-Stress, Sentence stress and

Intonation, Phonetic and Phonemic transcription, Phonological structure of English language, Morphological structure of English language, Phonemes, Morphemes, Allomorphs and Morphs, Word formation process in English language, Prefix, infix and suffixes (Inflectional and derivational suffixes), Syntactic Structure of English language, Semantic level of language, Layers of Meaning: Deep and Surface Structure, IC Analysis

Module II: Reading in Stylistics (15 hours)

Language and Literature, Levels of language at work, Sentence styles: development and illustration, Interpreting patterns of sound, Techniques of speech and through presentation, Dialogue in drama, Style in poetry: an exploration, A sociolinguistic model of narrative, Exploring metaphors in different kinds of texts, Style variation in narrative, Stylistics and media, An application of cognitive stylistics in poetry, Literature as discourse, Stylistic appreciation of poetry/prose

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the role of language in the contemporary world. (Remembering)
- CO2:** Interpret and stylistically appreciate works of literature. (Understanding)
- CO3:** Apply sound, word and sentence structure in transcribing a word or Analysing sentence. (Applying)
- CO4:** Analyse critically and stylistically read the various genres. (Analysing)
- CO5:** Analyse the structure of a word or sentence linguistically and stylistically. (Analysing)
- CO6:** Distinguish between the vowel and consonant sounds. (Analysing)
- CO7:** Assess and evaluate the structure of language using linguistic and stylistic tools. (Evaluating)
- CO8:** Discuss, summarise and interpret the role of language used in various genres. (Creating)
- CO9:** Compose phonetically using stress and intonation patterns. (Creating)

Suggested Readings

1. Balasubramanian, T. *A Textbook of English Phonetics for Indian Students*. Macmillan, 1981.
2. Crystal, David. *Linguistics*. Penguin, 1990.
3. Hudson, R.A. *Sociolinguistics*. CUP, 1980.
4. Lyons, John. *Language and Linguistics: An Introduction*. CUP, 1981.
5. Simpson, P. *Stylistics: A Resource Book for Students*, Routledge, 2004.
6. Trudgill, Peter. *Sociolinguistics*. Penguin, 1990.

LSEL0053: INTRODUCTION TO MODERN EUROPEAN LITERATURE II

(3 Credits-45 hours)

Objective: *The objective of this course is to expose students to the vast body of European literature starting from the 19th century to present. The course is designed to introduce to student to the changing trends and movements of literature as reflected in the writings of the great writers of the period. The course will help the students to explore and understand the great western modern philosophy as reflected in the poetry, drama and fictions written by the modern writers of Europe.*

Module I: Selected Modern European Poetry (20 hours)

- a. Federico Garcia Lorca: "Lament for a Bullfighter"
- b. Vladimir Mayakovsky: "To his Own Beloved Self"

Module II : Selected Modern European Drama (15 hours)

- a. Luigi Pirandello: Six Characters in Search of an Author
- b. Tom Stoppard: Rosencrantz and Guildenstern Are Dead

Module III: Modern European Fiction

- a. Albert Camus: The stranger
- b. Gunter Grass : The Tin Drum

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Outline the vast body of writings in European Literature. (Understanding)
- CO2:** Interpret different representative texts of European literature- poetry, fiction and Drama. (Understanding)
- CO3:** Apply critical reading skills to the emerging and vibrant area of literature. (Applying)
- CO4:** Analyse the specific issues such as the humanism, individualism, meaninglessness of life, liberty and identity, cultural loss and recovery and aesthetic universality in the literature from different nations of Europe. (Analysing)
- CO5:** Evaluate the overall Western modern philosophy in the works of the various writers of the area. (Evaluating)
- CO6:** Discuss, ascertain and summarise the changing trends and movements of literature as reflected in the selected texts. (Creating)

Suggested Readings

1. Abrams, M.H. & Harpham, Geoffrey Galt . A Glossary of Literary Terms. Cengage Learning, New Delhi,2015
2. Bloom, Harold: *The Western Canon: The Books and school of the ages*, New York:Harcourt,1994
3. Bradbury, Malcolm and MacFarlane, James(eds) *Modernism: A Guide to European Literature,1890-1930* London,Penguin,1976
4. Cohen, Walter. *A History of European Literature*, Oxford University Press, New Delhi,2017
5. Cohen, J.M.: *A History of Western Literature* :New York, Transaction Publishing,2007
6. Hamburger, Michael. *The Truth of Poetry: Modernist Poetry since Baudelaire*. London: Anvil Press Poetry,2004
7. Moretti, Franco.ed.: *The Novel*,2 Vols.,PricetonUP,2006
8. Nicoll, Allardyce: *British Drama*. New York: Barnes & Noble,1961
9. All the Selected Texts

LSAL0054: COLONIAL AND POST- COLONIAL AFRICAN LITERATURE II

(3 Credits-45 Hours)

Objective: *The objective of this course is to introduce the students to the African literature during colonial and post colonial period. The course is designed to introduce to student to the critical and theoretical concepts of liberation, independence and cultural assimilation through the representative texts of African literature. The course will help the students to explore and Analyse specific issues such as the resistance to colonialism and identity assertion, race relations, identity crisis and cultural conflicts.*

Module I: Selected Poetry (10 Hours)

- a. Phillis Wheatley: On Being Brought from Africa to America
- b. Wole Soyinka : Telephone Conversation.

Module II: Selected Fiction (20 Hours)

- a. **Infinite Riches By Ben Okri**
- b. July's People By Nadine Gordimer

Module III: Selected Non-Fiction Writings (15 Hours)

- a. On Abolition of the English Department- Ngugi wa' Thiongo
- b. The African writer and the English Language- Chinua Achebe.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Outline the vast body of writings in English from Africa. (Understanding)
- CO2:** Interpret the emerging genres of African literature- poetry, fiction and Drama. (Understanding)
- CO3:** Apply theoretical assumption as well as critical reading skills to the study of vibrant area of African literature. (Applying)
- CO4:** Analyse the specific issues such as the colonialism, of identity and unity, of cultural loss, of ethnic specificity of universality in the literature of Africa during and after Colonial Period. (Analysing)
- CO5:** Assess and evaluate the plot, theme, characters and context of the selected texts. (Evaluating)
- CO6:** Construct an innovative theoretical reading of the text. (Creating)

Suggested Readings

1. Achebe, Chinua. Hopes and Impediments:
2. Gordimer, Nadine. *July People* Jonathan Cape Ltd: Great Britain,1981
3. Okri, Ben. *Infinite Riches*, Vintage:London2009
4. Ngugi, Mukoma Wa. *The Rise of the African Novel*, University of Michigan Press:USA,2018
5. Fanon, Frantz. *The Wretched Of the Earth*, Translated by Constance Farrington, Penguin Books: London 1963.
6. Thiong'o. Ngugi wa. *Decolonising the Mind*, East African Educational Publishers:London1986

LSPW0055:POST-COLONIAL WRITINGS**(4 Credits - 60 hours)**

Objective: *The course attempts to acquaint the students with the basic concepts of Postcolonial Studies. The students are required to read the selected texts from a postcolonial perspective and try to understand the racist or colonial undertones in it.*

Module I: Introduction to Postcolonial studies (15 hours)

Scope of Postcolonial studies, Historical background to postcolonial studies, Reclaiming of history; Politics of Language, Nation and Nationalism, Politics of representation, Introduction to Gender, Identity and Culture.

Module II: Selected Texts- Drama and Fiction (25 hours)

- a. Nagamandala – Girish Karnad.
- b. One Hundred Years of Solitude- Gabriel Garcia Marquez
- c. Things Fall Apart- Chinua Achebe.

Module III: Selected Texts- Essays (20 hours)

- a. Decolonising the Mind- Ngugi wo Thiongo (Selected Essays).
- b. Orientalism- Edward Said (Selections).

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Relate the various critical elements in adherence to the Postcolonial literature (Remembering)
- CO2:** Distinguish the Historical context of the Postcolonial literature and the use of racist and colonial undertones in the texts under study. (Analysing)
- CO3:** Classify the texts on the basis of the Historical background, socio-political conditions of the respective time period and establish a connectedness across the commonalities of the theme and structure of the texts under study. (Analysing)
- CO4:** Analyse the various postcolonial theories and literary concepts from texts written in corresponding time frames and by authors coming from varied socio- linguistic milieu. (Analysing)
- CO5:** Examine and evaluate the significance of the Post-colonial literature from the historical, socio-political and literary perspective and its evolution within a relevant theoretical framework along with the writer's psyche and contribution towards it. (Evaluating)
- CO6:** Discuss, summarise and critically appreciate the literary and the thematic aspects of the texts under study. (Creating)

Suggested Readings

1. Eugene Benson and L. Conolly(eds). Encyclopaedia of Postcolonial Literatures in English. (2nd ed.)
2. B.M.Gilbert. Postcolonial Theory: Contexts, Practices, Politics.
3. Padmini Mongia. Postcolonial theory .Oxford.
4. Meenakshi Mukherjee and Harish Trivedi (eds.) Interrogating Post-colonialism.
5. Ashcroft, Griffiths and Tiffin. The Empire Writes Back.
6. Pramod K. Nayar. Postcolonial Literature: An Introduction.
7. Robert J.C.Young. Postcolonialism: A Very Short Introduction. New York: OUP,2003.

LSMD0056: MODERN ENGLISH DRAMA

(4 Credits – 60 hours)

Objective: *The course attempts to acquaint the students with the various dramas that belong to the modernist era. It focuses on the major dramatist and dramatic movement of the modern period, from realism to absurd. The shift from the nineteenth century farce and humour to the modern plays is evident from the dramas under study.*

Module I: Theatre Concepts (20 hours)

- a. Realism.
- b. Naturalism,
- c. Meta-theatre,
- d. Absurd Theatre,
- e. Epic Theatre: Distance Effect or Verfremdungseffekt
- f. Ethics for Theatre

Module II: Selected Plays (40 hours)

- a. The Playboy of the Western World (1907): J.M.Synge
- b. Six characters in search of an Author (1921): Luigi Pirandello.
- c. Mother courage (1939): Bertolt Brecht.
- d. Endgame (1956): Samuel Beckett.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Explain the basic concepts of theatre and performance. (Understanding)
- CO2:** Interpret the selected dramas in terms of plot, characterisation and the use of the theatrical concepts in it. (Understanding)
- CO3:** Distinguish the various theatrical concepts and critical elements in terms of the prescribed texts and their relevance to dramas of the modern era. (Analysing)
- CO4:** Analyse the various dramatic movements such as realism, *verfremdungseffekt*, absurdism and so on. (Analysing)
- CO5:** Examine and evaluate the significance of the modern English drama from the perspective of the various dramatic movements of the period and the dramatist's contribution towards it. (Evaluating)
- CO6:** Discuss, summarise and critically appreciate the theatrical and the thematic aspects of the dramas under study. (Creating)

Suggested Readings

1. Bentley Epic. *The Theory of the Modern Stage: An Introduction to Modern Theatre and Drama*. New York: Penguin. 1976.
2. Brater, Enoch and Ruby Cohn, eds. *Around the Absurd: Essays on Modern and Postmodern Drama*. Ann Arbor: U of Michigan Publishing, 1990.

LSAL0057: AMERICAN LITERATURE**(4 Credits – 60 hours)**

Objective: *The objective of this course is to introduce students to a body of literature by the writers of literature of the USA. This course will introduce major American writers in the genres of poetry, fiction and drama. This course expects the students to develop writing and analytical skills as these skills relate to developing a broad knowledge of American literature and its representative texts in relation to their historical and socio-cultural contexts.*

Module I: Selected Poems (16 hours)

- a. "Song of Myself"(section I & II) by Walt Whitman
- b. "Because I could not stop for Death" by Emily Dickinson
- c. "Stopping by Woods on a Snowy Evening" by Robert Frost
- d. "Ballad of the Landlord" by Langston Hughes

Module II: Selected Novels (22 hours)

- a. *The Old Man and the Sea* by Ernest Hemingway
- b. *Color Purple* by Alice Walker

Module III: Selected Drama (22 hours)

- a. *All My Sons* by Arthur Miller
- b. *A Streetcar Named Desire* by Tennessee Williams

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Illustrate major periods and trends in American literature with an understanding of common themes, metaphors, symbols along with a wide variety of literary devices (Understanding)
- CO2:** Relate different texts with one another and to the respective historical context of their appearance. (Understanding)

- CO3:** Identify key ideas, representative authors and works, significant historical or cultural events and characteristic perspectives or attitudes expressed in the literature of America. (Applying)
- CO4:** Analyse literary works as expressions of individual or communal values within the social, political, cultural or religious contexts of different literary periods. (Analysing)
- CO5:** Assess and evaluate the selected poems, novels and dramas vis-à-vis their context and socio- political and cultural background and their role in making the American canon. (Evaluating)
- CO6:** Discuss, summarize and critically appreciate the selected poems, novels and dramas. (Creating)

Suggested Readings

1. Selected Texts (mentioned in the detailed course)
2. Abrams, M. H. A Glossary of Literary Terms, MacMillan Publishers
3. Erskine, John & William Peterfield Trent. *The Cambridge History of American Literature*.
4. Gray, Richard. *A History of American Literature*
5. Murphy, Brenda. *American Realism and American Drama*
6. Ruland, Richard. & Malcolm Bradbury. *From Puritanism to Postmodernism: A History of American Literature*
7. Stonely, Peter and Weinstein, Cindy. *A Concise Companion to American Fiction*.

LSIL0058: INDIAN ENGLISH LITERATURE

(3 Credits - 45 hours)

Objective: *The course will introduce students to a kaleidoscopic pattern of literature produced in India. The students are expected to study the selected texts from the genres of poetry, fiction, drama and short-stories. The study will entail from a historical, political and cultural perspective instrumental in the production of literature.*

Module I: Selected Poetry (10 hours)

- a. Our Casuarina Tree- Toru Dutt.
- b. Breaded Fish- A.K.Ramanujan
- c. Night of the Scorpion- Nissim Ezekiel.
- d. My Grandmother's House- Kamala Das.
- e. Dawn at Puri- Jayanta Mohapatra

Module II: Selected Short Stories (15 hours)

- a. The Inner Rooms- Shashi Deshpande
- b. Room on the Roof- Ruskin Bond.
- c. The Road to Salvation- Munshi Premchand

Module III: Selected Fiction and Drama (20 hours)

- a. Namesake-Jumpa Lahiri
- b. The White Tiger-Arvind Adiga
- c. Tughlaq- Girish Karnad

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the literature produced in India in English. (Remembering)
- CO2:** Explain and comment on poetry, drama, short stories and novels produced in India in their various socio-cultural context. (Understanding)
- CO3:** Classify and explain the various critical theories involved in the production of various indigenous texts. (Understanding)
- CO4:** Analyse the techniques, style of writing and contribution of various writers to the Indian English literary tradition. (Analysing)
- CO5:** Evaluate the Indian writings in English and their representation of the Indian ethos on a global forum. (Evaluating)
- CO6:** Discuss, summarize and critically appreciate the selected literary works and find out the commonalities in terms of themes and issues. (Creating)

Suggested Readings

1. George, K.M(ed), Contemporary Indian Short Stories in English and Modern Indian Literature.
2. Deshpande, G.P.(ed.) Modern Indian Drama: An Anthology.
3. Naik, M.K. A History of English Literature.
4. Selected Texts.

LSLL0059: LANGUAGE AND LINGUISTICS I

(3 Credits - 45 hours)

Objective: *the objective of this open elective course is to introduce students across different disciplines in humanities and social sciences to linguistics as the scientific study of language and to familiarise them with the different levels of language organisation. This course will enable the students from different departments to have a scientific perspective on the area of language studies.*

Module I: Introduction to Linguistics (15 hours)

Definition of language; Characteristics of language; Different branches of linguistics; Linguistics and traditional grammar; langue and parole; competence and performance; synchrony and diachrony; syntagmatic and paradigmatic; sign, signifier and signified

Module II: Levels of Linguistics Organisation: Phonology, Morphology, Syntax & Semantics (30 Hours)

Organs of speech; speech mechanism; vowel sounds and consonant sounds; phonemic transcription; phonemes, morphemes, allomorphs and morphs; syllable and word formation processes; word stress and sentence intonation; syntactic structure of English language; layers of meaning at the semantic level of language; deep structure and surface structure

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define basic concepts in linguistics. (Remembering)
- CO2:** Distinguish between vowels and consonants sounds; langue and parole etc. (Understanding)
- CO3:** Identify and explain the different levels of language organisation. (Applying)
- CO4:** Analyse linguistics and traditional grammar. (Analysing)
- CO5:** Discuss and summarize the different processes for word formation in English. (Creating)
- CO6:** Examine the different layers of meaning in a sentence. (Evaluating)

Suggested Readings

1. Bansal, R. K. & J. B. Harrison. *Spoken English*. Orient Longman Pvt. Ltd.
2. Lyons, John. *Language And Linguistics: An Introduction*. Cambridge Publishing.
3. Balasubramanyam, T. A. *A Textbook Of English Phonetics For Indian Students*. Macmillan.
4. Roach, Peter. *English Phonetics And Phonology*. Cambridge

LSAF0060: AFRICAN LITERATURE

(4 Credits-60 hours)

Objective: *The course attempts to familiarize the students with the African literature along with the various issues that are reflected in the course of the narrative. The texts under consideration shall extend an overview of African history and its conditioning under postcolonial context. It focuses on the representative writers of African literature who contribute to the canons of African narratives in English.*

Module I: Fiction (40 hours)

- a. *A Grain of Wheat*: Ngugi Wa Thiongo
- b. *So Long a Letter*: Mariama Ba
- c. *My Son's Story*: Nadine Gordimer

Module II: Non Fiction (20 hours)

- a. Chinua Achebe: "An Image of Africa"
- b. Buchi Emecheta: "Feminism with a Small 'f'!"

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the cultural representation of the canonical works by African writers in English. (Remembering)
- CO2:** Select a recurrent theme appropriate in African context while reading the text.
- CO3:** Critically read and analyse the various genres of African literature. (Understanding)
- CO3:** Apply postcolonial theories in reading of the texts. (Applying)
- CO5:** Analyse the various circumstances that surrounds African writing in English. (Analysing)
- CO6:** Summarise and interpret the various themes widely explored in African writing in English. (Evaluating)
- CO7:** Assess and evaluate the plot, theme, characters and context of the selected texts. (Evaluating)
- CO8:** Construct an innovative theoretical reading of the text. (Creating)
- CO9:** Generate new interpretation of the novels based on African context. (Creating)

Suggested Readings

1. Agarwala, Shyam S. *The African Fiction*. Prestige Books, 2000.
2. Balibar, Etienne and Wallerstein, Immanuel. *Race, Nations, Class Ambiguous Identities*. Verso Publication, 1991.
3. Bayoumi, Moustafa and Rubin, Andrew. *The Edward Said Reader*. Vintage Books, 2000.
4. Gera, Anjali. *Three Great African Novelists*. Creative Books, 2001.
5. Olaniya, Tejumela. Quayson, Ato. *African Literature- An Anthology of Criticism and Theory*. Blackwell Publishing, 2007.
6. Pandurang, Mala. *Post-Colonial African Fiction, The Crisis of Consciousness*. Pencraft International, 1997.

LSDW0061: INDIAN DIASPORIC WRITINGS**(4 Credits- 60 hours)**

Objective: *The course aims to acquaint the students with the 'fight for identity' amongst the Indian diaspora. The course also aims to give an insight into the globalised Indian literature of the modern century.*

Module I: Introduction (15 hours)

Diaspora literature- meaning and features, Diaspora conditions and sensibilities, Role of memory, Cultural displacement, Nation and identity, Memory, Indo-American Diaspora, Main issues in Indian diaspora literature.

Module II: Selected Fiction (25 hours)

- a. The Namesake- Jhumpa Lahiri.
- b. The Jaguar Smile- Salman Rushdie

Module III: Selected Travel Texts (20 hours)

- a. The Middle Passage- V.S.Naipaul.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the various attributes of the Indian diaspora and the 'ambivalence' of their attitudes towards their own motherland as well as their adopted homeland. (Remembering)
- CO2:** Recall the cultural manifestation in the representative works of the Indian diasporic writings. (Remembering)
- CO3:** Demonstrate the quest for cultural identity on the part of the citizens of Indian diaspora and would be able to understand the psychological, social and political problems associated with diaspora culture. (Understanding)
- CO4:** Apply the themes of these texts to further explore the conscientiousness of relationship between the 'homeland' and the 'diaspora'. (Applying)
- CO5:** Discover our own country from a different prism through the eyes of writers who have lived in a composite culture. (Analysing)
- CO6:** Assess and evaluate the selected texts vis -a - vis their context and socio political and cultural background. (Evaluating)
- CO7:** Discuss, summarise and critically appreciate the selected poems and other literary texts. (Creating)
- CO8:** Construct and evaluate the theoretical readings of the various texts. (Creating)
- CO9:** Create an interpretation of the texts in the context of diaspora conditions. (Creating)

Suggested Readings

1. Appudurai, Arjun,. *Modernity at Large: Cultural Dimensions of Globalization*. University of Minnesota Press, Minneapolis, 2005
2. Anderson, Benedict. *Imagined Communities*. Verso, London, 1994
3. Khair, Tabish, Babu *Fictions: Alienation in Contemporary Indian English Novels* ; Oxford University Press, New Delhi, 2001
4. Mukherjee, Meenakshi. *The Twice Born Fiction*. Pencraft, New Delhi, 2001

LSCT0062: LITERARY AND CULTURAL THEORY: 20TH CENTURY AND AFTER

(3Credits-45 Hours)

Objective: *The course would acquaint the students with the works of significant critics. The course would familiarise the students with important critical movements and enable them to apply principles of criticism to literary text. The course would encourage them to undertake further reading in critical movements and critical theory and acquaint with the intellectual shifts in the reading of culture, language and literature in the 20th Century and later.*

Module I: Twentieth Century Criticism (12 hours)

- a. T.S. Eliot's Impersonality Theory, Objective Correlative, Dissociation of Sensibility.
- b. F.R. Leavis- Enactment, Literary Criticism & Philosophy.
- c. William Empson- Ambiguity
- d. New Criticism

Module II: Literary and Cultural Theory: 20th Century and After (16 hours)

- a. Russian Formalism- Defamiliarization, Foregrounding
- b. Mikhail Bakhtin's Dialogism and Polyphony
- c. Psychoanalysis
- d. Reader Response Theory

Module III: Critical essays (17 hours)

- a. "Structure, Sign and Play in the Discourse of Human Sciences- Jacques Derrida
- b. The Metaphysical Poets – T.S. Eliot

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the practical utility of these critical theories of the 20th century and later. (Remembering)
- CO2:** Explain the genesis and growth of the various critical fields and their use in analysing literary texts. (Understanding)
- CO3:** Utilize the contemporary theories in analysing the texts that they study in future. (Applying)
- CO4:** Make use of the theories in their subjects and would be able to generate a new approach of looking at literary texts. (Applying)
- CO5:** Estimate the texts in terms of their political, social and psychoanalytical, implications. (Evaluating)
- CO6:** Develop a more profound critical approach after the study of these theories. (Creating)

Suggested Readings

1. Cuddon. *A Dictionary of Literary terms and Theories* , Penguin
2. Wimsatt and Brooks eds. *Literary Criticism: A Short History* , Indian ed., Oxford Book Company
3. Selden, Widdowson and Brookereds, *A Reader's Guide to Contemporary Literary Theory*, 5th Edition , Indian ed. Cambridge University Press.

LSWL0063: WOMEN AND LITERATURE

(3 Credits-45 hours)

Objective: *The course is designed with the purpose of introducing students to the distinctive flavour of literature written by women. Its aim is to familiarize them with feminist theories in the light of*

the selected texts. The students are expected to examine issues related to women's experience and representation socially, culturally and psychologically in the prescribed texts.

Module I: Selected Poetry (12 hours)

- a. *Lady Lazarus* by Sylvia Plath
- b. *The Cry of the Children* by Elizabeth Barrett Browning
- c. *A Bird Came Down* by Emily Dickinson
- d. *The Four Ages of Man* by Anne Bradstreet.

Module II: Selected Novels (18 hours)

- a. *Clear Light of Day* by Anita Desai
- b. *Mrs Dalloway* by Virginia Woolf

Module III: Selected Feminist Theories (15 hours)

- a. Prejudice Against Women From "Women in The 19th Century" by Margaret Fuller.
- b. *A Room of One's Own* (Section 1&2) by Virginia Woolf

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the literature by women in English. (Remembering)
- CO2:** Explain and comment upon poetry, novels produced by women. (Understanding)
- CO3:** Apply feminist theories and feminist reading techniques to critically interpret the selected texts. (Applying)
- CO4:** Analyse the contribution of women writers to the literary tradition of English Language (Analysing).
- CO5:** Discuss and summarise the selected texts and critically appreciate the themes and issues in them. (Creating)
- CO6:** Assess and evaluate the essence of women's literature and appreciate their experiences and representations in literature. (Evaluating)

Suggested Readings

1. Selected Texts.
2. Butler, Judith. *Undoing Gender*, Routledge, 2004
3. Goodman, L. *Literature and Gender*. Routledge, 1996

LSEL0064: ENGLISH LANGUAGE AND LINGUISTICS II

(3 Credits-45 hours)

Objective: *The purpose of this course is to familiarize students with the development of English language from its origin to the modern age with its underlying theories of origin. The course will also introduce the students to the basic concepts of linguistics and its different levels namely phonetics, semantics, morphology, sociolinguistics. Moreover, the course will also introduce the students with some important critical concepts of literature.*

Module I: Origin and Development of English Language (8 hours)

Origins of language: Divine Source, Natural Sound Source, Social Interaction Source, Physical Adaptation Source, Genetic Source, Tool-making Source; Theories of language Origin: Ding-dong Theory, Pooh-pooh Theory ; Foreign Influences on English Language: French influence, Greek Influence, Latin Influence, Scandinavian Influence etc..

Module II: Introduction to linguistics (15 Hours)

Levels of linguistics: **Morphology:** free and bound morphemes, affixes, morphophonemics, word, clauses and phrases, Word Formation, Changing of meaning(word) **Semantics:** different aspects of meanings, lexical relations, synonymy, hyponymy, antonymy, homonymy, polysemy, denotation, connotation, collocation, association, prototypes; entailment, presupposition. **Sociolinguistics:** Language varieties, dialect, idiolect, register, isoglosses, dialect boundaries, diaglossia, pidgin and creole, speech community, speech event, speech situation, speech acts

Module III: Critical Literary Terms (22 hours)

Aesthetism, expressionism, impressionism, affective fallacy, alienation effect, ambiguity, anxiety of influence, binary opposition, association of Ideas, dissociation of sensibility, objective correlation, foregrounding, cannon of literature, pragmatism, carnivalesque, philosophical optimism, humanism, essentialism, intentional fallacy, hermeneutics, negative capability ,paradox,

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define basic concepts in language and linguistics. (Remembering)
- CO2:** Compare the linguistic dichotomies like synonymy, hyponymy, antonymy, homonymy, polysemy, denotation, connotation, collocation, association. (Understanding)
- CO3:** Identify and recognize the different levels of language organisation. (Applying)
- CO4:** Analyse the various theories and concepts of English language. (Analysing)
- CO5:** Evaluate different critical terms in different literary writings. (Evaluating)
- CO6:** Develop and summarise the basic concepts of linguistics and literature. (Creating)

Suggested Readings

1. Abrams, M.H. *A Handbook of Literary Terms*,2009,Cengage Learning India, New Delhi
2. Balasubramoniam, T. *A Textbook for English Phonetics for Indian Students*, Macmillan, New Delhi
3. Yule, George, *The Study of Language* ,fourth edition, Cambridge university Press, 2010 New Delhi
4. Wood, F.T. *An outline history of the English language*, Macmillan,1941, New Delhi

LSSM6005: SEMINAR AND PRESENTATION I

(1 Credit)

Objective: *As a preliminary stage, the course will engage students in the integrated activities of reading, research, discussion and composition around a particular topic/ theme or subject. At its core, this course is designed to provide students with opportunities for both sustained, rigorous investigation of a topic and close faculty-student interaction. Students will gain a deeper appreciation of the role of writing in scholarly investigation, as they refine, adapt and expand their abilities to absorb, synthesize and construct arguments in close-knit community.*

Module I: Introduction to Seminar (2 hours)

Basics of Seminar:

- a) Definition of Seminar
- b) Types of Seminar: Students Seminar, National Seminar, International Seminar.

Purpose of the seminar.

- a) The object of study
- b) The scope of study

Module II: Introduction to Seminar (3 hours)

Methodology:

- a) Steps to write a seminar paper/Research Methodology.
- b) Topics of the seminar paper.

Presentation:

- a) How to present a seminar paper: paralinguistic features.
- b) Mode of Presentation: Essay-type Presentation, Paper Presentation, Powerpoint(Ppt.) Presentation

Module III: Practical (15 hours)

- a) Two presentations per period.
- b) Each will be allotted 10-15 minutes for presentation.

Followed by a discussion and commentary on the paper presented.

COURSE/LEARNING OUTCOMES

At the end of this Seminar students will be able to:

- CO1:** Define academic writing, seminar presentation and publication. (Remembering)
- CO2:** Identify research topics for sustained and rigorous investigation so that original write-ups can be developed. (Applying)
- CO3:** Assess and evaluate the various works of literature to write research reports and papers. (Evaluating)
- CO4:** Create write-ups for scholarly journals by doing analysis of textual evidence. (Creating)
- CO5:** Develop critical reading, research, discussion and composition around a particular topic/ theme or subject. (Creating)
- CO6:** Estimate and expand their abilities to absorb, synthesize and construct arguments in close-knit community. (Creating)

Suggested Readings

1. Correa, Delia Da Souza & Owens, W.R. The Handbook to Literary Research
2. Kothari, C. R. & Gaurav Garg. Research Methodology: Methods and Techniques
3. MLA Handbook for Writers of Research Papers, Eighth Edition.

LSCE6001: COMMUNICATION PRACTICE LABORATORY I**(1 Credit)**

The following are some of the tasks that a student should be able to perform.

1. Take passages of descriptive, expressive and social functions and Analyse them.
2. Expressive (exposing feeling) language in English and your mother tongue.
3. Make a list of sexist language (e.g. poetess, chairman)
4. Say formulaic expressions (Thank you, sorry, hello, that's right, etc.) with proper intonation.
5. Make a list of words which should be avoided because they sound pompous. Which words would you use instead of them?
6. Take similar vowels and consonants and practice them in pairs of words.
7. Practice stress and intonation in connected speech.
8. Conversation practice in familiar situations (Play the role of a tailor and customer, for example)

9. Ask for specific information (Can you tell me where the railway station is?)
10. Making a request (Can I borrow your scooter, please?)
11. Asking for permission (Do you mind if I smoke?)
12. Say the following pairs of words: beg, bag, full, fool, sit, seat, etc. and collect fifty such pairs.
13. Collect words which are used as nouns, verbs and adjectives and pronounce them correctly according to their context: progress, object, record, perfect, etc.
14. Collect words and pronounce them with correct stress (education, examination, village, etc.)
Practice the following in the Language Lab with audio-visual aids:
 - Listening, repeating, recording and comparing consonant sounds and vowel sounds in the English Language
 - Pronunciation of mono-syllabic and multi-syllabic words with proper stress pattern
 - Pronunciation of two or three-worded phrases with proper stress and intonation
 - English conversation in various contexts

LSCE6002: COMMUNICATION PRACTICE LABORATORY II

(1 Credit)

The following are some of the tasks a student should be able to perform:

1. Write a paragraph with the topic sentence "Protection of environment should not be at the cost of development". Identify the supporting details and sentence connectors.
2. Make notes from a given passage.
3. Prepare a short bibliography on the list of books prescribed in this course.
4. Write a letter complaining to a firm which supplied defective computers.
5. Write a functional CV of your own.
6. Prepare an agenda of a mock meeting.
7. Imagine that you are chairing a meeting. How would you go about it?
8. How would you propose a vote of thanks?
9. Make an oral presentation on a new product your company has brought out/ make seminar presentations.
10. Make a checklist for preparing for an interview.
11. Hold a mock job interview.
12. Prepare an agenda for a meeting you are organizing.
13. Prepare a report of a field visit.
14. Prepare minutes of a meeting that you attended.
15. Read the following chart and describe the information.
16. Arrange a group discussion on the topic "Globalization and India".

Practice the following in the language lab with the help of audio-visual aids:

- Soft skills – introduction with video lessons
- Conducting and facing mock-interviews with examples of video lessons
- Public speaking: students are asked to speak on certain topics
- Writing reports, applications and CVs
- Conducting Group discussions on familiar subjects
- Correction of errors in sentences

LSOC6004: ORAL COMMUNICATION PRACTICE LAB**(1 Credit) (L-T-P:0-0-2)**

(This unit involves interactive practice sessions in Language Lab)

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

Suggested Readings

1. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
2. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

LSSP6006: SEMINAR AND PRESENTATION II**(1 Credit)**

Objective: *The course will engage students in the integrated activities of reading, research, discussion and composition around a particular topic/ theme or subject. At its core, this course is designed to provide students with opportunities for both sustained, rigorous investigation of a topic and close faculty-student interaction. Students will gain a deeper appreciation of the role of writing in scholarly investigation, as they refine, adapt and expand their abilities to absorb, synthesize and construct arguments in close-knit community.*

Module I: Making an Argument in Research Paper (3 hours)

- a) Beginning: Choosing a topic
- b) Body of the Research Paper.
- c) Review of Literature.
- d) Developing an argument.
- e) Bringing a critical interpretation into writing.
- f) Framing the Conclusion.
- g) Referencing and Citation.
- h) Bibliography

Module II: Practical (17 hours)

- a) Two presentations per period.
- b) Each will be allotted 10-15 minutes for presentation.
- c) Followed by a discussion and commentary on the paper presented.

COURSE/LEARNING OUTCOMES

At the end of this Seminar students will be able to:

- CO1:** Define academic writing, seminar presentation and publication. (Remembering)
- CO2:** Identify research topics for sustained and rigorous investigation so that original write-ups can be developed. (Applying)
- CO3:** Estimate and expand their abilities to absorb, synthesize and construct arguments in close-knit community. (Evaluating)

CO4: Assess and evaluate the various works of literature to write research reports and papers. (Evaluation)

CO5: Develop critical reading, research, discussion and composition around a particular topic/ theme or subject. (Creating)

CO6: Compose write-ups for scholarly journals by doing analysis of textual evidence. (Creating)

Suggested Readings

1. Correa, Delia Da Souza & Owens, W.R. The Handbook to Literary Research
2. Kothari, C. R. & Gaurav Garg. Research Methodology: Methods and Techniques
3. MLA Handbook for Writers of Research Papers, Eighth Edition.

DEPARTMENT OF MASS COMMUNICATION

Vision

To be a centre of excellence in teaching, learning and research committed to mould ethical and socially responsible media professionals and entrepreneurs who can deliver professional content for diverse media platforms.

Mission

The Department of Mass Communication seeks to:

1. Achieve excellence in teaching, learning and research.
2. Promote critical thinking and problem solving skills.
3. Equip learners by combining the theoretical aspects with creative innovation and entrepreneurship practices.
4. Mold ethical and socially responsible media professionals and entrepreneurs.
5. Provide knowledge base and consultancy services to the community in the field of media and communication.

B.A MASS COMMUNICATION

The B.A Mass Communication programme of Assam Don Bosco University is a three-year (six semesters) programme consisting of theory and practical components, taught and learned through a combination of lectures, hands-on training and project execution.

PROGRAMME OUTCOME

- To introduce students to the various fields of mass communication.
- To equip students with the knowledge and understanding of theories and practices of communication that prepares them for future careers in mass media or further studies.
- To develop media technology skills in students and hone written and spoken communication skills essential for various media platforms.
- To enable students to write, deliver, and direct media programmes for varied audience need.
- To equip learners with an improved sense of self-confidence and self-efficacy and an awareness of their responsibilities as professionals in their field.

M.A MASS COMMUNICATION

The M.A Mass Communication programme of Assam Don Bosco University is a two-year (four semesters) programme consisting of theory and practical components, taught and learned through a combination of lectures, hands-on training, seminar, guest lecture, industry-academia interface and project execution. The programme offers specialization in the area of Print Media, Electronic Media and Communication for Development.

PROGRAMME OUTCOME

- To put communication practices in context of the social and cultural milieu of the region and to sensitize the students to use media for development, particularly in response to the needs of development communication in the state as well as in other parts of the northeastern region of the country.
- To demonstrate knowledge of the field of communication and the meaning and purpose of communication at the individual, group and societal level.

- To develop in-depth and professional skills in the area of print media, electronic media and communication for development.
- To demonstrate mastery of behaviors expected of competent media professionals in public performance of professional duties.
- To develop student's ability to test and evaluate research findings by demonstrating critical thinking and problem-solving skills.
- To develop skills of the various software and hardware used in the media industry.

MCRC0026: RURAL COMMUNICATION

(3 Credits – 45 hours)

Module I: Rural Communication and Participation (9 hours)

Community and Rurality-Concept and Definition, Communication Structure in Rural Settings-Folk and Traditional Media, Radio in Rural Communication, Community Media for Participatory Communication, Media and Communication Habits among Rural Communities, Media Penetration and Changing Rurality, Rural Communication Channels - Village Meetings; Village Market; Village fair, ICT and Rural Governance

Module II: Documenting Development in Rural Settings (9 hours)

Role of Communication in Rural Development, Documenting and Analysing Rural Development and Communication Agenda, Rural Health and Communication, Crisis and Natural Disaster Communication, Communicating Education and Agriculture, Communication and Extension Activities in Rural Settings

Module III: Evaluating Communication Needs in Rural Areas (9 hours)

Media and Communication Awareness among the Rural Mass, Assessing the Urban Rural Divide, Communication Divide-Knowledge and Infrastructure, Need for Media and Communication Literacy, Communication Research in Rural Context-Participatory Action Research-Survey, Natural Resource Management, and Human Rights

Module IV: Channelizing Development in a Rural Context (9 hours)

Contextualising Paulo Freire in the Process of Rural Development and Rural Communication, Context Specific Communication-Local Culture, Tradition, Language and Folk Art Forms, Intercommunity Communication, Utilising Intra-community Communication Channels, Disseminating Community Specific Information and Disbursing Local Knowledge, Participatory Action and Rural Development

Module V: Practicum (9 hours)

As part of this module, students are required to conduct community outreach programmes in rural areas on issues of rural development or design communication programmes for rural development.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the meaning and concept of community and rurality. (Remembering)
- CO2:** List the communication structures in rural settings. (Remembering)
- CO3:** Explain the role of communication in rural development. (Understanding)
- CO4:** Identify the rural communication channels. (Applying)
- CO5:** Analyse the social, economic, political and cultural framework of rural communication. (Analysing)
- CO6:** Justify the need for media and communication literacy. (Evaluating)
- CO7:** Design communication programme for rural development. (Creating)

Suggested Readings

1. Castello, R. D. (2006). *Framework on Effective Rural Communication for Development*. FAO: Rome.
2. Berrigan, F. J. (1979). *Community Communications: The Role of Community Media in Development*. UNESCO: Paris.
3. Freire, P. (1970). *Pedagogy of the Oppressed*. Continuum: New York.
4. Acunzo, M. (2014). *Communication for Rural Development: Sourcebook*. FAO: Rome.
5. Santucci, F. M. (2005). *Strategic Communication for Rural Development*. World Bank.

MCML0027 : MEDIA LITERACY**(3 Credits – 45 hours)****Module I: Introduction to Media Literacy**

Meaning and definition, Development and Importance of Media literacy, Media audience and media literacy approach, Types and Role of Media, Ownership Pattern and Control of Mass Media, Communication and Information Industry, Information Society, New Media Culture

Module II: Digital Media

Information and Communication Technology (ICT), Digital file types: documents, picture, video and audio, Editing Software: Print, Audio and video, creating digital media content with mobile phone

Module III: Computer Mediated Communication

Internet, Websites, Online Social media, User Generated Content in Social Media, SEO, Blogging, Live Streaming, E-Governance, Digital Marketing

Module IV: Convergence Media

E-newspaper and web-edition, Internet and Satellite radio, TV: Internet Television, YouTube Channel, MOJO, Interactive Learning, IT Act, 2000.

Module V: Confronting Issues

Digital divide, Cyber Security, Cyber Crime, Cyber Bullying, Digital Privacy and Piracy, Digital investigation, Misinformation and Disinformation, Propaganda and fake news, Physical and emotional effects of Digital Media

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept, meaning and characteristics of media industry. (Remembering)
- CO2:** Explain the functions of communication. (Understanding)
- CO3:** Choose appropriate media channels for effective communication. (Applying)
- CO4:** Distinguish different types of media. (Analysing)
- CO5:** Assess the emerging trends in communication industry. (Evaluating)
- CO6:** Create contents for various media platforms. (Creating)

Suggested Readings

1. Allan, S. & Thorsen, E. *Citizen Journalism: Global perspectives (Vol. 1)*. Peter Lang.
2. Baldwin, T. F., McVoy, D. S., & Steinfield, C. *Convergence: Integrating Media, Information & Communication*. Sage Publications.
3. Friedman, Batya & Nissenbaum, Helen. *Bias in Computer Systems*. Journal ACM Transactions on Information Systems, 1996, Vol. 14, No. 3, 330-47.
4. Feldman, T. (1997). *An Introduction to Digital Media*. Psychology Press.
5. May, Keenan; Newcomb, Peter. *How the Web Was Won*. Vanity Fair, 2008.
6. Castells, Manuel. *The Rise of the Network Society*. Wiley-Blackwell.

7. Hirst, Martin. *Navigating Social Journalism: A Handbook for Media Literacy and Citizen Journalism*. Routledge.
8. O'Reilly, Tim. *What Is Web 2.0?* O'Reilly Media.
9. Webster, F. (2014). *Theories of the Information Society*. Routledge.
10. James Potter, W. *Media Literacy*. Sage Publications.
11. Pernisco, Nick. *Practical Media Literacy: An Essential Guide to the Critical Thinking Skills for Our Digital World*. Createspace Independent Pub.

MCHD0028: HISTORY AND DEVELOPMENT OF COMMUNICATION MEDIA

(3 Credits – 45 hours)

Module I: Early history of Communication and the Printing Era (15 hours)

Communication in pre-historic era, Development of language and the oral tradition, Development of writing and record keeping, Development of printing in Europe and India, Development of newspapers and magazines, History of the Press in India: Colonial Period, National Freedom Movement, Post-Independence Era, Emergency and Post Emergency Era, Changing Readership, Print Cultures, Language Press

Module II: Development of Electronic Media (15 hours)

Development of Radio as a medium of mass communication, History of radio in India, Evolution of AIR Programming, Penetration of radio in rural India, Commercial Broadcasting, FM Radio, Overview of community radio, Development of Television as a medium of mass communication, History of Television in India, Television and the State 's Development Agenda; Prasar Bharati, Doordarshan, Cable and Satellite Television in India; Commercialization of Programming, The Coming of Transnational Television

Module III Development of Visual Media and Folk Media (15 hours)

The early years of Photography, Development of film as a medium of communication, History of Films in India, Issues and Problems of Indian Cinema

Types of folk media, Use of folk media, Advantages of folk media, Folk Media and communication, Role of folk media in promoting – health, education, Women's issues and Community development, Folk vs Electronic media

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Demonstrate an understanding of the history of media and the evolution of the mediated environment. (Understanding)
- CO2:** Organize a historical survey of media and diachronic analysis of a variety of mediated forms especially in the context of India. (Applying)
- CO3:** Identify the rich folk heritage of India and its role in grass-root communication. (Applying)
- CO4:** Evaluate the relationship between media and development in Indian culture, politics and society. (Evaluating)

Suggested Readings

1. Kumar, K.J. *Mass Communication in India*, Mumbai:Jaico Publishing House.
2. Odlyzko, A. *The History of Communication and its Implications for the Internet*, ATandT Labs-research, 2000 – e-book PDF.
3. Lievrouw, L.A. and Livingstone, Sonia. *The Handbook of New Media*, Sage Publications:New Delhi.
4. Schramm, Wilbur. *The Story of Human Communication: Cave Painting to Microchip*, Harpercollins College Div.

5. Parmar, Shyam. *Traditional folk media in India*, Routledge.
6. Luthra, H.R. *Indian Broadcasting*, Publication Division New Delhi.

MCPC0029: PHILOSOPHY OF COMMUNICATION

(3 Credits – 45 hours)

Module I: Concept of Communication (10 hours)

Elements of Communication, Process of Communication, Role; Scope and Need of Communication in Society, Barriers to Communication, Types of Communication, Types and Characteristics of Mass Media Audiences, Functions of Mass and Social Communication

Module II: Philosophy and Knowledge (20 hours)

Epistemology, Ontology, Dialectic – hegelian and universal, Buddhist philosophy of communication, Positivist and Post-positivist, Locke’s account of knowledge, Phenomenology, Hyper-realism, Hegemony, Political economy and Frankfurt School, Marxist Media Theory, Propaganda model

Module III: Psychoanalysis of Communication (15 hours)

Philosophy of the unconscious, Oedipus concept, Id, Ego, Superego, Sexuality, Idea of myth

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept of communication and list the types of communication. (Remembering)
- CO2:** Infer analytical reasoning. (Understanding)
- CO3:** Identify the philosophical and sociological bases of communication. (Applying)
- CO4:** Analyse critically the purpose of human communication. (Analysing)
- CO5:** Interpret and decode media contents wisely. (Evaluating)
- CO6:** Discuss the idea of knowledge and psychological understanding of media text. (Creating)
- CO7:** Develop within them the consciousness and see the positives and negatives of media in relation to the society. (Creating)

Suggested Readings

1. Easthope, Antony. *The Unconscious*. Routledge Publication.
2. Locke, John. *An Essay concerning human understanding*. Penguin.
3. Freud, Sigmund. *The Ego and the Id*. Martino Fine Books.
4. Barthes, Roland. *Mythologies*. Hill and Wang.
5. Marx, Karl. *Capital*. Wordsworth Editions Ltd.
6. Chomsky, Noam & Herman, S. Edward. (2002). *Manufacturing Consent: The Political Economy of the Mass Media*. Knopf Doubleday Publishing Group.

MCTC0030: THEORETICAL PERSPECTIVES OF COMMUNICATION

(4 Credits – 60 hours)

Module I: Theories and Models of Communication (15 hours)

Normative Theories, Democratic Participation Theory, Shannon-Weaver’s Mathematical Model, Aristotle’s definition of Rhetoric, Berlo’s SMCR Model, Westely and MacLean’s Conceptual Model, Newcomb’s Model of Communication, George Gebner’s Model, Schramm’s Interactive Model, Harold D. Laswell, De Fleur Model

Module II: Media Effects Theory, Psychological & Sociological Theory (15 hours)

Magic Bullet Theory, Two-Step Flow and Multi-Step Flow, Gate-Keeping Theory, Cognitive Dissonance Theory, Selectivity Theory, Cultivation Theory, Uses and Gratification Theory, Media Dependency Theory

Module III: Powerful Effects of Media (15 hours)

Dominant Paradigm, Spiral of Silence, Diffusion of Innovation, Agenda Setting, Marshall McLuhan's Medium Theory

Module IV: Semiology and Post Modern Theories (15 hours)

Semiotic theory and practice - historical context and doctrinal perspectives in semiotics, Models of the Sign and types of Codes, Structuralism; Formalism and Post-Structuralism

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept of semiotic theory and practice. (Remembering)
- CO2:** Demonstrate an understanding of the key terms, models, concepts and a range of theories about communication. (Understanding)
- CO3:** Explain the intersection between communication, in its many forms, and society and culture. (Understanding)
- CO4:** Apply communication theories and models in communication programmes and research. (Applying)
- CO5:** Analyse the link between major theoretical understandings of communication and the socio-cultural setting they have developed in. (Analysing)
- CO6:** Test the various models and theories of communication in real-world situation. (Creating)

Suggested Readings

1. Andal, N. (2004). *Communication Theory and Models*. Himalaya Publishing House
2. Baran, J. Stanley & Davis, K. Dennis. (2015). *Mass Communication Theory: Foundations, Ferment, and Future (6th Ed)*. Wadsworth.
3. McQuail, Dennis (2005). *Mass Communication Theory: An Introduction*. Sage
4. McLuhan, Marshall. (2008). *Understanding Media: The Extension of Man*. Routledge
5. McLuhan, Marshall. (2008). *The Medium is the Massage: An Inventory of Effects*. Penguin Books
6. Roger, E. Everett. (1997). *A History of Communication Study*. Free Press
7. Vivian, J. (1999). *The Media of Mass Communication*. Boston: Pearson

MCPJ0031: PRINCIPLES AND PRACTICES OF JOURNALISM

(4 Credits – 60 hours)

Module I: News & News Writing Principles (15 hours)

Concept of News, Types of News, News Values, Ethics, Concept of Reporting, Types of Reporting, Qualities of a Reporter, Roles and responsibilities of media journalists, Sources of news, Cultivation of sources, Emerging trends in journalism

Module II: News and Features format (12 hours)

News format vs. Features Format, Lead writing, Types of lead, Editorial, Feature, Column, Middle, Interviews, Reviews and Special Articles, Letter to Editors, Writing Headlines, Types of Headlines

Module III: Organisational Structure and Regulating Bodies (9 hours)

Editorial, Advertising, Marketing, Circulation, Accounts and Finance, News Production Hierarchy, Readership, Case study of news organisations, Registrar for Newspaper of India (RNI), Journalists' Union, Editors' Guild of India, Audit Bureau of Circulation (ABC), Press Information Bureau, Press Council of India (PCI), News Agencies

Module IV: Editing and Layout (9 hours)

Meaning, Purpose, Tools & Techniques, Media language, Editing Symbols, Style Sheets, Copy testing, Proof reading, Page Layout – modular; horizontal; vertical; photo placements; photo-caption; use of art work; breaking the layout, Agency Copy Editing, Page design – innovations in the edit page

Module V: Practicum (15 hours)

Basic of design, Introduction to page layout software, Field reporting and publication

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept, meaning and function of journalism. (Remembering)
- CO2:** Classify different types of news media. (Understanding)
- CO3:** Explain the role and responsibilities of a journalist. (Understanding)
- CO4:** Apply the concepts and techniques of journalism in news reporting. (Applying)
- CO5:** Analyse the role of news media in society. (Analysing)
- CO6:** Compose, produce and edit news stories. (Creating)

Suggested Readings

1. Berkowitz, Dan. (1997). *Social Meanings of News – A Text Reader*. London: Sage Publication
2. Branston, G. and Stafford, R. (1997). *The Media Student's Handbook*. London: Routledge.
3. Fedler F, et.al. *Reporting for the Media*. London: Oxford University Press.
4. Hough, G.A (1988). *News Writing*. New Delhi: Kanishka Publications
5. Hendricks, John A (2010). *The Twenty-First-Century Media Industry, Economic and Managerial Implications in the Age of New Media*. Lexington Books.
6. Kamath, M.V (1995). *The Journalists Handbook*. New Delhi: Vikas Publishing House.
7. *NDTV Style Book*. New Delhi
8. *The Statesman Stylesheet*. Kolkata
9. Parthasarathi, R (2009). *Here is the News: Reporting for Media*. New Delhi: Sterling Publishers
10. Schudson, Michael. (2003). *Sociology of News*. New York: W.W.Norton & Company
11. Srivastava, K.M. (1995) *News Reporting and Editing*. New Delhi: Sterling Publishers

MCID0032: INVESTIGATIVE AND DATA DRIVEN JOURNALISM**(3 Credits – 45 hours)****Module I: Basics of Investigative Journalism (10 hours)**

Concept; meaning; definition, Types and History, Sources, Research, Fact checking and editing, Role of investigative reporting in a democratic society, Trends in Investigative Reporting, Investigative techniques, Case Review, Associations of Investigative Journalists, The soul of the investigative reporter, ethics of investigative reporting

Module II: Digital Investigation (8 hours)

Understanding Digital Investigation, Computer Assisted Reporting, Web research and data collection, Data Literacy, Data Mining Tools, Open Source Intelligence Tools (OSINT), Social Media Auditing, Online Fact Checking and Verification

Module III: Data Journalism (8 hours)

Concept, meaning, definition of Data Journalism, Data-driven Storytelling, Data Acquisition, Data Analytics, Reporting with Data, Public, Private and Open Source Database, Overcoming Information Overload

Module IV: Tools and Techniques of Data Driven Journalism (8 hours)

Analysis and Design, Tools and Techniques, **Challenges with Data: Finding and Cleaning, Statistical Tools and Methods, Open Source Software**

Module V: Practicum (11 hours)

Develop an investigative pitch/plan for a major investigative story, Data Visualisation, Online Fact Checking, and Social Auditing

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the meaning and concept of investigative and data journalism. (Remembering)
- CO2:** Demonstrate how to conduct news investigation. (Understanding)
- CO3:** Plan and execute investigative news reporting methodically and ethically. (Applying)
- CO4:** Analyse different sets of data and information. (Analysing)
- CO5:** Assess the risk involved in investigative reporting. (Evaluating)

Suggested Readings

1. Cairo, Alberto. *The Functional Art: An Introduction to Information Graphics and Visualization*. New Riders
2. Houston, Brant. *Computer-Assisted Reporting: A Practical Guide*. Routledge
3. Gray, Jonathan; Bounegru, Liliana and Chambers, Lucy. *The Data Journalism Handbook*. Shroff/O'Reilly.
4. Herzog, David. *Data Literacy: A User's Guide*. Sage Publication
5. Gaines, C. William. *Investigative Journalism: Proven Strategies for Reporting the Story*. CQ Press.
6. Houston, Brant. *The Investigative Reporter's Handbook: A Guide to Documents, Databases and Techniques*. Bedford/St. Martins.
7. Foreman, John W. *Data Smart: Using Data Science to Transform Information into Insight*. Wiley.
8. Mair, John; Keeble, Richard L. & Lucero, Megan. *Data Journalism: Past, Present and Future*. Theschoolbook.com.
9. Meyer, Philip. *The New Precision Journalism*. John Wiley & Sons, 1991.
10. Riche, Nathalie H; Diakopoulos, Nicholas; hurter, Christophe & Carpendale, Sheelagh. *Data-Driven Storytelling*. AK Peters/CRC Press.
11. Munzner, Tamara. *Visualization Analysis and Design*. AK Peters/CRC Press.

MCTS0033: THEORIES OF DEVELOPMENT COMMUNICATION AND SOCIAL CHANGE

(4 Credits – 60 hours)

Module I : Introduction to Development (15 hours)

Meaning, definition and process of Development, Growth and Development, Characteristics of Developing and Underdeveloped countries, Regional Development, Development Challenges, Emerging Issues in Development

Module II: Theories, Models and Approaches of Development (15 hours)

Basic Needs Model, Theories and Paradigms of Development – Unilinear, Non-unilinear, Dominant, Alternative and New paradigms of development, Dependency Model, Marxist concept of stages of

society, Social Responsibility Theory, Top Down (Trickle Down) Approach, Growth Pole Approach, Bottom Up (Grass Roots) Approach, Neo-Liberalism, New Millennium Development Goals.

Module III: Concepts, Theories and Models of Development Communication (15 hours)

Origin, Meaning, Concepts, Definition Media and Modernization, ICT and Development, Participatory Communication, Approaches to Communication for Development: Diffusion of Innovation, Magic Multiplier, Development Support Communication.

Module IV: Social and Behaviour Change Communication (15 hours)

Concepts of SBCC, Managing information for social change; individual level behavioural change, Models of Change: persuasion model; health belief model; stages of trans-theoretical model; socio-ecological model, Communication planning models: ACADA Model; P-Process; COMBI Model and Integrated Communication, Case studies

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic terms related to development & development communication. (Remembering)
- CO2:** Explain different models and approaches of development. (Understanding)
- CO3:** Develop communication strategy for development. (Applying)
- CO4:** Examine role of media in socio-economic development and social change. (Analysing)
- CO5:** Assess situation for communication intervention. (Evaluating)
- CO6:** Create advocacy and initiate for behaviour change through communication channels. (Creating)

Suggested Readings

1. Everett, Roger. (2003). *Diffusion of Innovations*. Free Press.
2. Gupta, VS. (2004). *Communication for Development and Civil Society*. Concept.
3. Manyozo, Linje. (2012). *Media, Communication and Development: Three Approaches*. London: Sage.
4. Paravala V & Malik K V. (2007). *Other Voices: The Struggle for Community Radio in India*. Sage India.
5. Prasad, Kiran. (2009). *Information and Communication Technology: Reinvesting Theory and Action*. New Delhi: BRPC.
6. Pieterse, Jan Nederveen. (2001). *Development Theory: Deconstruction/Reconstruction*. Vistaar.
7. PW Preston. (1997). *Development Theory*. Blackwell.
8. RK Ravindran. (2000). *Media in Development Arena*. Indian Publishers Distributors.
9. Srinivas Melkore & Steeves (2001). *Communication for Development in the Third World*. Sage.
10. VS Gupta. (2000). *Communication and Development-The Challenges of the Twenty-First century*. Concept Publishing.

MCRM0034: COMMUNICATION RESEARCH METHODOLOGY

(4 Credits – 60 hours)

Module I: Meaning and Objectives of Research (15 hours)

Media Research – Meaning; Scope; Objectives and Significance, Research Process, Formulation of Research Problem, Literature Survey, Research Design, Collection of Data, Developing a Questionnaire, Aids for Writing Research Reports – Bibliography; Footnote and Reference; Synopsis and Abstracts, Writing of Report; Summary; Executive Summary; Conclusion and Recommendation

Module II: Research Methods and Applications (20 hours)

Techniques of Data Collection – Observation; Questionnaire and Interview; Content Analysis, Qualitative Methods - Field Experiments; Ethnography; Focus Groups; Case Studies, Quantitative Research Methods - Experimental Research; Survey Research; Content Analysis, Audience Research in Print and Electronic Media

Module III: Statistical Applications in Communication Research (25 hours)

Statistics – Definitions; Uses and Limitations, Classification and Tabulation of Data, Univariate and Bivariate, Diagrammatic and Graphic Presentations, Sampling - Types of Sampling; Guiding Principles of Sampling, Test of Hypothesis – Basics; Probability distribution; normal distribution; t-test; Chi-square test; Measures of Central Tendencies, Measure of Variability, Correlation - Computation of Product Moment; Correlation Co-Efficient; Spearman's Rank; Co-Efficient Correlation, Scaling Techniques – Arbitrary; Thurstone; Likert-Scale

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define meaning, scope, objectives and significance of media research. (Remembering)
- CO2:** Demonstrate appropriate methods for collecting and analysing research data. (Understanding)
- CO3:** Apply research methods related to the disciplinary areas of communication and media. (Applying)
- CO4:** Develop critical and analytical skills. (Applying)
- CO5:** Assess and appraise relevant literature. (Evaluating)

Suggested Readings

1. Wimmer, Roger D. and Joseph R. Dominick. *Mass Media Research: An Introduction*. Belmont: Wadsworth Publishing Company. 1998
2. Agarwal, Binod C., and S.R. Joshi and Arbind Sinha. *Communication research for Development: The ISRO Experience*. New Delhi: Concept Publishing Company. 1986.
3. Berger, Arthur Asa. *Media Research Techniques*. Thousand Oaks: Sage Publication. 1998.
4. Berger, Arthur Asa. *Media Analysis Techniques*. Beverley Hills: Sage Publications. 1998.
5. Gibaldi, Joseph and Walter S. Achtert. *MLA Handbook for Writers of Research Papers*. New Delhi: Affiliated East-West Press Pvt. Ltd. 1994.
6. Kothari, C.R. *Research Methodology Methods and Techniques*
7. Krishnaswamy, O.R. *Research Methods in Social Sciences*
8. Natziger, Ralph O. and David M. White. *Introduction to Mass Communication Research*. Baton Rouge: Louisiana State University Press. 1981.
9. Oliver, Paul. *Writing your thesis*. New Delhi: Sage Publications. 2008
10. Stempel, Guido H. (III) and Bruce H. Westley (Ed). *Research Methods in Mass Communication*. Englewood Cliffs: Prentice-hall Inc. 1981

MCDM0035: DIGITAL MEDIA

(3 Credits – 45 hours)

Module I: Digital Communication (12 hours)

New Media and Information Society, The Characteristics of New Media, Hyper-textuality and Hyper Mediacy, New Media and Visual Culture, Interactivity, Mobile journalism (MOJO)

Module II: The Internet and the Public Sphere (10 hours)

Online News; Digital Economics, Access and the Digital Divide, Economics and Networked Media Culture, The social form of New Media, Globalisation; neo-liberalism and the Internet

Module III: Media, Culture, Technology and Society (13 hours)

Relationship between Space and Identity, Ideological Connotation of the new Cyber and Participatory Culture, Intensity of Change; Intensifying Process of Globalization, Cyber-Culture, Fragmentation and Convergence

Module IV: Online Media Praxis (10 hours)

Challenges and Opportunities for Journalists - Readers as Publishers, New Media Journalism; Online Edition of Newspapers-Management and Economics, Security Issues in Using Digital Technology (Malware, Phishing, Identity Thefts), Social Media and Citizen Journalism, E-governance, Internet and Live Streaming

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define new media and information society. (Remembering)
- CO2:** List the characteristics of new media. (Remembering)
- CO3:** Show their ability to engage in contemporary debates on the implications of digital culture. (Understanding)
- CO4:** Demonstrate the ability to deal critically with social analysis of popular media. (Understanding)
- CO5:** Analyse key issues emerging from recent development into digital culture. (Analysing)

Suggested Readings

1. Aitchison, J. (2003). *New Media Language*. London: Routledge
2. Dewdney, Andrew and Ride, Peter. *The New Media Hand Book*. Routledge: London.
3. Fuchs, Christian and Sandoval, Marisol (Eds.,) (2006). *Critique, Social Media and the Information Society*. London: Routledge
4. Dovey, J. (2009). *New Media: A Critical Introduction*. London: Routledge
5. Creeber, Glen and Martin, Royston (Eds.,) (2009). *Digital Cultures: Understanding New Media*. UK: Open University Press
6. Hansen, Mark B. N. 2004. *New Philosophy for New Media*. Massachusetts: MIT Press.
7. Harries, Dan (Ed.,) (2002). *The New Media Book*. UK: Palgrave MacMillan
8. Lievrouw, Leah A. & Livingstone, S. (2006). *Handbook of New Media*. London: Sage
9. Martin Lister, Jon D., Seth Giddings, Iain Grant, Kieran K. (2009). *New Media: A Critical Introduction*. London: Routledge.
10. Papachirisi, Z. (Ed.,) (2011). *A Networked Self: Identity, Community and Culture in social Networking Sites*. London: Routledge

MCPC0105: PROFESSIONAL COMMUNICATION**(3 Credits – 45 hours)**

Objective: *To equip learners with the essential knowledge, skills and attitudes for effective communication; To equip learners with the essential knowledge and techniques of professional writing; To enable learners to dynamically engage with presentation and communication skills; To learn the role of non-verbal communication in effective communication.*

Module I: Professional writing (15 hours)

Principles and elements of professional writing, Types of writing - business letters/correspondences; professional emails; press releases; reports; features/articles, Copy-editing and proof-reading; Digital content curation

Module II: Professional Presentation Skills (15 hours)

Presentation skills, 7 P's of presentation, Use of visual aids in a presentation, Non-verbal communication in a presentation situation

Module III: Verbal, Non-verbal and Listening Skills (15 hours)

Strategies for effective oral communication, Developing the right speaking skills - one-to-one conversations; interview; group and public speaking; handling criticism, Effective listening skills and interpretation, Non-verbal communication

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the meaning and concept of communication. (Remembering)
- CO2:** Demonstrate a holistic understanding of the principles of professional communication. (Understanding)
- CO3:** Demonstrate presentation skills using a range of materials including text, visual, sounds and technology. (Understanding)
- CO4:** Identify the principles and elements of professional writing. (Applying)
- CO5:** Develop professional writing skills in business letters, email, press release, articles etc. (Applying)
- CO6:** Explain the nature and importance of body language and listening skills in acts of communicative intention. (Evaluating)
- CO7:** Build the essential skills to effectively work in various professional contexts. (Creating)

Suggested Readings

1. Hargie, Owen. *Skilled Interpersonal Communication: Research Theory and Practice*. Routledge.
2. Hardman, Emilia. *Active Listening 101: How to Turn Down Your Volume to Turn Up Your Communication Skills*. Kindle Edition.
3. Krishnamacharyulu and Lalitha. *Business Communication*. Himalayan Publishing House, New Delhi.
4. Anderson, Chris. *TED Talks: The Official TED guide to Public Speaking*. Nicholas Brealey Publishing.
5. Matsumoto, David; Frank, Mark G. and Hwang, Hyi Sung. *Nonverbal Communication: Science and Applications*. Sage Publications.

MCBP0106 : BASICS OF PHOTOGRAPHY

(3Credits – 45 hours)

Course Objective: *To provide learners an introductory yet broad-based understanding of digital photography; To make learners proficient in digital image post-production and presentation techniques; To equip learners with all aspects of creative image production including capturing and rendering of lights; editing and critique; and print production.*

Module I: Digital Camera Basics (15 hours)

Essential components of digital camera, Digital camera sensors, Digital image capture and file formats, Photographic lenses, Exposure triangle, Exposure meter, Exposure Stops, Focal length, Depth of field, Image stabilization, White balance, Lens filters, Camera kits and accessories

Module II: Photographic Lighting (9 hours)

Basic characteristics of lighting, Basics optics – wavelength and colour; shadows; reflection and refraction, Recognizing sources of light, Light quality and intensity, Relationship between light source and subject, Manipulating natural light, Lighting equipment, Practical lighting problems

Module III: Photographic Composition (8 hours)

Elements of photographic design – lines; shape and form; texture; pattern, Arranging visual elements in a frame – foreground; background and middle ground; rule of thirds; space, Understanding perspective, Framing and formatting, Balance and sense of scale, Rhythm and repetition

Module IV: Digital Image - Post-production and Presentation (13 hours)

Overview, Organising photographs, Saving digital file, Basic image editing, Getting one's work noticed, Pictures on the world wide web, Building one's own site, Getting connected, Stock photography

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Show working knowledge of digital SLR cameras. (Remembering)
- CO2:** Demonstrate an understanding of composition and image design process. (Understanding)
- CO3:** Apply image editing and output techniques. (Applying)
- CO4:** Analyse and critique one's own artistic output. (Analysing)
- CO5:** Determine safe and responsible work practices. (Evaluating)
- CO6:** Plan ways to promote ones work on the internet. (Creating)

Suggested Readings

1. Langford, Michael; Fox, Anna and Smith, Richard Sawdon. *Langford's Basic Photography*. Focal Press.
2. Peterson, Bryan. *Understanding Exposure*. Amphoto Books.
3. Comon, Paul R. *Fundamentals of Photo Composition*. Sterling Publications.
4. Judge, Al. *Mastering Digital Cameras*. Createspace Independent Pub.

MCHE0107: HISTORY AND EVOLUTION OF MEDIA**(4 Credits – 60 hours)**

Course Objective: *To acquaint learners about history and development of various mass media channels; To impart knowledge on how different technological transitions have shaped media industries; To introduce learners to the evolution of digital media and other emerging trends.*

Module I: Origin of Press and Evolution (15 hours)

Invention of Printing Press, Evolution of Print Media, Development of Press in India

Module II: Radio and Its Evolution (15 hours)

The Coming of Radio, History of Radio Broadcasting, Development of AIR; FM Radio; Community Radio Stations

Module III: Television and Its Evolution (15 hours)

Coming of Television, Public and Private Broadcasting System, Coming of Cable TV; Satellite TV; Direct-To-Home (DTH)

Module IV: Digital Media and its Revolution (15 hours)

Birth of Internet and Online Newspaper, Emergence of Web Radio, Web TV, Social Media

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** List the major historical events in the development of mass media globally. (Remembering)

- CO2:** Outline the history of the press, radio broadcasting and television in India. (Understanding)
- CO3:** Elaborate the contribution of Christian missionaries in the development of press in India. (Understanding)
- CO4:** Explain the role of Prasar Bharati. (Understanding)
- CO5:** Explain the various committees/acts related to radio and television broadcasting in India. (Understanding)
- CO6:** Identify the role of community radio. (Applying)
- CO7:** Distinguish between cable television, satellite television and direct-to-home. (Analysing)
- CO8:** Develop an understanding of the evolving role of social media messages on individual and the society. (Creating)

Suggested Readings

1. Kumar, Keval J. Mass Communication in India. Jaico Publishing House, New Delhi.
2. Schramm, Wilbur. The Story of Human Communication: Cave Painting to Microchip. Harpercollins College Div.
3. Luthra, H.R. Indian Broadcasting. Publication Division, New Delhi.
4. Ahuja, B.N and Chhabra, S.S. History of Indian Press: Growth of Newspapers in India. Surjeet Publications, Delhi (1996)
5. Lievrouw, L.A. and Livingstone, Sonia. The Handbook of New Media. Sage Publications, New Delhi.

MCCM0108: COMMUNICATION THEORIES AND MODELS

(3 Credits – 45 hours)

Objective: To introduce learners to the major theoretical positions used in communication studies; To equip learners with knowledge of the basic communication models, key terms and concepts used in the discipline; To introduce learners to a broad range of theories in order to evaluate communication in its many forms and investigate its relationship to society and culture.

Module I: Introduction to Communication (5 hours)

Communication – Definition; Concept and Meaning, Communication Process; Elements of Communication, Types of Communication – Intrapersonal; Interpersonal; Group and Mass Communication, Barriers to Communication

Module II: Communication Models (8 hours)

Aristotle's Model, SMCR Model, Harold Lasswell's Model, Shannon and Weaver's Model, David Berlo's Model

Module III: Early Effects Theory (10 hours)

Magic Bullet/Hypodermic Needle Theory, Two Step Flow Theory, Multi Step Flow Theory, Diffusion of Innovation Theory, Cognitive Dissonance Theory

Module IV: Limited Effects Theory (12 hours)

Selective Exposure; Perception; Retention, Cultivation Theory, Uses and Gratification Theory, Dependency Theory, Agenda Setting Theory, Gate Keeping Theory

Module V: Normative Theories (10 hours)

Authoritarian Theory, Libertarian Theory, Soviet Communist Theory, Social Responsibility Theory, Democratic Participatory Theory

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept and meaning of communication. (Remembering)
- CO2:** List the types of communication. (Remembering)
- CO3:** Explain the different models of communication. (Understanding)
- CO4:** Illustrate the process of communication. (Understanding)
- CO5:** Identify the barriers to communication. (Applying)
- CO6:** Analyse the various theories of communication. (Analysing)
- CO7:** Develop critical thinking and analytical skills expressed in written and verbal modes. (Creating)

Suggested Readings

1. McQuail, Dennis. *McQuail's Mass Communication Theory*. Sage Publications, New Delhi.
2. Stevenson, N. (1997). *Understanding Media Culture: Social Theory and Mass Communication*.
3. Singhal, A. & Rogers, E. M. *India's Communication Revolution: From Bullock Carts to Cyber Marts*. Sage Publications, New Delhi.
4. Chandler, Daniel and Munday, Roy. *A Dictionary of Media and Communication*. Oxford University Press.
5. Fiske, J. (1997) *Introduction to Communication Studies*. Routledge, New York.

MCFM0109: TRADITIONAL FOLK MEDIA

(3 Credits – 45 hours)

Objective: *To acquaint learners with the definition, role and potential of folk media in contemporary times; to introduce learners to the scope and nature of traditional folk media in India; to explore the rich variety of folk media in Northeast India; to train learners in the various techniques of street play and puppetry performances.*

Module I: Meaning of Traditional folk media (7 hours)

Role and importance of Performing Arts; Types of Performing Arts; Definitions and types of Traditional Media; Strength and Advantages of Traditional Media; Status of Folk Media in India today; Challenges faced by Folk Media; Major forms of folk media in India

Module II: Nature and Scope of Folk and Traditional media (8 hours)

Participatory Communication and Folk Media, Folk Media and Its Role in Social Change, UNESCO's Recognition of Folk Media, Case Studies, Traditional Folk Media as Development Media, Differences Between Folk Media and Electronic Media. Impact on rural development, uses in different fields – Directorate of Field Publicity (DFP), Songs and Drama Division, NGOs, Social Action Groups

Module III: Traditional Media of Northeast India (7 hours)

Types of Traditional Folk Media in Northeast India, Musical Instruments and their social appeal in Northeastern Societies, Folk fusion, Representations of folk forms in North East, Various folk forms of Assam and its significance – Bihu songs, Lokageet, Bhaona, Lullabies, Ojapali, Ainaam, Sattriya, Borgeet

Module IV: Street theatre and Puppetry (8 hours)

Influence of folk theatre on street theatre, role of street theatre in the Indian Freedom struggle, street theatre for social change, origin of puppets, traditional forms of puppets, contemporary forms of puppet, window on the world puppets, use of puppets – entertainment; education; social education

Module V: Traditional Folk Media in practice (15 hours)

As part of the course students will be trained in various techniques of street play and puppetry. At the end of the semester the students will stage street play and puppet performance in the vicinity of the university.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the meaning and concept of traditional folk media. (Remembering)
- CO2:** List the general characteristics of folk media. (Remembering)
- CO3:** List the different varieties of folk media that are popular in India. (Remembering)
- CO4:** List the popular forms of folk media in Northeast India. (Remembering)
- CO5:** Identify the role of folk media in social change. (Applying)
- CO6:** Apply puppetry and street theatre for community outreach programme. (Applying)
- CO7:** Examine the role of street theatre in India. (Analysing)
- CO8:** Discuss the history and use of puppetry in India. (Creating)

Suggested Readings

1. Parmar, Shyam. Traditional Folk Media in India. Gekha Books.
2. Ghosh, Sampa and Banerjee, K. Utpal. Puppets in India and Abroad. National Book Trust, New Delhi.
3. Kumar, Sathish. Role of Traditional Folk Arts as Media of Mass Communication. Lambert Academic Publishing, London
4. Naskar, Reshmi. The Role of Folk Media and Participatory Communication in Rural Development: An Exploratory Case Study of Combating Child Marriage in Malda. Global Media Journal. Volume 2, No.2, December 2011, pp 1-9.
5. Bhushan, Chandra. Assam: Its Heritage and Culture. Kalpaz Publications, New Delhi.

MCIC0110: INTRODUCTION TO COMPUTER APPLICATION

(3 Credits – 45 hours)

Objective: To provide learners an introductory understanding of word-processing tool; To make learners proficient in the fundamentals of an image editing software; To equip learners with fundamentals of creative page layout techniques.

Module I: Word Processing Tool (10 hours)

Word Processing Basic: Introduction to Word Processing; Getting started with Word Processing software; Menu Bar; Using the Help; Using icons below menu bar; saving documents; Page Setup; Printing of documents; Paragraph marks and inter word space.

Text creation and Manipulation: Paragraph and Tab setting; Text selection; Cut, Copy, and Paste; Font and Size selection; Text Alignment; Font size and colour; Paragraph Indenting; Bullets and Numbering; Handling Multiple Documents: Opening and closing multiple documents; Cut, Copy, and Paste across multiple documents; Table Manipulation: Rows, Columns and Cells; Draw table; Changing Cell Width and Height; Text Alignment inside cells; Borders for Table; Printing: Print setting; Print Preview; Print selected page

Module II: Image Editing Tool (15)

Introduction to image editing tool, Getting started with image editing software, Menu Bar, Using the Help, Using icons below menu bar, Saving documents, Page Setup, Printing of documents, Toolbox, Layers and importance of layers, Filters, Layer Styles, Adjustment Layers, Retouch and Healing Tools, Type Tool, Free Transform Tool, Master Selection Tools, Installing And Managing Brushes And Other Presets, Image editing actions and common effects, Colour correction tools, Print setting

Module III: Page Layout Tool (20)

Introduction to page layout tool, Getting started with Page Layout software, Menu Bar, Using the Help, Using icons below menu bar, Saving documents, Page Setup, Printing of documents, Create; Edit; and Format text and paragraphs, Working with multiple images in a document, Drawing tools, Work with multiple pages; margins and columns, Working with master page, Customizing page layout software, Selecting page size, Working with text, Working with objects and layers, Applying and managing color, Applying Fills; Strokes; and Effects, Publish work as PDF, Proof-reading, Print setting

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Demonstrate competency in image editing. (Understanding)
- CO2:** Develop skills in the designing of print and on-line publications using a page layout tool. (Applying)
- CO3:** Utilize the various techniques of a word-processing tool. (Applying)
- CO4:** Apply the conceptual and technical aspects of design such as logo, banner, brochure, poster-making etc. (Applying)

Suggested Readings

1. Jain, Satish and Geetha, M. MS-Office 2010 Training Guide. BPB Publications.
2. Weverka, Peter. MS-Office 2013 All-in-one for dummies. Wiley.
3. Adobe Photoshop Official Guide
4. Adobe Indesign official guide

MCLE0111: MEDIA LAWS AND ETHICS**(4 Credits – 60 hours)**

Objective: To introduce students on the constitutional provisions related to media in India while understanding Freedom of Speech and Expression, Freedom of the Press; RTI and Right to Privacy; To introduce learners to a broad range of specific ethical and legal issues pertinent to various aspects of the media in India; To expose students to the ethical issues in mass media for media producers as well as media consumers.

Module I: Introduction to Indian Constitution (20 hours)

Preamble-Salient Features, Fundamental Rights and Duties, Features of Article 19 (1A) and 19 (2), Directive Principles of State Policy, Indian Judiciary and Parliamentary System, Press as fourth estate of democracy

Module II: Media Laws (20 hours)

Freedom of Press and Reasonable Restriction, Defamation, Contempt of Court, Sedition and Obscenity, Emergence of Censorship, Vernacular Press Act, Right to Information Act, IT Act and Cyber Law 2000

Module III: Media and Ethical Principles (20 hours)

Importance of Media Ethics, Fairness and Objectivity, Right to Privacy, Ethics in Print and Broadcast Media, Code of Ethics in Advertising and Films

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Demonstrate an understanding of the salient features of the Indian Constitution. (Understanding)

- CO2:** Identify the legal issues relevant to media in India. (Applying)
CO3: Analyse a range of ethical issues, perspectives and debates relevant to media. (Analysing)
CO4: Evaluate the current situation of the press in India in terms of media ethics. (Evaluating)
CO5: Discuss the purpose and role of media professionals in modern society. (Creating)
CO4: Explain purpose and role of media professionals in modern society

Suggested Readings

1. Basu, D.D. (2004). Introduction to the Constitution of India. Prentice-Hall of India.
2. Thakurta, Paranjay Guha (2011). Media Ethics: Truth, Fairness and Objectivity. New Delhi: OUP
3. Manna, B. (2006). Mass Media and Related Laws in India. Academic Publishers.
4. Singh, P.P et. al. (1998). Media, Ethics and Laws. Anmol.
5. Prabhakar, M. et. al. (1999). A Compendium of Codes of Conduct for Media Professional. University Book House.

MCIJ0112: INTRODUCTION TO JOURNALISM

(3 Credits – 45 hours)

Objective: To introduce learners to the professional practice of contemporary journalism through consideration of the nature and role of news and current affairs in society; To equip learners with the skills required for reporting across media platforms; To engage learners in the analysis and production of journalism with a focus on news and current affairs.

Module I: Understanding News (5 hours)

News: Meaning; Definition; Nature, Elements and Types of News; News Value, Source of News; News Gathering; News Agencies, Structure of a news organisation, Skills of News Reporting

Module II: News Writing, Reporting and Editing (10 hours)

Writing Formats, Writing for Newspaper and Magazine, Writing for Electronic Media, Writing for Online media, Techniques of News Editing, Newspaper Size and Content, Masthead, Front Page, Placement of Photographs and Cartoons, Page Design, Editorial Page, Proof- Reading, Symbols, Style Sheets

Module III: Investigative and Data Journalism (10 hours)

Investigative Journalism - Concept; meaning and definition, Tools and techniques, Understanding online investigation, Open Source Intelligence Tools (OSINT)

Data Journalism - Concept; meaning and definition, Data literacy, Data visualisation, Analysis and design, Tools and techniques, **Challenges with data - finding and cleaning**

Module IV: Photojournalism (8 hours)

Photojournalism - Meaning; Types, Ethics of photojournalism, Photographing a single-image news and feature assignment, Techniques for developing and structuring professional calibre long-form photo stories, Edit; caption; keyword and organize photos

Module V: Practicum (12 hours)

Publication/Lab Journal, Field reporting, Layout Design, Photo Feature

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concepts, meaning and functions of news. (Remembering)
CO2: Classify different types of news media. (Understanding)
CO3: Apply the concepts and techniques of journalism in news reporting. (Applying)

- CO4:** Analyse ethical issues in journalism. (Analysing)
CO5: Explain the roles and responsibilities a journalist. (Evaluating)
CO6: Elaborate, produce and edit news stories. (Creating)

Suggested Readings

1. Srivastava, M.V. The Journalistic Hand Book. Sterling Publishers, New Delhi
2. Chadda, Sativa. Modern Journalism and News writing. Popular Prakashan, Bombay
3. Rangaswami, Parthasarathi. Basic Journalism. Macmillan India Ltd.
4. Kessler, Lauren & McDonald, Duncan. (1996). When Words Collide: A Media Writer's Guide to Grammar and Style. Belmont, California: Wadsworth.
5. Clark, Roy Peter. (2006). Writing Tools: 50 Essential Strategies for Every Writer. Little Brown.

MCMS0113: MEDIA AND SOCIETY

(4 Credits – 60 hours)

Objective: To provide learners with the opportunity to explore issues in the interaction between mass media and society; To provide an in-depth understanding of the impact of mass media; To provide learners with an understanding of mass media and its democratic influences and social functions; To explore the emerging trends in mediated communication.

Module I: Media and Democracy (15 hours)

Media and Modernization, Media and Culture - Mass culture; Popular culture; Cultural hybridity, Media; Public Sphere and Public Opinion, Media and Representation, Media Literacy;

Module II: Impact of Media (15 hours)

Media and Socialization, Media and Democracy, Media and Mobilization-Social; Political and Cultural, Mediated Culture and its Impact

Module III: Media and Social Issues (15 hours)

Media and Social Responsibility, Media and Human Rights, Sociology of News, Media; Conflict and Peace

Module IV: Emerging Trends in Media (15 hours)

New Media and Society, Globalisation and Media, Multicultural Society, Virtual Reality

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept and meaning of society. (Remembering)
CO2: Explain the role of media in the shaping and development of culture and society. (Understanding)
CO3: Develop an understanding of the democratic/political potential of mass media. (Applying)
CO4: Identify relationship between media and social issues and aspects of society. (Applying)
CO5: Distinguish between culture and tradition. (Analysing)
CO6: Examine the recent development in mass media and its social impact. (Analysing)
CO7: Discuss the cultural and social role of the media. (Creating)

Suggested Readings

1. IGNOU (1992) Introduction to Mass Communication
2. Kumar Keval J. (2012) Mass Communication in India, Jaico Publishing House, New Delhi, Fourth Edition
3. Schramm Wilbur, Roberts Donald F. (ed), (1971)The Process and Effects of Communication, University of Illinois Press.

4. Fiske John (1982) Introduction to Communication Studies, Routledge.
5. Rogers Everett M., A History of Communication Study, The Free Press

MCNE0117: INTRODUCTION TO NORTH EAST INDIA

(4 Credits – 60 hours)

Objective: To provide learners with an in-depth understanding of the history, geography, culture and politics of Northeast India; To acquaint learners on various socio-cultural, political and development issues of the region; To provide an understanding on International borders and its significance in the socioeconomic development of the region.

Module I: Physiographic Features (15 hours)

Natural resources – Landscape, Forest, Water, Cultivation, International Borders

Module II: Demographic Profile (15 hours)

Area, Race, Major Tribes, Population, Social structure

Module III: Cultural and Practices (15 hours)

Language, Religion and Festivals, Traditional beliefs and Practices, Customary Laws

Module IV: Challenges and Prospects (15 hours)

Inner Line Permit, Armed Forces Special Power Act (AFSPA), Human Rights, Socio-political movements, Immigration, Look-East Policy, Tourism and Cottage Industry

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the various physiographic features of northeast region. (Remembering)
- CO2:** Demonstrate understanding of the complex socio-cultural and political mosaic of the region. (Understanding)
- CO3:** Identify the various development issues in the region. (Applying)
- CO4:** Examine opportunities and challenges of the region. (Analysing)
- CO5:** Discuss policies for intervention in the Northeast region. (Creating)

Suggested Readings:

1. Baruah, Sanjib. Beyond Counter-Insurgency: Breaking the Impasse in Northeast India. Oxford University Press.
2. Das, Samir Kumar. Governing India's Northeast. Springer.
3. Singh, Thingam Kishan. Look East Policy and India's Northeast: Polemics and Perspectives. Concept Publishing Company.
4. Gill, Preeti. The Peripheral Centre: Voices From India's Northeast. Zubaan.
5. Verma, Rajesh. History of North East India. Mittal Publications.
6. Agnihotri, S.K and Ray, B. Datta. Perspectives of Security and Development in Northeast India. Concept Publishing.

MCRP0118: INTRODUCTION TO RADIO PRODUCTION

(3 Credits – 45 hours)

Module I: Writing for Radio (10 hours)

Characteristics of radio as a mass media, Formats of radio programming – spoken words and music, Radio scripting, Terminology and writing techniques of news on radio, Radio commercials/jingles, Radio interview, Radio discussion

Module II: Radio Production Technology (15 hours)

Basics of sound, Analogue and digital audio, Equipment for programme production, Microphone, Types of microphones, Audio cables and connectors

Module III: Audio Hardware and Field Recording (6 hours)

Hardware for audio recording, Microphone Selection, Audio recorders, Headphones, Recording audio in the field, Portable audio mixers, Sound cards, Digital Audio Workstations (DAW)

Module IV: Audio Post Production (14 hours)

Understanding sound recording, Single and multitrack recording, Understanding audio editing, Introduction to an audio editing software

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** List the characteristics of radio. (Remembering)
- CO2:** Explain radio production technologies. (Understanding)
- CO3:** Identify various career paths in community, commercial and government radio. (Applying)
- CO4:** Develop skills required for creating radio content as applicable to the radio industry. (Applying)
- CO5:** Experiment with audio editing and output techniques. (Applying)
- CO6:** Distinguish between analogue audio and digital audio. (Analysing)
- CO7:** Plan, record and edit radio programmes. (Creating)

Suggested Readings

1. Mcleish, Robert. *Techniques of Radio Production*. Focal Press.
2. Siegel, Bruce. *Creative Radio Productions*. Focal Press.
3. Kedia, Krishan K. *Writing for Radio and Television in India*. Cyber Tech Publications.
4. *Nine Components of Sound* [Video file]. (n.d.). Retrieved from <http://www.filmsound.org/articles/ninecomponents/9components.htm#Pitch>
5. Dobrian, C. (n.d.). *Digital Audio*. Retrieved from <http://music.arts.uci.edu/dobrian/digitalaudio.htm>

MCVC0119: VISUAL COMMUNICATION

(4 Credits – 60 hours)

Module I: Introduction to Visual Communication (10 Hours)

Visual communication - Definition; concept; nature and functions, Characteristics and types of visual communication, Advantages and disadvantages, Techniques of visual communication, Importance of human and visual communication, Communication as an expression

Module II: Fundamentals of Design (15 Hours)

Definition and approaches of design, Centrality of design, Elements of Design – symmetry; rhythm; contrast; balance; mass and scale, Design and Designers, Perception, Illusions, Gestalt theory

Module III: Principles of Visual Communication (15 Hours)

Principles of visual and other sensory perceptions, Colour psychology and theory, Various stages of design process, Semiotics, Sign and code, Index and symbol, Dyadic and triadic model of sign, Types of code, Branches of semiotics, Denotation, Connotation and Myth

Module IV: Creativity (10 Hours)

Ideation, Understanding creativity, Process of creativity, Creativity tools, Approaches to creativity; Understanding innovation; Understanding lateral thinking

Module V: Graphic Design (10 Hours)

Definition and elements of graphic design, Design process – research; source of concept; process of developing ideas – verbal; visual; combination and thematic, Visual thinking, Associative techniques, Materials, Tools, Design execution and presentation

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define and analyse the concepts and theories of visual communication. (Remembering)
- CO2:** Illustrate the fundamentals of design. (Understanding)
- CO3:** Apply a sharpened sense of aesthetics and skills in communication through visual imagery and design. (Applying)
- CO4:** Experiment with the creativity and visual perceptions of a design or art. (Applying)
- CO5:** Evaluate how specific visual arts and design convey meaning. (Evaluating)
- CO6:** Originate the ability to present through visual Communication. (Creating)
- CO7:** Create and compose artistic ideas and works of art with internal and external meaning. (Creating)

Suggested Readings

1. Seema Hasan (2010). *Mass Communication- Principles and Concepts*, CBS Publishers, New Delhi.
2. Lester. E (1998). *Visual Communications: Images with Messages*, Thomson Learning, London
3. Schildgen, T (1998). *Pocket Guide to Colour with Digital Applications*, Thompson Learning.
4. Palmer, Frederic. *Visual Elements of Art and Design*, 1989, Longman
5. Porter, Tom and Goodman, Sue. *Manual of Graphic Technique 2: For Architects, Graphic Designers, and Artists*, Astragal Books, London
6. Palmer. F. *Visual Awareness* (Batsford, 1972)
7. Bono, Edward De. *Lateral Thinking: Creativity Step by Step*, Harper and Row Publishers, New York.

MCAD0120: ADVERTISING

(4 Credits - 60 hours)

Module I: Introduction to Advertising (10 Hrs)

Advertising – concept; classification and functions, Media of advertising, Advertising as a key element in the promotional mix of marketing, Evolution of advertising – World and India, Difference between advertising and publicity, Marketing communication and propaganda

Module II: Types of Advertisement (10 Hrs)

Geographical Spread, Target Group, Public awareness advertising, Product advertising, Service advertising, Corporate advertising, Public relations advertising, Financial advertising, Global advertising, Political advertising

Module III: Theoretical Aspects of Advertising (10 Hrs)

Stimulus response theory, Starch model, FLIRT model, AIDA, AIDCA, DAGMAR approach, Aspects of Consumer Behaviour, Analysing Human Behaviour, Market Segmentation

Module IV: Brand Management & Strategic Planning (15 Hrs)

Evolution of branding, Concept of a brand, Characteristics of brands, The Importance of brand planning Understanding brand management, Theories and models in brand management, Brand

Prism Model, Perceptual Mapping, Brand Name Spectrum, Brand Positioning, Brand Benefits, Consumer Benefits, Brand Matrix and Media Matrix, Introduction to Strategic Planning and Client Servicing

Module V: Practicum (15 Hrs)

Copy editing, Copy writing, Outdoor Publicity, Print advertisement, Digital advertisement

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the basic terms related to advertising and publicity. (Remembering)
- CO2:** Classify different types advertising and its implication. (Understanding)
- CO3:** Analyse the behaviour of Consumer and market. (Analysing)
- CO4:** Assess implications of Brand Management and Strategic planning. (Evaluating)
- CO5:** Apply the art of copy editing and copy writing. (Applying)
- CO6:** Develop and produce print advertisement, digital advertisement and outdoor publicity materials. (Creating)

Suggested Readings

1. Jethwane, Jaishri and Jain, Shruti (2012). *Advertising Management*.
2. Ogilvy, David. *Ogilvy on Advertising*, Prion.
3. Dennison, Dell. *The Advertising Handbook*, Jaico Books
4. Vilanilam J. V & Verghese A.K. *Advertising Basics*, Sage Publications, India
5. Clifton Rita & John Simmons. *Brands and Branding*, Profile Books Ltd. UK.

MCIV0121: INTRODUCTION TO VIDEO PRODUCTION

(4 Credits - 60 hours)

Module I: Television and Video Systems (10 hours)

Types of telecasting, Television standards, Video formats, Resolution lines, Television studio equipment, Cables and connectors, Production crew members, Camera techniques and operation, Video jargons

Module II: Pre-production Techniques (15)

Creative writing, Script formats, Planning the story, Screenplay, Three act structure, Storyboard, Shooting script, Selection of cast; costumes; locations; sets and props , Budgeting, Copyright and legal issues

Module III: Production Techniques (15 hours)

Camera buttons and controls, Lenses and Filters, White balance, Framing and shot types, Camera movements, Time-lapse, Hyper-lapse, Recording live programme, Types of lighting, Lighting for different situations, Audio for video, Types of microphones, Audio recording techniques, Camera accessories

Module IV: Post-production Techniques (20 hours)

Editing principles, Five phases of editing, Editing techniques, Linear editing, Non-linear editing, Editing modes, Sound in editing, Distribution, Introduction to a video editing software

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Show skills in camera operations and techniques. (Remembering)
- CO2:** Explain the television and video systems and standards. (Understanding)

- CO3:** Identify the production crew members. (Applying)
- CO4:** Apply the techniques of script writing. (Applying)
- CO5:** Identify various career paths in television and video. (Applying)
- CO6:** Develop skills required for creating content as applicable to the video and television industry. (Applying)
- CO7:** Experiment with video editing and output techniques. (Applying)
- CO8:** Compose, shoot and edit programmes. (Creating)

Suggested Readings

1. Muratore, Stephen and York, Matt. *The Videomaker Guide to Digital Video and DVD Production*, Focal Press.
2. Friedman, Anthony. *Writing for Visual Media*, Focal Press.
3. Musburger, Robert B. and Ogden, Michael R. *Single-Camera Video Production*, Focal Press.
4. Owens, Jim. *Video Production Handbook*, Routledge.
5. Dockery, Joe; Chavez, Conrad and Schwartz, Rob. *Learn Adobe Premiere Pro CC for Video Communication*, Adobe Press.

MCAV0122: ANIMATION AND VFX

(3 Credits - 45 hours)

Module I: Introduction to a 2D Animation Software (20 hours)

Getting started, Exploring the software, Exploring the Drawing and Painting Tools, Manipulating Objects, Creating an Animation, Basics of Action Script, Creating a New Document, Understanding Objects, Creating a Table, Understanding Links, Understanding Text Formatting Options

Module II: Adobe After Effects (25 hours)

Getting Started, Adobe After Effects Workflow, Creating a basic animation using effects and presets, Animating text, Working with shape layers, Animating layers, Working with masks, Puppet tools, Roto brush tool, Performing colour correction, Rendering and outputting

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Show a good understanding of compositing process. (Remembering)
- CO2:** Develop a visual effects pipeline. (Applying)
- CO3:** Apply the techniques of 2D animation. (Applying)
- CO4:** Experiment with animation and VFX software. (Applying)
- CO5:** Create basic 2D animation video. (Creating)

Suggested Readings

1. Adobe Creative Team. *Adobe Flash Professional CC: Classroom in a Book*, Adobe Press.
2. Wells, Paul. *Basics Animation 03: Drawing for Animation*, Bloomsbury Publishing India Pvt. Ltd.
3. White, Tony. *How to Make Animated Films*, Focal Press.
4. Fridsma, Lisa and Gyncild, Brie. *Adobe After Effects CC: Classroom In A Book*, Adobe Press.
5. Kogent Learning Solutions Inc. *After Effects CS6 in Simple Steps*. Dreamtech Press.

MCCM0123: COMMUNITY MEDIA**(3 Credits - 45 hours)****Module I: Community Media (15 hours)**

Understanding community, Concept, Characteristics and forms of community media, Types, Relevance, Purpose and significance, History and practice of community media, Community radio, Community video, Sustainability of community media

Module II: Communication for Community Engagement (8 hours)

Participatory communication, Socio-cultural mediation, Communication for social and behavioural change (CSBC)

Module III: Skills, Tools and Techniques (22 hours)

Skills; tools and techniques of community media, Programming for community media, Ethical issues, Community media practicum – community outreach

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define what community media is. (Remembering)
- CO2:** Classify the different types of community media. (Understanding)
- CO3:** Utilize community media for social change and development. (Applying)
- CO4:** Analyse the key functions of community media. (Analysing)
- CO5:** Explain the significance of community media in rural areas. (Evaluating)
- CO6:** Compose and produce content for community media. (Creating)

Suggested Readings

1. Fuller, K. Linda, (2007). *Community Media: International Perspectives*, Palgrave Macmillan.
2. Howley, Kevin. (2005). *Community Media: People, Places, and Communication Technologies*, Kindle Edition.
3. Manyozo, Linje. (2012). *Media, Communication and Development: Three Approaches*, Sage India.
4. Howley, K. *Understanding Community Media*, Sage New Delhi.
5. Halleck, D.D. (2002). *Hand Held visions: The impossible possibilities of community media*, USA: Fordham University Press.

MCGD0124: GRAPHIC DESIGNING**(4 Credits- 60 hours)****Module I: Digital Graphic Design (10 hours)**

Graphic design, Digital design, Graphic design Vs. Digital design, Fonts and typefaces, Ethical concerns

Module II: Design Concepts (10 hours)

Elements of Design – colour; line; shape; texture; value, Design principles – balance; contrast; emphasis/dominance; harmony; movement/rhythm; proportion; repetition/pattern; unity; variety

Module III: Introduction to Equipment and CorelDraw (25 hours)

Computer configuration, Scanner, Digital tablet, Printer, Paper size - type and quality, Formats and Resolution, Raster vs. Vector images, Introduction to CorelDraw, Practicum – visiting card; logo design

Module IV: Introduction to Adobe Illustrator (15 hours)

Getting Started, Adobe Illustrator Workflow, Practicum - artwork for a postcard; artwork for t-shirt; poster design; preparing content for the web

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept of digital graphic design. (Remembering)
- CO2:** Explain what a design is, in the context of the product and its Branding. (Understanding)
- CO3:** Apply the knowledge of the elements and principles of design to solve real world design problems. (Applying)
- CO4:** Make use of Typography effectively. (Applying)
- CO5:** Create a design brief, conduct online research, and Come up with appropriate solutions independently. (Creating)
- CO6:** Design logos as well as collaterals such as letterheads, Business cards, Advertisements, Portfolios, etc. (Creating)

Suggested Readings

1. Gordon, B. and Gordon, M. (2002). *The Complete Guide to Digital Graphic design*, Watson-Guptill Publications, Inc.
2. Berger, A. A. (1989). *Seeing Is Believing: An Introduction to Visual Communication*. Mayfield Publishing Company.
3. Kress, G. R. and Van Leeuwen, T. (1996). *Reading images: The grammar of visual design*, Psychology Press.
4. Pender, K. R. (1997). *Digital Graphic Design*, Butterworth-Heinemann.
5. Conover, C. (2011). *Designing for Print*, John Wiley and Sons.
6. Arntson, A. E. (2011). *Graphic design basics*, Cengage Learning.
7. Roberts, L. (2006). *Good: An Introduction to Ethics in Graphic Design*, Ava Publishing.
8. DT Editorial Services. *Illustrator CC in Simple Steps*. Dreamtech Press.
9. Kogent Learning Solutions Inc. *CorelDraw X7 in Simple Steps*. Dreamtech Press.

MCFS0125: FILM STUDIES

(4 Credits-60 hours)

Module I: Birth of Cinema (10 hours)

Historical background, Pioneers of Cinema, Influence of Studios on cinema, Development of Classical Hollywood Cinema, The silent era

Module II: World Cinema (20 hours)

Different Schools of World Cinema, Silent Comedy, German Expressionism, French Impressionism; Surrealism and New Wave Cinema, Soviet Montage, Italian Neo Realism, Japanese Cinema, Iranian Cinema, Third world Cinema

Module III: Indian Cinema (20 hours)

Arrival of Cinema in India, Pioneers of Indian Cinema, Bollywood, New Indian Cinema, Government and Indian Cinema, Regional Cinema, Cinema in Northeast India

Module IV: Mise-en-scene (10 hours)

Mise-en-scene - four Ps of mise-en-scene; elements of mise-en-scene; narrative functions of mise-en-scene

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define film theories. (Remembering)
- CO2:** Classify the language of cinema and film narratives. (Understanding)
- CO3:** Outline the brief history of cinema, important revolutions and key theoretical frame works. (Understanding)
- CO4:** Analyse cinema critically. (Analysing)
- CO5:** Explain the concept of mise-en-scene. (Evaluating)

Suggested Readings

1. Thoraval, Yves. *The Cinema of India (1896-2000)*. Macmillan Publishers India.
2. Buckland, Warren (2010). *Film Studies: Teach Yourself*. McGraw Hills.
3. Saran, Renu. *History of Indian Cinema*. Diamond Books.
4. Nelmes, Jill (2012). *Introduction to Film Studies*. Routledge.
5. Nowell-Smith, Geoffrey (1999). *The Oxford History of World Cinema*. Oxford University Press.
6. Kupsc, Jarek. *The History of Cinema for Beginners*. Orient BlackSwan.
7. Monaco, James. *How to Read a Film: Movies, Media, and Beyond*. Oxford University Press.
8. Kaliyamoorthy and Chandrasekhar (Eds:2007), *Entrepreneurial Training: Theory and Practice*, New Delhi, Kanishka Publishers.
9. Baruah, S.B. *Created Entrepreneurs from Northeast: Stories of 100 Successful trained Entrepreneurs*. Indian Institute of Entrepreneurship.

MCCD0128: COMMUNICATION FOR DEVELOPMENT

(3 Credits- 45 hours)

Module I: Introduction to Development (10 hours)

Meaning, definition and process, Growth and development, Characteristics of developing and underdeveloped countries, Regional development

Module II: Theories & Models of Development (20 hours)

Basic Needs Model (Bariloche Foundation), Theories and paradigms of development – unilinear; non-unilinear; dominant; alternative and new paradigms of development, Dependency Model, Gandhian Model, Social Responsibility Theory, Approaches to development

Module III: Understanding Communication for Development (15 hours)

Meaning, Concepts, Definition, Historical background, ICTs in development, Diffusion of Innovation, Media and modernization approach, Development Support Communication (DSC), E-Governance, Case Studies

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concepts and theories of development and social change. (Remembering)
- CO2:** Explain the roles of media in development and social change. (Understanding)
- CO3:** Develop communication strategy for development. (Applying)
- CO4:** Classify media roles in socio-economic development and social change. (Analysing)
- CO5:** Assess the situation for communication intervention. (Evaluating)
- CO6:** Create advocacy and initiate for behavior change through communication channels. (Creating)

Suggested Readings

1. Everett, Roger. (2003). *Diffusion of Innovations*, Free Press
2. Gupta, V.S. (2004). *Communication for Development and Civil Society*, Concept.
3. Manyozo, Linje. (2012). *Media, Communication and Development: Three Approaches*, London: Sage
4. Paravala V & Malik K V. (2007). *Other Voices, The Struggle for Community Radio in India*, Sage India
5. Prasad, Kiran. (2009). *Information and Communication Technology: Reinventing Theory and Action (2Volumes)*. New Delhi: BRPC
6. Pieterse, Jan Nederveen. (2001). *Development Theory: Deconstruction/Reconstruction*, Vistaar.
7. PW Preston. (1997). *Development Theory*, Blackwell.
8. RK Ravindran. (2000). *Media in Development Arena*, Indian Publishers Distributors.
9. Srinivas Melkore & Steeves (2001). *Communication for Development in the Third World*, Sage
10. VS Gupta. (2000). *Communication and Development-The Challenges of the Twenty-First century*, Concept Publishing.

MCWD0129: WEB DESIGNING

(3 Credits- 45 hours)

Module I: Hyper Text Markup Language (12 hours)

Introduction, Basic Structure, Head Section, Elements of Head Section, Meta Tags, External Link Tags, Tags - Structure, Table, Div, Frames, Content/Media, Header, Paragraph, Span, Anchor Links and Named Anchors, Image / Image Hot Spots, Iframe

XHTML: Introduction, Difference between HTML & XHTML, XHTML Basics, Introduction to Doc Types (Strict, Transitional and Mobile), XHTML Validation

HTML5: Introduction, HTML5 DocType, New Structure Tags, SECTION, NAV, ARTICLE, ASIDE, HEADER, FOOTER, New Form Tags, search, tel, URL, e-mail, number and range, New Media Tags, Audio Tag, Video Tag, Designing a Layout using HTML5

Module II: Forms (9 hours)

Working with Forms, Form Tag, POST and GET Method, Text Input, Text Area, Checkbox, Image Input and Radio, Select Option, Option Group, File Upload and Hidden Fields, Submit Button, Reset Button, Creating a Live Website Form

Module III: Cascading Style Sheets (14 hours)

Introduction, Types of Style Sheets (Inline, Internal and External), CSS for Website Layout and Print Layout, Types of CSS Selectors - Universal Selector; Type Selector; Class Selector; ID Selector; Child Selector; Descendant Selector; Adjacent Sibling Selector; Attribute Selector; Query Selector; Nesting of Selectors, CSS properties - Type Properties; Background Properties; Block Properties; Box Model Properties; List Properties; Border Properties; Positioning Properties, Properties useful in Real-time Designing, Using CSS for Real-time Practical Works, Defining the Text Styles, Defining the Background Styles, Designing a Menu System (Horizontal, Vertical and Drop Down), Custom Form Designing, DIV + CSS Layout Design, PSD to CSS Conversion, CSS Optimization Tips

Module IV: Web Hosting and User Experience Design (10 hours)

Introduction and Web Hosting Basics, Types of Hosting Packages, Registering domains, Defining Name Servers, Using Control Panel, Creating Emails in C-panel, Using FTP Client, Maintaining a Website, User Experience (UX) design - Introduction and concept, Elements, Design Process, Case Study.

Practical Work: Registering a domain and creating a portfolio using the concepts learned.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the concept of web hosting and user experience design. (Remembering)
- CO2:** Develop skills in HTML and CSS. (Applying)
- CO3:** Analyse usability of website. (Analysing)
- CO4:** Examine web design standards and their importance. (Analysing)
- CO5:** Create, design and maintain webpages and websites. (Creating)

Suggested Readings

1. Esposito, Dino. *Modern Web Development: Understanding Domains, Technologies, And User Experience*, PHI.
2. Lemay, Laura. *Mastering HTML, CSS & Javascript Web*, BPB.
3. Xavier, C. *Web Technology & Design*, New Age International.
4. *Fundamentals of Web Application Projects*. Faculty Members of CSE and IT, ADBU, Assam Book Hive.
5. <https://www.w3.org>
6. <https://www.w3schools.com/>
7. https://www.tutorialspoint.com/internet_technologies/website_designing.htm
8. NPTEL Online Course - <https://nptel.ac.in/courses/106106156/>

MCME0130: MEDIA ENTREPRENEURSHIP

(3 Credits - 45 hours)

Module I: Entrepreneurship Development (12 hours)

Entrepreneurship – concept; definition, need and significance, Entrepreneurship growth process, Barriers, Entrepreneurship education model, Entrepreneur – characteristics; types and role demands, Entrepreneurial Motivation and challenges, Types of enterprises - based on capital; product; location; ownership pattern and process

Module II: Media Entrepreneurship (8 hours)

Concept of Media Entrepreneurship, Characteristics of Media Entrepreneurs, Case Studies, Govt. Initiative and Schemes for Entrepreneurship

Module III: Media Entrepreneurial Scenario in Northeast India (12 hours)

Scope; opportunities; problems and issues, Print media, Broadcast media, Online media, Local cable networks, Production houses, Recording studios, Film industry

Module IV: Understanding Social Entrepreneurship (13 hours)

Social Entrepreneurship - concepts and approaches, Factors impacting transformation into social entrepreneur, Characteristics of social entrepreneurs, Comparison between business and social entrepreneurship, Innovations and social entrepreneurship, Financing Social Enterprises and Start-Ups, Business Models, Case studies

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define the meaning and concept entrepreneurship. (Remembering)
- CO2:** Explain the concept of media and social entrepreneurship. (Understanding)
- CO3:** Apply the knowledge of entrepreneurship and start-up for creation of own entrepreneurial venture. (Applying)

CO4: Distinguish between business entrepreneurship and social entrepreneurship. (Analysing)

CO5: Evaluate media entrepreneurship scenario in Northeast India. (Evaluating)

Suggested Readings

1. D.D Mali. *Entrepreneurial scenario in North east*. Indian Institute of Entrepreneurship.
2. Akhouri, M.M.P. (1990) *Entrepreneurship for Women in India*. New Delhi: NIESBUD
3. Dinanath Kaushik (2013) *Studies in Indian Entrepreneurship*, New Delhi, Cyber Tech Publications
4. Gopalkrishnan (2014) *The Entrepreneur's Choice: Cases on Family Business in India*, New Delhi, Routledge.

MCMC0131: MOBILE COMMUNICATION

(3 Credits – 45 hours)

Module I: Introduction to Mobile Communication (10 hours)

Wireless communication, Evolution of mobile communication, Basic components of a mobile communication system, Mobile phone as a tool for development communication

Module II: Mobile Communication and Convergence (12 hours)

Interactive content development, Mobile convergence - visual; text; images and video, Blogging; podcasting and live streaming, Television; radio and internet content through mobile communication

Module III: Mobile Journalism (MOJO) (13 hours)

Concept and meaning, Advantages of mobile journalism, Mastering mobile journalism, Skills and workflow, Technology and Equipment – MOJO Apps; hardware

Module IV: Practicum (10 hours)

As part of this module, students are required to create visual, sound and text messages for mobile media and produce an audio-video PSA on themes such as health, agriculture, education, and environment.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Define mobile journalism and explain the journalistic genre. (Remembering)
- CO2:** Explain the evolution of wireless and mobile communication technology. (Understanding)
- CO3:** Apply the key technologies used in developing and distributing content for the mobile platform. (Applying)
- CO4:** Develop skills in gathering news, videos, and photos using smartphones. (Creating)
- CO5:** Create stories for mobile phone audience. (Creating)

Suggested Readings

1. Maccise, Diana Larrea and Marai, Montaser. *Mobile Journalism*. Al Jazeera Media Training and Development Centre. E-book.
2. Kolodzy, Janet. *Practicing Convergence Journalism: An Introduction to Cross-Media Storytelling*. Routledge.
3. Lozano, José. *Multimedia Sound and Video*. Pearson.
4. Bayles, Fred. *Field Guide to Covering Local News: How to Report on Cops, Courts, Schools, Emergencies and Government*. CQ Press.
5. Katz, James E. *Magic in the Air: Mobile Communication and the Transformation of Social Life*. Routledge.

MCTP6015: TECHNIQUES OF PHOTOGRAPHY AND IMAGE EDITING**(2 Credits – 60 hours)**

The objective of this course is to equip students with introductory skills and knowledge about the art of digital photography. Students will learn to comfortably handle DSLR cameras, understand technical concepts from the different shooting modes to aperture and shutter speed; and apply composition techniques from finding effective backgrounds to rule of the thirds. Students will have hands-on training on outdoor photography as well as studio photography. Besides learning photography, students will learn to be proficient in the use of a digital image editing software.

Recommended Assignments:

Street photography, Landscape photography, Action Photo story, Cityscapes, Studio portrait, Building a Photography portfolio

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Show working knowledge of digital SLR cameras. (Remembering)
- CO2:** Demonstrate an understanding of composition and image design process. (Understanding)
- CO3:** Apply image editing and output techniques. (Applying)
- CO4:** Analyse and critique one's own artistic output. (Analysing)
- CO5:** Determine safe and responsible work practices. (Evaluating)
- CO6:** Create photographic work of acceptable standard. (Creating)

Suggested Readings:

1. *Basics of Digital Images*. OIT Academic Computing, PDF.
2. Koo, R. *The DSLR Cinematography Guide*, Creative Commons, e-book.
3. Langford, Michael; Fox, Anna and Smith, Richard Sawdon. *Langford's Basic Photography*. Focal Press.
4. Peterson, Bryan. *Understanding Exposure*. Amphoto Books.
5. Comon, Paul R. *Fundamentals of Photo Composition*. Sterling Publications.
6. Judge, Al. *Mastering Digital Cameras*. Createspace Independent Pub.

MCJG6016: JOURNALING**(1 Credit – 30 hours)**

During this 30 hours course, students are required to maintain a daily reflective journal, using the Visible Thinking Routine as a critical structure for guiding their journal writing. Students are required to do journaling once a week and submit the journal to the assigned faculty member every Friday for analysis. Grades will be awarded for this course on the basis of the journal entries and a presentation at the end of the semester.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Demonstrate the ability to explore different options for handling daily experiences. (Understanding)
- CO2:** Develop self-awareness, self-learning and communication skills. (Applying)
- CO3:** Apply contextual and experiential learning in their everyday lives. (Applying)
- CO4:** Improve creativity and imagination. (Creating)

Suggested Readings

1. Bryson, J. M. (2004). *Visible thinking: Unlocking causal mapping for practical business results*. Chichester, West Sussex: J. Wiley.
2. Logan, Debra Kay (2005) *Journaling During Research*. *Library Media Connection*; Vol. 23 Issue 6, p12
3. Miller, D. (2003). *Journaling: Telling your professional "story."* *Library Media Connection*.
4. Lin, Hung-Yuan; Chiang, Chi-Hsian (2013) *Social Behavior and Personality: an international journal*, Volume 41, Number 1, 2013, pp. 113-122(10) Scientific Journal Publishers.
5. Brock, B. (1999). *The principal's role in mentor programs*. Mid— Western Educational Researcher; London: Kogan Pag.

MCDI6017: DISSERTATION PHASE I

(2 Credits – 60 hours)

During this 60-hours course students will learn the different methods for conducting academic research in communication studies. Students will learn to conduct review of literature, prepare synopsis outline, format or structure of report. They will also learn how to add appendices, such as references to sources of data, instruments of data collection; give bibliography and footnotes.

The Exercise:

Students will have to choose a research topic of their choice, conduct a literature review with bibliography, and develop a research proposal which will be submitted in partial fulfilment for the requirement of Master's degree in Mass Communication. Students will also write and present a research paper.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** List the objectives, research question and proposed outcomes for the dissertation. (Remembering)
- CO2:** Explain the rationale for undertaking the dissertation. (Understanding)
- CO3:** Justify the proposed method for undertaking the dissertation. (Evaluating)
- CO4:** Develop skills in critiquing and appraising relevant literature. (Creating)

Suggested Readings

1. Gibaldi, Joseph and Walter S. Achtert. *MLA Handbook for Writers of Research Papers*. New Delhi: Affiliated East-West Press Pvt. Ltd. 1994.
2. Kothari, C.R. *Research Methodology Methods and Techniques*
3. Krishnaswamy, O.R. *Research Methods in Social Sciences*
4. Natziger, Ralph O. and David M. White. *Introduction to Mass Communication Research*. Baton rouge: Louisiana State University Press. 1981.
5. Oliver, Paul. *Writing your thesis*. New Delhi: Sage Publications. 2008
6. Stempel, Guido H. (III) and Bruce H. Westley (Ed). *Research Methods in Mass Communication*. Englewood Cliffs: Prentice-hall Inc. 1981.
7. Wimmer, Roger D. and Joseph R. Dominick. *Mass Media Research: An Introduction*. Belmont: Wadsworth.

MCAV6018: AUDIO-VIDEO PRODUCTION

(2 Credits – 60 hours)

Through this course students will develop the basic knowledge of audio and video production techniques and aesthetics via practical (hands-on) experience in the writing and production of

several programme formats. Students will work on specific projects designed to help them acquire the skills of audio and video recording, editing, mixing and storytelling techniques.

Class lectures, discussions, studio and location recordings, along with individual group projects will be utilized to help students demonstrate a proper understanding of the audio-video medium.

The Exercise:

Basics of audio editing, Basics of video editing, Principles of scripting, Audio recording techniques and equipment, Radio News, Radio Discussion, Radio Commercials, Studio recording, Outdoor recording, Hands-on training on Camera techniques and accessories, Framing and Shot sizes, Lighting techniques for video, TV news production, Commercials, , Music video, Video Interview, Live recording techniques.

COURSE/LEARNING OUTCOMES

At the end of this course students will be able to:

- CO1:** Show awareness of safe and responsible work practices. (Remembering)
- CO2:** Demonstrate an understanding of script writing process. (Understanding)
- CO3:** Apply knowledge of audio and video recording techniques in the field. (Applying)
- CO4:** Experiment with different types of audio and video production tools. (Applying)
- CO5:** Develop competency in editing and output techniques. (Creating)
- CO6:** Create different formats of audio and video programmes. (Creating)

Suggested Readings:

1. Mcleish, Robert. *Techniques of Radio Production*, Focal Press.
2. Kedia, Krishan K. *Writing for Radio and Television in India*. Cyber Tech Publications.
3. Owens, Jim. *Video Production Handbook*, Routledge.
4. Musburger, Robert B. and Ogden, Michael R. *Single-Camera Video Production*, Focal Press.
5. Muratore, Stephen and York, Matt. *The Videomaker Guide to Digital Video and DVD Production*, Focal Press.

MCIN6101: INTERNSHIP

(3 Credits-90 hours)

Students will undertake 4 weeks internships in media and communication organizations during the winter vacation between fifth and sixth semester. They will discuss the choice of media and communication organization with their respective mentors and obtain the consent of the head of the department. Before going for the internship, an *Internship Agreement Contact* form from the concerned organization will be submitted by the student to their respective mentors. After completion each student will submit a copy of the *Internship Completion Certificate* to their mentors from the designated authority of the concerned media and communication organization.

The final evaluation will be on the basis of the following criteria:

- a) Journal – 30%
- b) Portfolio and Presentation – 50%
- c) Written evaluation by the employer – 20%

Journal: Each student will keep a daily journal with an entry for each day spent doing work for the internship. This journal should be e-mailed to the mentor at the beginning of each work week. In this journal the students should summarize the activities and assignments on which the student worked. The student should also keep track of the number of hours for each week.

Portfolio: At the end of the internship, each student is required to prepare a professional portfolio

that contains examples of the students' work during the internship. The portfolio will additionally contain a written evaluation of the media organization, employer evaluation of the student, a copy of the internship completion certificate, a one-page summary of the internship.

Summary: Each student must type a one page summary of the internship. He/she should include highlights of the internship experiences and evaluate his/her skills and projects.

Employer Evaluation: At the end of the internship the supervising employer will be asked to submit a written evaluation of the student's performance.

Student Evaluation: At the end of the internship the student will be asked to submit a written evaluation of the employer.

The department will issue the following to the students:

- a) Internship Application Form – to be submitted to the mentor prior to internship.
- b) Internship Agreement Contract – to be submitted to the mentor prior to internship.
- c) Student Evaluation of the Internship – to be included in the portfolio
- d) Employer Evaluation of Intern – to be included in the portfolio

Last date of Internship: To be notified by the department

Portfolio Submission and Presentation: To be notified by the department

MCPW6102: PROJECT WORK

(2 Credits - 60 hours)

Students will create video production project which will be an application of the skills gained by them during the duration of their study. As part of the project work students will apply their theoretical knowledge and understanding in the practical realm and work together in a group. The video production project can be in a fictional format, documentary format or animated format. The subject, topic, content of the project will be of 20 minutes duration. After approval of the idea from the teacher in-charge and the script selection committee, students will execute the project within the given time frame. Students should have sponsors for their project which shall cover some percentage of their approved budget. The video production project will be publicly screened in the university followed by discussion with the groups.

The final evaluation will be on the basis of the following criteria:

- a) Video Production Project – 50%
- b) Screening and Discussion – 20%
- c) Viva-Voce – 20%
- d) Pre-screening Publicity and Marketing – 10%

Project Submission Date: To be notified by the department

Screening Date: To be notified by the department

Viva-voce: To be notified by the department

Our Vision

“To mould intellectually competent, morally upright, socially committed and spiritually inspired persons at the service of India and the world of today and tomorrow, by imparting holistic and personalized education.”

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