

REGULATIONS AND SYLLABUS

2019-2020

- 🔍 School of Technology
- 🔍 School of Commerce and Management



ASSAM DON BOSCO UNIVERSITY

Tapesia Gardens | Azara, Guwahati - 781017
Sonapur - 782402 | Assam, India
Assam



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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 SGPAs 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 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.

COURSE STRUCTURE

SCHOOL OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BACHELOR OF TECHNOLOGY (BATCH 2018-19), (BATCH 2019-20)

Semester I						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	PSPT0038	Physics for Technologists	3-1-0	4	721
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	706
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	142
Lab	Basic Science Course/IC	PSTC6016	Physics for Technologists- Lab	0-0-4	2	726
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	2	201
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	444
	Mandatory Course/IC	BTIP7	Student Induction Program - Universal Human Values I	0-0-0	NC	NA
Total Credits					18	

Semester II						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	CHEC0027	Engineering Chemistry	3-1-0	4	728
	Basic Science Course/IC	MAIN0013	Mathematics II- Multiple Integrals, Numerical Methods and Differential Equations	3-1-0	4	707
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	338
	Humanities & Social Sciences including Management/IC	LSEH0017	English	2-0-0	2	739
Lab	Basic Science Course	CHCE6006	Engineering Chemistry Lab1	0-0-4	1	730
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	380
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	499
	Mandatory Course/IC	BTIP9	Student Induction Program- Universal Human Values II	0-0-0	NC	NA

Semester III						
Type	Type of Course/Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	MAPS0024	Mathematics III-Probability and Statistics	2-0-0	2	708
	Engineering Science Course/IC	ECEC0050	Analog Electronic Circuits	3-0-0	3	250
	Professional Core Courses/DC	CSOP0080	Object Oriented Programming	3-0-0	3	144
	Professional Core Courses/DC	CSDC0081	Digital Computer Design	3-0-0	3	145
	Professional Core Courses/DC	CSDS0082	Data Structure	3-0-0	3	146
	Humanities & Social Sciences including Management/IC	MTPM0087	Functional Principles of Management	3-0-0	3	693
Lab	Engineering Science Course/IC	ECEC6039	Analog Electronic Circuits	0-0-2	1	304
	Professional Core Courses/DC	CSOP6070	Object Oriented Programming Lab	0-0-4	2	202
	Professional Core Courses/DC	CSDC6071	Digital Computer Design Lab	0-0-4	2	203
	Professional Core Courses/DC	CSDS6072	Data Structure Lab	0-0-4	2	203
Internship		BTIA8	Internship Programme		3	NA
	Mandatory Course/IC	BTIP10	Student Induction Program- Universal Human Values III	0-0-0	NC	NA
Total Credits					27	

Semester IV						
Type	Type of course/Category	Course Code	Course Title	L-T-P	Credits	Page
	Professional Core Courses/DC	MADM0025	Discrete Mathematics	3-1-0	4	709
	Professional Core Courses/DC	CSOA0083	Computer Organization & Architecture	3-0-0	3	147
	Professional Core Courses/DC	CSRD0084	Relational Database Management Systems	3-0-0	3	149
	Professional Core Courses/DC	CSAD0085	Analysis and Design of Algorithms	3-0-0	3	150
	Humanities & Social Sciences including Management/IC	MTOB0086	Organisational Behavior	3-0-0	3	692
	Professional Core Courses/DC	CSOA6073	Computer Organization & Architecture Lab	0-0-4	2	204
	Professional Core Courses/DC	CSRD6074	Relational Database Management Systems Lab	0-0-4	2	205
	Professional Core Courses/DC	CSAD6075	Analysis and Design of Algorithms Lab	0-0-4	2	205

	Mandatory Course/IC	BTIP11	Student Induction Program- Universal Human Values IV	0-0-0	NC	NA
	Mandatory Course/IC	CHES0029	Environmental Science		0	727
Total Credits					22	

Semester V						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core Courses/DC		Formal Language & Automata Theory	3-0-0	3	
	Professional Core Courses/DC		Operating Systems	3-0-0	3	
	Professional Core Courses/DC		Data Communication	3-0-0	3	
	Professional Elective Courses/DE		Information System Design/ System Analysis and Design	3-0-0	3	
Software Engineering & Designing Concepts						
	Humanities & Social Sciences including Management/IC		Economics for Engineers	3-0-0	3	
Lab	Professional Core Courses/DC		Operating Systems Lab	0-0-4	2	
	Professional Core Courses/DC		Data Communication Lab	0-0-4	2	
Project	Project/DC		Mini Project-I	0-0-2	1	
	Mandatory Course/IC		Constitution of India/Es- sence of Indian Traditional Knowledge		0	
Internship			Internship		3	
Total Credits					23	

Semester VI						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core Courses/DC		Compiler Design	3-0-0	3	
	Professional Core Courses/DC		Computer Networks	3-0-0	3	
	Professional Elective Courses/DE		Computer Graphics& Multimedia/ System Programming	3-0-0	3	
	Professional Elective Courses/DE		Microprocessor/ Embedded System	3-0-0	3	
	Open Elective Courses/IE		Production and Operations Management	3-0-0	3	
Lab	Professional Core Courses/DC		Compiler Design Lab	0-0-4	2	
	Professional Core Course/DC		Computer Networks Lab	0-0-4	2	

■ COURSE STRUCTURE

	Professional Elective Courses/DE		Computer Graphics & Multimedia Lab/ System Programming Lab	0-0-2	1	
	Professional Elective Courses/DE		Microprocessor Lab/ Embedded System Lab	0-0-2	1	
Project	Project/DC		Mini Project-II	0-0-2	1	
Total Credits					22	

Semester VII						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC		Biology	2-0-0	2	
	Professional Elective Courses/DE		Artificial Intelligence/ Robotics & Unmanned devices	3-1-0	4	
	Professional Elective Courses/DE		Data Warehousing and Data Mining/Machine Learning	3-0-0	3	
	Open Elective Courses/IE		Personal and Mobile Communications/Image Processing and pattern Recognition/Android Application Development Fundamentals	3-0-0	3	
Lab	Professional Elective Courses/DE		Artificial Intelligence Lab/ Robotics & Unmanned devices Lab	0-0-2	1	
Project	Project/DC		Major Project- Phase I	0-0-4	2	
Internship			Internship		3	
Total Credits					17	

Semester VIII						
Type	Type of course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Elective Courses/DE		Emerging Trends in Computing-Cloud Computing/ E-Commerce and Data Security	3-0-0	3	
	Open Elective Courses/IE		Distributed Computing/ Network Security and Cryptography/Concepts of Advanced Operating Systems	3-0-0	3	
	Open Elective Courses/IE		Computer Vision/Speech Processing /Pattern Recognition/Natural Language Processing	3-0-0	3	
Project	Project/DC		Major Project- Phase II	0-0-6	3	
Total Credits					12	
Total Programme Credits					160	

BACHELOR OF TECHNOLOGY (BATCH 2017-18, 2016-17)

Semester V					
Type	Course Code	Course Name	Credits	Category	Page
Theory	CSMA0047	Microprocessors and Applications	4	DC	116
	CSOC0048	Operating Systems and Concepts	4	DC	117
	CSFL0049	Formal Language and Automata Theory	4	DC	118
	CSDC0050	Data Communication	4	DE	119
	CSIS0051	Information System Design	4	DE	121
	MTFP0070	Functional Principles of Management	2	IE	685
Lab	CSMA6047	Microprocessors and Applications lab	2	DC	193
	CSOC6048	Operating Systems and Concepts Lab	2	DC	193
	CSDC6049	Data Communication Lab	2	DE	194
Project	CSMI6050	Mini Project I	2	DC	195
EAP	BTEAP5	Extra Academic Programmes	NC	DC	NA
Total Credits			30		

Semester VI					
Type	Course Code	Course Name	Credits	Category	Page
Theory	CSNS0057	Computer Networks	4	DE	124
	CSSD0058	Software Engineering and Designing Concepts	3	DE	125
	CSAA0059	Analysis and Design of Algorithms	4	DC	127
	MADM0002	Discrete Mathematics	4	IC	703
	CSCD0060	Compiler Design	4	DC	128
	MTOM0071	Production and Operations Management	2	IE	686
Lab	CSNS6054	Computer Networks lab	2	DE	195
	CSCD6055	Compiler Design Lab	2	DC	196
	CSAA6056	Analysis and Design of Algorithms Lab	2	DC	197
	CSMI6057	Mini Project II	2	DC	197
AP	BTEAP6	Extra Academic Programmes	NC	IC	NA
Total Credits			29		

Semester VII						
Type	Course Code	Course Name	Credits	Category	Page	
Theory	CSAI0061	Artificial Intelligence	4	DE	129	
	CSDW0056	Data Warehousing and Data Mining	4	DE	123	
	CSGM0062	Computer Graphics and Multimedia	3	DE	130	
	MTQM0072	Quality Management Systems	2	IE	688	
	One Elective to be opted					
		CSEC0055	e-Commerce and Data Security	4	DE	122
		CSPM0063	Personal and Mobile Communications		DE	132
		CSIR0064	Image Processing and Pattern Recognition		DE	133
	CSAD0075	Android Application Development Fundamentals			141	
Lab	CSAI6059	Artificial Intelligence Lab	2	DE	198	
	CSGM6060	Computer Graphics and Multimedia Lab	2	DE	198	

Seminar	CSTS6061	Training Seminar	2	DC	199
Project	CSMP6062	Major Project (Phase I)	4	DC	200
Total Credits			27		
Semester VII					
Theory	CSRE0065	Real Time and Embedded Systems	4	DE	135
	CSAP0066	Advanced Computer Architecture and Parallel Processing	3	DE	136
	CSET0067	Emerging Trends in Computing - Cloud Computing	3	DE	137
	PYTW0021	Thoughts That Shaped the World	2	IE	746
	MTFC0073	Financial Management and Accounting	3	IC	689
	One elective to be opted				
	CSDG0068	Distributed Computing	3	DE	138
	CSNC0069	Network Security and Cryptography		DE	139
	CSAO0070	Concepts of Advanced Operating Systems		DE	140
Project	CSMP6063	Major Project (Phase II) and Viva Voce	8	DC	201
Total Credits			26		

MASTER OF TECHNOLOGY (MTECH) COMPUTER SCIENCE AND ENGINEERING

Semester I						
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page
Specialization: Data Science						
Theory	Core 1	CSMF0086	Mathematical foundations of Computer Science	3-0-0	3	151
	Core 2	CSDT0087	Advanced Data Structures	3-0-0	3	153
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	240
	Prog. Specific Elective I	CSSC0088	Data Science	3-0-0	3	154
		CSDI0089	Distributed Systems			155
		CSDP0090	Data Preparation and Analysis			156
	Prog. Specific Elective II	CSRS0091	Recommender System	3-0-0	3	157
		CSML0092	Machine Learning			158
CSTN0093		Data Storage Technologies and Networks	159			
Lab	Lab1	CSDT6076	Advanced Data StructuresLab	0-0-4	2	206
	Lab2	CSML6077	Machine LearningLab	0-0-4	2	207

Specialization: Internet of Things						
Theory	Core 1	CSMF0086	Mathematical foundations of Computer Science	3-0-0	3	151
	Core 2	CSDT0087	Advanced Data Structures	3-0-0	3	153
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	240
	Prog. Specific Elective I	CSSC0088	Data Science	3-0-0	3	154
		CSWA0094	Wireless Access Technologies			
		CSMS0095	Mobile Applications and Services			
	Prog. Specific Elective II	CSML0092	Machine Learning	3-0-0	3	158
		CSSI0096	Smart Sensors and Internet of Things			
		CSLF0097	Logic and Functional programming			
Lab	Lab1	CSDT6076	Advanced Data Structures Lab	0-0-4	2	206
	Lab 2	CSML6077	Machine Learning Lab	0-0-4	2	207
Specialization: Information Security						
Theory	Core 1	CSMF0086	Mathematical foundations of Computer Science	3-0-0	3	151
	Core 2	CSDT0087	Advanced Data Structures	3-0-0	3	153
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	240
	Prog. Specific Elective I	CSDF0098	Digital Forensics	3-0-0	3	165
		CSEH0099	Ethical Hacking			
		CSID0100	Intrusion Detection			
	Prog. Specific Elective II	CSMR0101	Malware Analysis & Reverse Engineering	3-0-0	3	168
		CSSC0102	Secure Software Design and Enterprise Computing			
		CSML0092	Machine Learning			
Lab	Lab1	CSDT6076	Advanced Data Structures Lab	0-0-4	2	206
	Lab2	CSML6077	Machine Learning Lab	0-0-4	2	207
Audit	Audit 1	LSRW0041	English for Research Paper Writing	2-0-0	2	738
Total Credits				16-0-8	20	

Semester II						
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page
Specialization: Data Science						
Theory	Core 3	CSAA0103	Advance Algorithms	3-0-0	3	171
	Core 4	CSSP0104	Soft Computing	3-0-0	3	172
	Prog. Specific Elective III	CSDV0105	Data Visualization	3-0-0	3	173
		CSBD0106	Big Data Analytics			
		CSDD0107	Data Warehouse and Data Mining			
	Prog. Specific Elective IV	CSDS0108	Data Security and Access Control	3-0-0	3	177
		CSWD0109	Web Analytics and Development			
		CSKD0110	Knowledge Discovery			
		CSNL0111	Natural Language Processing			
Lab	Lab3	CSAA6078	Advanced Algorithm Lab	0-0-4	2	207
	Lab4	CSDV6079	Data Visualization Lab	0-0-4	2	208

Specialization: Internet of Things						
Theory	Core 3	CSAA0103	Advance Algorithms	3-0-0	3	171
	Core 4	CSSP0104	Soft Computing	3-0-0	3	172
	Prog. Specific Elective III	CSNI0112	Sensor Networks and Internet of Things	3-0-0	3	181
		CSDV0105	Data Visualization			173
		CSAC0113	IoT Application and Communication Protocol			182
	Prog. Specific Elective IV	CSBD0106	Big Data Analytics	3-0-0	3	174
		CSNY0114	Network Security			193
		CSAM0115	Advanced Machine Learning			184
	Lab	Lab3	CSAA6078	Advance Algorithms Lab	0-0-4	2
Lab4		CSDV6079	Data Visualisation Lab	0-0-4	2	208
Specialization: Information Security						
Theory	Core 3	CSAA0103	Advance Algorithms	3-0-0	3	171
	Core 4	CSSP0104	Soft Computing	3-0-0	3	172
	Prog. Specific Elective III	CSEC0116	Data Encryption & Compression	3-0-0	3	186
		CSSW0117	Steganography & Digital Watermarking			187
		CSIT0118	Information Theory & Coding			188
	Prog. Specific Elective IV	CSRA0119	Security Assessment and Risk Analysis	3-0-0	3	189
		CSCD0120	Secure Coding			191
		CSBI0121	Biometrics			192
	Lab	Lab3	CSAA6078	Advance Algorithms Lab	0-0-4	2
Lab4		CSEN6080	Data Encryption & Compression Lab	0-0-4	2	209
Project		CSMI6081	Mini Project	0-0-4	2	210
Audit	Audit 2 MOOCs)	EDCI0100	Constitution of India	2-0-0	2	
Total Credits				14-0-12	20	

Semester III							
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page	
Specialization: Data Science							
Theory	Prog. Specific Elective V		GPU Computing	3-0-0	3		
			Cloud Computing				
			Distributed Databases				
	Specialization: Internet of Things						
	Prog. Specific Elective V		Cloud Computing	3-0-0	3		
			IOT and Smart Cities				
			Emulation and Simulation Methodologies				
	Specialization: Information Security						
	Prog. Specific Elective V		Data Warehousing & Mining	3-0-0	3		
		Web Search & Information Retrieval					
		Database Security and Access Control					
Open Elective		Business Analytics	3-0-0	3			
Project	Dissertation		Dissertation Phase – I	0-0-20	10		
Total Credits				6-0-20	16		

Semester IV						
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page
Project	Specialization: Data Science					
	Dissertation		Dissertation Phase – II	0-0-32	16	
	Specialization: Internet of Things					
	Dissertation		Dissertation Phase – II	0-0-32	16	
Project	Specialization: Information Security					
	Dissertation		Dissertation Phase – II	0-0-32	16	
Total Credits				0-0-32	16	

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BACHELOR OF TECHNOLOGY (BATCH 2018-19), (BATCH 2019-20)

Semester I						
Type	Type of Course/Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	PSPT0038	Physics for Technologists	3-1-0	4	721
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	706
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	142
Lab	Basic Science Course/IC	PSTC6016	Physics for Technologists- Lab	0-0-4	2	726
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	2	201
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	444
	Mandatory Course/IC	BTIP7	Student Induction Program- Universal Human Values I	0-0-0	NC	NA
Total Credits					18	

Semester II						
Type	Type of Course/Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	CHEC0027	Engineering Chemistry	3-1-0	4	728
	Basic Science Course/IC	MAIN0013	Mathematics II- Multiple Integrals, Numerical Methods and Differential Equations	3-1-0	4	707
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	338
	Humanities & Social Sciences including Management/IC	LSEH0017	English	2-0-0	2	739

■ COURSE STRUCTURE

Lab	Basic Science Course/IC	CHCE6006	Engineering Chemistry Lab1	0-0-4	1	730
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	380
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	499
	Humanities & Social Sciences including Management/IC	LSOC6004	Oral Communication Practice Lab	0-0-2	1	745
	Mandatory Course/IC	BTIP9	Student Induction Program- Universal Human Values II	0-0-0	NC	NA
Total Credits					20	

Semester III						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core Course /DC	ECED0043	Electronic Devices	3-0-0	3	241
	Professional Elective courses/ DE	ECSS0044	Signal and Systems	2-1-0	3	242
	Professional Core Course /DC	ECNT0045	Network Theory	2-1-0	3	243
	Professional Core Course /DC	ECDS0046	Digital System Design	3-0-0	3	244
	Basic Sciences Course /SC	MATC0026	Mathematics III- Transform Calculus, Complex Variable and Probability and Statistics	2-1-0	3	711
	Humanities and Social Science Course /IC	MTEC0074	Economics for Engineers	2-0-0	2	690
	Mandatory Course/IC	CHES0029	Environmental Science	0-0-0	NC	727
Lab	Professional Core Course /DC	ECED6034	Electronic Devices Lab	0-0-2	1	300
	Professional Core Course /DC	ECDS6035	Digital System Design Lab	0-0-2	1	301
Internship		BT1A8	Internship Activity	0-0-6	3	NA
	Mandatory Course/IC	BTIP10	Student Induction Program- Universal Human Values III	0-0-0	NC	NA
Total Credits					22	

Semester IV						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core Course /DC	ECAC0047	Analog Circuits	3-0-0	3	246
	Professional Core Course /DC	ECEL0048	Electronic Measurements	3-0-0	3	247
	Basic Science Course /IC	BOBI0001	Biology	2-1-0	3	733
	Professional Core Course /DC	ECDP0049	Digital Signal Processing	2-1-0	3	248

	Engineering Science Course /IC	MNEE0042	Engineering Mechanics for Electronics and Electricals	3-1-0	4	490
	Humanities and Social Science Course /IC	MTOB0069	Introduction to Organisational Behaviour	2-0-0	2	683
Lab	Professional Core Course /DC	ECAC6036	Analog Circuits Lab	0-0-2	1	301
	Professional Core Course /DC	ECEL6037	Electronic measurements Lab	0-0-2	1	302
	Professional Core Course /DC	ECDP6038	Digital Signal Processing Lab	0-0-2	1	303
	Mandatory Course/IC	BTIP11	Student Induction Program- Universal Human Values IV	0-0-0	NC	NA
Total Credits					21	

Semester V						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core Course /DC		Analog and Digital Communication	3-0-0	3	
	Professional Core Course /DC		Microprocessor and Microcontroller	3-0-0	3	
	Professional Core Course /DC		Computer Architecture	3-0-0	3	
	Professional Core Course /DC		Probability Theory and Stochastic Processes	3-0-0	3	
	Professional Elective Course /DE		Power Electronics/ Biomedical Electronics / Speech and Audio Processing/	3-0-0	3	
	Open Elective Course /SE		Nanotechnology	3-0-0	3	
Lab	Professional Core Course /DC		Analog and Digital Communication Lab	0-0-2	1	
	Professional Core Course /DC		Microprocessor and Microcontroller Lab	0-0-2	1	
	Professional Core Course /DC		Mini Project	0-0-2	1	
Internship			Internship Seminar	0-0-0	3	
			Mini Project	0-0-2	1	
Total Credits				24		

Semester VI						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	SE		Control System	3-0-0	3	
	Professional Core Course /DC		Computer Networks	3-0-0	3	
	Professional Core Course /DC		Electromagnetic Waves	2-0-0	2	

■ COURSE STRUCTURE

	Professional Elective Course/DE		CMOS Design/ Nanoelectronics / Information Theory and Coding	3-0-0	3	
	Open Elective Course/IE		Robotics	3-0-0	3	
	Humanities and Social Science Course /IC		Production and Operations Management	3-0-0	3	
Lab	Professional Core Course /DC		Electromagnetic Waves Lab	0-0-2	1	
	Professional Core Course /DC		Computer Networks Lab	0-0-2	1	
Internship			Industrial Training	0-0-0	0	
Total Credits					20	

Semester VII						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core Course /DC		Antenna and Wave Propagation /Wavelets	3-0-0	3	
	Professional Elective Course /DE		Embedded System/ Mobile Communication and Networks	3-0-0	3	
	Professional Elective Course/DE		Wireless Sensor Network/ Satellite Communication	3-0-0	3	
	Open Elective Course/IC		Pattern Recognition and Machine Learning	3-0-0	3	
	Humanities and Social Science Course/IC		Financial Management and Accounting	2-0-0	2	
Internship			Project-I	0-0-2	1	
			Training Seminar	0-0-0	4	
Total Credits					20	

Semester VIII						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Elective Course /DE		Fiber Optic Communication / Adaptive Signal Processing	3-0-0	3	
	Professional Elective Course /DE		Microwave Theory & Technique / Digital Image and Video Processing/ Mixed Signal Design	3-0-0	3	
	Open Elective Course/IE		IoT-The future of technology	3-0-0	3	
	Open Elective courses/IE		Bioinformatics	3-0-0	3	

Internship	Professional Core Course /DC		Project-II	0-0-9	3	
	Mandatory Course/IC		Essence of Indian Traditional Knowledge		NC	
Total Credits					15	
Total Programme Credits					160	

BACHELOR OF TECHNOLOGY (BATCH 2017-18, 2016-17)

Type	Course Code	Course Name	Credits	Category	Page
Semester V					
Theory	ECMM0021	Microprocessors and Microcontrollers	4	DC/SC	214
	EECE0022	Control System Engineering	4	SC	319
	ECDP0022	Digital Signal Processing	3	DC	215
	ECAC0023	Analog Communication Techniques	4	DC	216
	ECME0024	Microwave Engineering	3	DC	218
	MTFP0070	Functional Principles of Management	2	IE	685
Lab	ECMM6020	Microprocessors and Microcontrollers lab	2	DC/SC	288
	ECAC6021	Analog Communication Techniques Lab	2	DC	289
	ECDP6022	Digital Signal Processing Lab	2	DC	290
Project	ECMI6023	Mini Project II	2	DC	290
EAP	BTEAP5	Extra Academic Programmes	NC	IC	NA
Total Credits			28		
Semester VI					
Theory	EEPE0025	Power Electronics	4	SE	323
	ECAP0026	Antenna and Wave Propagation	3	DC	219
	ECVD0027	VLSI Design	4	DE	221
	ECCT0028	Digital Communication Techniques	4	DC	222
	ECAM0029	Adv Microprocessors and Embedded Systems	3	DE	224
	MTOM0071	Production and Operations Management	2	IE	686
Lab	ECVD6024	VLSI Design Lab	2	DE	291
	ECCT6025	Digital Communications Lab	2	DC	292
	ECME6026	Microwave and Antenna Engineering Lab	2	DC	293
	ECAM6027	Embedded Systems Lab	2	DE	294
Project	ECMI6029	Mini Project III	2	DC	296
AP	BTEAP6	Extra Academic Programmes	NC	IC	NA
Total Credits			30		

Semester VII					
Theory	ECFS0031	Fiber Optic and Satellite Communication	4	DC/SC	225
	EEEM0021	Electrical Machines	4	SC	318
	MTQM0072	Quality Management Systems	2	IE	688
	Two Electives to be opted				
	Elective 1				
	ECTS0032	Telecommunication Switching and systems	4	DE	227
	ECIP0033	Digital Image Processing		DE	228
	ECME0034	Microelectronics		DE	230
	Elective 2				
		CSAI0061	Artificial Intelligence	4	SE
	ECES0035	Embedded Systems	4	DE/SE	232
	ECLV0036	Low Power VLSI Design		DE	233
Lab	ECOP6030	Fiber Optic Lab	2	DC/SC	297
	EEEM6012	Electrical Machines Lab	2	SC	372
Seminar	ECTS6031	Training Seminar	2	DC	297
Project	ECMP6032	Major Project (Phase I)	4	DC	298
Total Credits			28		
Semester VIII					
Theory	ECCC0037	Computer Communication	4	DE	234
	ECMC0038	Mobile Communication	4	DE/SE	235
	PYTW0021	Thoughts That Shaped the World	2	IE	746
	MTFC0073	Financial Management and Accounting	3	IC	689
	Any one elective to be opted				
	ECOD0039	Optoelectronic Devices	3	DE/SE	236
	ECSP0040	Speech Processing		DE	237
ECNT0041	Introduction to Nanotechnology	DE		239	
Project	ECMP6033	Major Project (Phase II) and Viva Voce	8	DC	299
Total Credits			24		

MASTER OF TECHNOLOGY (MTECH) (2019-2020 BATCH)
ELECTRONICS AND COMMUNICATION ENGINEERING

Semester I						
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page
Specialization: Signal Processing						
Theory	Core 1	ECAP0053	Advanced Digital Signal Processing	3-0-0	3	253
	Core 2	ECDV0054	Digital Image and Video Processing	3-0-0	3	255
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	240
	Prog. Specific Elective I	ECAU0055	Audio Processing	3-0-0	3	256
		ECCV0056	Computer Vision			257
		ECAA0057	Advanced Computer Architecture			259
	Prog. Specific Elective II	ECSI0058	Statistical Information Processing	3-0-0	3	260
		ECVD0059	Voice and Data Networks			262
ECVC0060		Audio Video Coding & Compression	263			
Lab	Lab1	ECAP6041	Advanced Digital Signal Processing Lab	0-0-4	2	305
	Lab2	ECDV6042	Digital Image and Video Processing Lab	0-0-4	2	306
Specialization: Communications						
Theory	Core 1	ECAP0053	Advanced Digital Signal Processing	3-0-0	3	253
	Core 2	ECWM0061	Wireless and Mobile Communication	3-0-0	3	264
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	240
	Prog. Specific Elective I	ECSC0062	Satellite Communication	3-0-0	3	265
		ECWN0063	Wireless Sensor Networks			266
		ECON0064	Optical Networks			268
	Prog. Specific Elective II	ECCR0065	Cognitive Radio	3-0-0	3	269
		ECSI0058	Statistical Information Processing			260
ECRC0066		RF and Microwave Circuit Design	270			
Lab	Lab1	ECAP6041	Advanced Digital Signal Processing Lab	0-0-4	2	305
	Lab 2	ECWM6043	Wireless and Mobile Communication Lab			307
Specialization: Embedded System						
Theory	Core 1	ECAP0053	Advanced Digital Signal Processing	3-0-0	3	253
	Core 2	ECMA0067	Microcontroller and Applications	3-0-0	3	271
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	240
	Prog. Specific Elective I	ECP0068	Parallel Processing	3-0-0	3	272
		ECAA0057	Advanced Computer Architecture			259
	Prog. Specific Elective II	ECWM0061	Wireless and Mobile Communication	3-0-0	3	264
ECDV0054		Digital Image and Video Processing	255			
Lab	Lab1	ECAP6041	Advanced Digital Signal Processing Lab	0-0-4	2	305
	Lab2	ECMA6044	Microcontroller and Applications Lab	0-0-4	2	308
Audit	Audit 1	LSRW0041	English for Research Paper Writing	2-0-0	2	742
Total Credits				16-0-8	20	

Semester II						
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page
Specialization: Signal Processing						
Theory	Core 3	ECPM0069	Pattern Recognition and Machine Learning	3-0-0	3	273
	Core 4	ECDE0070	Detection and Estimation Theory	3-0-0	3	274
	Prog. Specific Elective III	ECIA0071	IOT and Applications	3-0-0	3	275
		ECDD0072	Digital Design and Verification			276
	Prog. Specific Elective IV	ECBS0073	Biomedical Signal Processing	3-0-0	3	278
ECDS0074		DSP Architecture	279			
Lab	Lab3	ECPM6045	Pattern Recognition and Machine Learning Lab	0-0-4	2	308
	Lab4	ECDE6046	Detection and Estimation Theory Lab	0-0-4	2	309
Specialization: Communications						
Theory	Core 3	ECRS0075	Antennas and Radiating Systems	3-0-0	3	280
	Core 4	ECCN0076	Advanced Communication Networks	3-0-0	3	281
	Prog. Specific Elective III	ECDS0074	DSP Architecture	3-0-0	3	279
		ECIA0071	IOT and Applications			275
	Prog. Specific Elective IV	ECPM0069	Pattern Recognition and Machine Learning	3-0-0	3	273
ECMS0077		MIMO System	282			
Lab	Lab3	ECRS6047	Antennas and Radiating Systems lab	0-0-4	2	310
	Lab4	ECCN6048	Advanced Communication Networks Lab	0-0-4	2	310
Specialization: Embedded System						
Theory	Core 3	ECDS0074	DSP Architecture	3-0-0	3	279
	Core 4	ECSA0078	Embedded System and Applications	3-0-0	3	284
	Prog. Specific Elective III	ECDD0072	Digital Design and Verification	3-0-0	3	276
		ECIA0071	IOT and Applications			275
	Prog. Specific Elective IV	ECMT0079	Memory Technologies	3-0-0	3	285
ECBS0080		Communication Buses and Interfaces	286			
Lab	Lab3	ECDS6049	DSP Architecture lab	0-0-4	2	312
	Lab4	ECSA6050	Embedded System and Applications Lab	0-0-4	2	312
Project		ECMI6051	Mini Project	0-0-4	2	313
Audit	Audit 2 (MOOCs)	EDCI0100	Constitution of India	2-0-0	2	
Total Credits				14-0-12	20	

Semester III							
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page	
Specialization: Signal Processing							
Theory	Prog. Specific Elective V		Artificial Intelligence	3-0-0	3		
			Optimization Techniques				
			Remote Sensing				
	Specialization: Communications						
	Prog. Specific Elective V		Artificial Intelligence	3-0-0	3		
			Optimization Techniques				
		Remote Sensing					
Specialization: Embedded System							
	Prog. Specific Elective V		Artificial Intelligence	3-0-0	3		
			Nanotechnology and Nanoelectronics				
			SoC Design				
	Open Elective		Composite Materials	3-0-0	3		
Project	Dissertation		Dissertation Phase – I	0-0-20	10		
Total Credits				6-0-20	16		

Semester IV							
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page	
Specialization: Signal Processing							
Project	Dissertation		Dissertation Phase – II	0-0-32	16		
	Specialization: Communications						
	Dissertation		Dissertation Phase – II	0-0-32	16		
	Specialization: Embedded System						
	Dissertation		Dissertation Phase – II	0-0-32	16		
	Total Credits				0-0-32	16	

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BACHELOR OF TECHNOLOGY (BATCH 2018-19), (BATCH 2019-20)

Semester I						
Type	Type of Course/Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	PSPT0038	Physics for Technologists	3-1-0	4	721
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	706
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	142
Lab	Basic Science Course/IC	PSTC6016	Physics for Technologists- Lab	0-0-4	2	726
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	2	201
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	444
	Mandatory Course/IC	BTIP7	Student Induction Program- Universal Human Values I	0-0-0	NC	NA
Total Credits					18	

Semester II						
Type	Type of Course/Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	CHCE0027	Engineering Chemistry	3-1-0	4	728
	Basic Science Course/IC	MAIN0013	Mathematics II-Multiple Integrals, Numerical Methods and Differential Equations	3-1-0	4	707
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	338
	Humanities & Social Sciences including Management/IC	LSEH0017	English	2-0-0	2	739
Lab	Basic Science Course	CHEC6006	Engineering Chemistry Lab1	0-0-4	1	730
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	380
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	499
	Humanities & Social Sciences including Management/IC	LSOC6004	Oral Communication Practice Lab	0-0-2	1	745
	Mandatory Course/IC	BTIP9	Student Induction Program- Universal Human Values II	0-0-0	NC	NA
Total Credits					20	

Semester III						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core Courses/DC	EECA0041	Electrical Circuit Analysis	3-1-0	4	342
	Professional Core Courses/DC	EEAE0042	Analog Electronics	3-0-0	3	343
	Professional Core Courses/DC	EEMC0044	Electrical Machines – I	3-0-0	3	345
	Professional Core Courses/DC	EEDE0045	Digital Electronics	3-0-0	3	347
	Professional Core Courses/DC	EEEF0043	Electromagnetic Fields	3-0-0	3	344
	Humanities & Social Sciences including Management/IC	MTEC0074	Economics for Engineers	2-0-0	2	690
Lab	Professional Core Courses/DC	EEAE6028	Analog Electronics Lab	0-0-2	1	380
	Professional Core Courses/DC	EEMC6029	Electrical Machines Lab - I	0-0-2	1	381
	Professional Core Courses/DC	EEDE6030	Digital Electronics Lab	0-0-2	1	382
	Mandatory Course/IC	EDCI0100	Constitution of India		NC	
	Mandatory Course/IC	CHES0029	Environmental Science		NC	727
	Internship	BTIA8	Internship Activity		3	NA
	Mandatory Course/IC	BTIP10	Student Induction Pro- gram- Universal Human Values III	0-0-0	NC	NA
Total Credits					24	
Semester IV						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Engineering Science Course/IC	MNEE0042	Engineering Mechanics for Electronics and Electricals	3-1-0	4	490
	Professional Core Courses/DC	EEMS0046	Electrical Machines – II	3-0-0	3	348
	Professional Core Courses/DC	EEPE0047	Power Electronics	3-0-0	3	349
	Basic Sciences Course/IC	MACS0027	Mathematics III – Com- plex Variable, Transform Calculus and Probability and Statistics	3-1-0	4	712
	Basic Sciences Course/IC	BOBI0001	Biology	2-1-0	3	733
	Humanities & Social Sciences including Management/IC	MTOB0069	Introduction to Organisational Behaviour	2-0-0	2	683

■ COURSE STRUCTURE

Lab	Professional Core Courses/DC	EEMS6031	Electrical Machines – II Lab	0-0-2	1	382
	Professional Core Courses/DC	EEPE6032	Power Electronics Laboratory	0-0-2	1	383
	Mandatory Course/IC	BTIP11	Student Induction Program- Universal Human Values IV	0-0-0	NC	NA
Total Credits					21	

Semester V						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core Courses/DC		Power Systems - I	3-0-0	3	
	Professional Core Courses/DC		Control Systems	3-0-0	3	
	Professional Core Courses/DC		Microprocessors	3-0-0	3	
	Professional Core Courses/DC		Signals and Systems	3-0-0	3	
	Professional Elective Courses/DE		Electrical Machine Design/ Electromagnetic Waves	3-0-0	3	
	Open Elective Courses/SE/IE		Electronic Devices/Data Structures and Algorithms	3-0-0	3	
Lab	Professional Core Courses/DC		Microprocessors Laboratory	0-0-2	1	
	Professional Core Courses/DC		Power Systems Laboratory - I	0-0-2	1	
	Professional Core Courses/DC		Control Systems Laboratory	0-0-2	1	
Project	Professional Core Courses/DC		Mini Project-I	0-0-2	1	
Internship			Internship Seminar		3	
Total credits					24	

Semester VI						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core Courses/DC		Power Systems - II	3-0-0	3	
	Professional Core Courses/DC		Measurements and Instrumentation	2-0-0	2	
	Professional Core Courses/DC		Electronic Design	1-0-0	1	
	Humanities & Social Sciences including Management/IC		Production and Operations Management	3-0-0	3	
	Professional Elective Courses/DE		Electrical Drives / High Voltage Engineering	3-0-0	3	

	Professional Elective Courses/DE		Digital Control Systems / Digital Signal	3-0-0	3	
	Open Elective Courses/SE/IE		Embedded Systems	3-0-0	3	
Lab	Professional Core Courses/DC		Power Systems Laboratory - II	0-0-2	1	
	Professional Core Courses/DC		Measurements and Instrumentation Lab	0-0-2	1	
	Professional Core Courses/DC		Electronic Design Laboratory	0-0-4	2	
Project	Professional Core Courses/DC		Mini Project-II	0-0-2	1	
Total Credits					23	

Semester VII						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
	Humanities & Social Sciences including Management/IC		Financial Management and Accounting	2-0-0	2	
	Professional Elective Courses/DE		Power System Protection/ Renewable Energy Systems	3-0-0	3	
	Professional Elective Courses/DE		Power Quality and FACTS/ Power System	3-0-0	3	
	Open Elective Courses/SE/IE		Power Plant Engineering	3-0-0	3	
	Open Elective Courses/SE/IE		Electrical Materials	3-0-0	3	
	Professional Core Courses/DC		Industrial Training		3	
	Professional Core Courses/DC		Major Project Phase-I	0-0-2	1	
Total credits					18	

Semester VIII						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Elective Courses/DE		Electrical Energy Conservation and Auditing / Industrial Electrical Systems	3-0-0	3	
	Open Elective Courses/SE/IE		Analog and Digital Communication	3-0-0	3	
			Utilization of Electrical Energy	3-0-0	3	
Lab	Professional Core Courses/DC		Major Project Phase-II	0-0-6	3	
Total Credits					12	
Total Programme Credits					160	

BACHELOR OF TECHNOLOGY (BATCH 2017-18, 2016-17)

Type	Course Code	Course Name	Credits	Category	Page	
Semester V						
Theory	ECMM0021	Microprocessors and Microcontrollers	4	SC	214	
	ECSP0025	Signal Processing	4	SE	NA	
	EECE0022	Control System Engineering	4	DC	319	
	EEMN0023	Electro Mechanical Energy Conversion II	4	DC	320	
	EEPS0024	Electrical Power Systems I	3	DC	321	
	MTFP0070	Functional Principles of Management	2	IE	685	
Lab	ECMM6020	Microprocessors and Microcontrollers lab	2	SC	288	
	EECE6018	Control and Simulation Lab	2	DC	374	
	EEMN6019	Electro Mechanical Energy Conversion Lab II	2	DC	374	
Project	EEMI6020	Mini Project II	2	DC	376	
AP	BTEAP5	Extra Academic Programmes	NC	IC		
Total Credits			29			
Semester VI						
Theory	EEAD0040	Analog and Digital Communication	3	DC	340	
	EEPD0026	Power Electronics and Drives	4	DC	324	
	EEPS0027	Electrical Power Systems II	4	DC	325	
	EERS0039	Renewable Energy Systems	4	DC	339	
	EEHV0028	High Voltage Engineering	3	DE	327	
	ECAC0019	Analog Integrated Circuits	4	SC	NA	
	MTOM0071	Production and Operations Management	2	IE	686	
Lab	EEPD6021	Power Electronics and Drives Lab	2	DC	376	
	ECAC6011	Analog Integrated Circuits Lab	2	SC	NA	
	ECSP6028	Signal Processing Lab	2	SE	295	
Project	EEMI6022	Mini project III	2	DC	377	
AP	BTEAP6	Extra Academic Programmes	NC	IC	NA	
Total Credits			29			
Semester VII						
Theory	ECFS0031	Fiber Optic and Satellite Communication	4	SE	225	
	EECE0029	Advanced Control System Engineering	4	DE	328	
	EEPP0030	Power System Protection	4	DC	329	
	MTQM0072	Quality Management Systems	2	IE	688	
	One Elective to be opted					
		ECES0035	Embedded Systems	4	SE	232
		CSAI0061	Artificial Intelligence		SE	129
		EEIT0036	Instrumentation and Telemetry		SE	336
		EEUE0032	Utilization of Electrical Energy		DE	332
		EEPE0031	Power Plant Engineering		DE	330
Lab	EECE6023	Control System Engineering Lab	2	DE	377	
	ECOP6030	Fiber Optic Lab	2	SE	297	
Seminar	EETS6024	Training Seminar	2	DC	378	

Project	EEMP6025	Major Project (Phase I)	4	DC	378
Total Credits			28		
Semester VIII					
	EEHV0028	High Voltage Engineering	3	DE	327
	EEED0033	Electrical Drives	4	DC	333
	PYTW0021	Thoughts That Shaped the World	2	IE	746
	MTFC0073	Financial Management and Accounting	3	IC	689
One elective to be opted					
	EEAM0034	Energy Audit and Management	3	DE	334
	ECOD0039	Optoelectronic Devices		SE	236
	EEOC0035	Power System Operation and Control		DE	335
Project	EEMP6026	Major Project (Phase II) and Viva Voce	8	DC	379
Total Credits			23		

MASTER OF TECHNOLOGY (MTECH)

ELECTRICAL AND ELECTRONICS ENGINEERING

Semester I							
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page	
Specialization: Power Systems							
Theory	Core 1	EESA0048	Power System Analysis	3-0-0	3	351	
	Core 2	EESD0049	Power System Dynamics-I	3-0-0	3	352	
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	240	
	Prog. Specific Elective I	EEHP0050	High Power Converters	3-0-0	3	353	
		EEWS0051	Wind and Solar Systems			353	
	Prog. Specific Elective II	EEPD0052	Electrical Power Distribution System	3-0-0	3	354	
EEMM0053		Mathematical Methods for Power Engineering	356				
Lab	Lab1	EESS6033	Power System Steady State Analysis Lab	0-0-4	2	384	
	Lab2	EERE6034	Renewable Energy Lab	0-0-4	2	384	
Specialization: Control Systems							
Theory	Core 1	EEMC0054	Mathematical Methods in Control	3-0-0	3	357	
	Core 2	EENS0055	Non-Linear Systems	3-0-0	3	358	
	Core	ECRM0042	Research Methodology and IPR	2-0-0	2	240	
	Prog. Specific Elective I			Robotics and Automation	3-0-0	3	
		EECL0056	Digital Control				358
		EENC0057	Non Linear Control				359
	Prog. Specific Elective II			Systems Biology	3-0-0	3	
		EESC0058	SCADA system and Applications				360
EEDA0059		Design Aspects in Control		361			

■ COURSE STRUCTURE

Lab	Lab1	EECT6035	Control Lab 1	0-0-4	2	385
	Lab 2	EECL6036	Control Lab 2			385
Audit	Audit 1	LSRW0041	English for Research Paper Writing	2-0-0	0	742
Total				16-0-8	18	

Semester II						
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page
Specialization: Power Systems						
Theory	Core 3	EEDP0060	Digital Protection of Power System	3-0-0	3	362
	Core 4	EEP0061	Power System Dynamics-II	3-0-0	3	363
	Prog. Specific Elective III	EERP0062	Restructured Power Systems	3-0-0	3	364
		EEAS0063	Advanced Digital Signal Processing			365
	Prog. Specific Elective IV	EEAS0064	Power System Transients	3-0-0	3	364
EEFC0065		FACTS and Custom Power Devices	367			
Lab	Lab3	EEPL6037	Power System Protection Lab	0-0-4	2	386
	Lab4	EEPA6038	Power Electronics Applications to Power Systems Lab	0-0-4	2	386
Specialization: Control Systems						
Theory	Core 3	EEOC0066	Optimal Control Theory	3-0-0	3	368
	Core 4	EESF0067	Stochastic Filtering and Identification	3-0-0	3	369
	Prog. Specific Elective III	EECS0068	Advance Control System	3-0-0	3	370
		EEAL0069	Adaptive Learning and Control			371
	Prog. Specific Elective IV	EEMR0070	Model Reduction in Control	3-0-0	3	371
EERC0071		Robust Control	372			
Lab	Lab3	EEAL6039	Advanced Control Lab 1	0-0-4	2	387
	Lab4	EEAC6040	Advanced Control Lab 2	0-0-4	2	387
Project		EEMP6041	Mini Project	0-0-4	2	388
Audit	Audit 2 (MOOCs)	EDCI0100	Constitution of India	0-0-4	2	
Total Credits				14-0-12	18	

Semester III						
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page
Specialization: Power Systems						
Theory	Prog. Specific Elective V		Advanced Micro-Controller Based Systems	3-0-0	3	
			Power Quality			
	Prog. Specific Elective V		Modeling and Control of Distributed	3-0-0	3	
			Parameter Systems			
			Stochastic Control			
		Computational Methods				

	Open Elective		1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy	3-0-0	3	
Project	Dissertation		Dissertation Phase – I	0-0-20	10	
Total Credits				6-0-20	16	

Semester IV						
Type	Course Type/Category	Course Code	Course Title	L-T-P	Credits	Page
Project	Specialization: Power Systems					
	Dissertation		Dissertation Phase – II	0-0-32	16	
	Specialization: Control Systems					
	Dissertation		Dissertation Phase – II	0-0-32	16	

DEPARTMENT OF CIVIL ENGINEERING
BACHELOR OF TECHNOLOGY (BATCH 2018-19), (BATCH 2019-20)

Semester I						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	CHCE0027	Engineering Chemistry	3-1-0	4	728
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	706
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	338
Lab	Basic Science Course	CHCE6007	Engineering Chemistry Lab	0-0-2	2	731
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	380
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	499
	Mandatory Course/IC	BTIP7	Student Induction Program- Universal Human Values I	0-0-0	NC	NA
Total Credits					18	

Semester II						
Type	Type of Course/Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	PSEP0039	Engineering Physics: Mechanics	3-1-0	4	722
	Basic Science Course/IC	MAIN0013	Mathematics II-Multiple Integrals, Numerical Methods and Differential Equations	3-1-0	4	707
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	142
	Humanities & Social Sciences including Management/IC	LSEH0017	English	2-0-0	2	739
Lab	Basic Science Course/IC	PSEG6017	Physics Lab for Engineers	0-0-2	1	726
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	444
	Humanities & Social Sciences including Management/IC	LSOC6004	Oral Communication Practice Lab	0-0-2	1	745
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	2	201
	Mandatory Course/IC	BTIP9	Student Induction Program- Universal Human Values II	0-0-0	NC	NA
Total Credits					20	

Semester III						
Type	Type of Course/Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Engineering Science Course/IC	ECBE0051	Basic Electronics	1-0-0	1	251
	Basic Science Course/IC	BOBE0002	Biology for Engineering	3-0-0	3	734
	Engineering Science Course/IC	MNEM0034	Engineering Mechanics	3-1-0	4	479
	Engineering Science Course/IC	CVES0046	Energy science and Engineering	1-1-0	2	422
	Basic Science Course/IC	MATD0028	Mathematics III- Transform Calculus and Discrete Mathematics	2-0-0	2	714
	Humanities & Social Sciences including Management/IC	LSET0040	Effective Technical communication	3-0-0	3	741
	Humanities & Social Sciences including Management/IC	CVIC0054	Introduction to Civil Engineering	2-0-0	2	434
	Engineering Science Course/IC	ECBE6040	Basic Electronics Lab	0-0-2	1	305
	Engineering Science Course/IC	CVCA6025	Computer Aided Civil Engineering Drawing Lab	1-0-2	2	447

Internship		BTIA8	Internship Activity	0-0-3	3	NA
	Mandatory Course/IC	BTIP910	Student Induction Program- Universal Human Values III	0-0-0	NC	NA
Total Credits					23	
Semester IV						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	page
Theory	Engineering Science Course/DC	MNME0041	Elements of Mechanical Engineering	2-1-01	3	489
	Professional core course/DC	CVIS0053	Instrumentation and sensor Technologies for Civil engineering Applications	1-1-0	2	432
	Professional core course/DC	CVEG0047	Engineering Geology	1-0-0	1	423
	Professional core course/DC	CVDP0048	Disaster Preparedness & Planning	1-1-0	2	425
	Professional core course/DC	CVFM0049	Introduction to Fluid Mechanics	2-0-0	2	427
	Professional core course/DC	CVSM0050	Introduction to Solid Mechanics	2-0-0	2	428
	Professional core course/DC	CVSG0051	Surveying & Geomatics	1-1-0	2	429
	Professional core course/DC	CVMT0052	Materials, Testing and Evaluation	1-1-0	2	431
Lab	Humanities and Social Sciences including Management courses/IC	CVSG0055	Civil Engineering - Societal & Global Impact	2-0-0	3	436
	Professional core course/DC	CVIS6031	Instrumentation & Sensor Technologies for Civil Engineering Applications Lab	0-0-2	1	451
	Professional core course/DC	CVEG6026	Engineering Geology Lab	0-0-2	1	448
	Professional core course/DC	CVFM6027	Introduction to Fluid Mechanics Lab	0-0-2	1	449
	Professional core course/DC	CVSM6028	Introduction to Solid Mechanics Lab	0-0-2	1	449
	Professional core course/DC	CVSG6029	Surveying & Geomatics Lab	0-0-2	1	450
	Professional core course/DC	CVMT6030	Materials, Testing and Evaluation Lab	0-0-2	1	451
	Mandatory Course/IC	MTOB0086	Organizational Behaviour	3-0-0	0	692
	Mandatory Course/IC	BTIP11	Student Induction Program- Universal Human Values IV	0-0-0	NC	NA
Total Credits					23	

Semester V						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Core course/DC		Mechanics of Materials	3-0-0	3	
	Professional Core course/DC		Hydraulic Engineering	2-0-0	2	
	Professional Core course/DC		Structural Engineering	2-1-0	3	
	Professional Core course/DC		Geotechnical Engineering	2-0-0	2	
	Professional Core course/DC		Hydrology & Water Resources Engineering	2-1-0	3	
	Professional Core course/DC		Environmental Engineering	2-0-0	2	
	Professional Core course/DC		Transportation Engineering	2-0-0	2	
	Humanities and Social Sciences including Management courses /IC		Professional Practice, Law & Ethics	2-0-0	2	
	Mandatory courses/IC		Constitution of India	0-0-0	NC	
Lab	Professional Core course/DC		Hydraulic Engineering	0-0-2	1	
	Professional Core course/DC		Geotechnical Engineering	0-0-2	1	
	Professional Core course/DC		Environmental Engineering	0-0-2	1	
	Professional Core course/DC		Transportation Engineering	0-0-2	1	
	Internship		Internship Seminar		4	
Total Credits					26	

Semester VI						
Type	Course Code		Course Title	L-T-P	Credits	Page
Theory	Professional Core courses/DC		Construction Engineering & Management	2-1-0	3	
	Professional Core courses/DC		Engineering Economics, Estimation & Costing	2-1-0	3	
	Professional Elective courses/DE		Elective-I (Design of Concrete Structures I/Building construction practice/Design of Structural Systems	3-0-0	3	
			Civil Engineering Design I			
	Professional Elective courses/DE		Elective-II(Structural Analysis I/Metal Structure Behavior – I/Design of Structural Systems)	3-0-0	3	
	Open Elective courses/IE		Open Elective-I (Humanities) History of Science and Engineering	3-0-0	3	

	Professional Elective courses/ DC		Elective-III (Soil Mechanics I/ Railway Engineering	3-0-0	3	
			Physico Chemical Processes of Water and Waste Water Treatment			
	Professional Elective courses/ DE		Elective-IV (Design of Steel Structures/Urban transportation planning/Port and Harbour Engineering)	3-0-0	3	
Lab	Professional Core courses/DC		Engineering Economics, Estimation & Costing-Lab	0-0-4	2	
	Internship		Internship (Survey Camp)	0-0-2	1	
Total Credits						

Semester VII						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Engineering Science Course		Life Science	1-0-2	2	
	Professional Elective courses/ DE	Structural Analysis II)	Elective V (Open Channel flow/Traffic Engineering and Management/	3-0-0	3	
	Professional Elective courses/ DE	Design of hydraulic structure/Irrigation Engineering)	Elective-VI (Design of Concrete Structures II/ Basics of Computational Hydraulics/ environmental Geotechnology/	3-0-0	3	
	Project/DC		Project-I	0-0-2	1	
	Internship		Industrial Training		4	
Total Credits					13	

Semester VIII						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Elective courses/ DE		Elective VII (Bridge Engineering/ Prestressed Concrete/	3-0-0	3	
			Soil Mechanics II/			
			Environmental Impact Assessment and Life Cycle Analysis			
			Elective VIII (Structural Dynamics/ Earthquake Engineering/ Geographic Information Systems and Science/Port and Harbor Engineering/ Repairs and Rehabilitation of Structures)			

			Open Elective-II- Environmental Law and policy/ Soft skills and inter personal communication			
			Open Elective-III-Sustainable engineering and Technology- /Economic Policies in India			
			Project-II			
			Essence of Indian Traditional Knowledge			
Total Credits				13		
Total Programme Credits				160		

BACHELOR OF TECHNOLOGY (BATCH 2017-18, 2016-17)

Type	Course Code	Course Name	Credits	Category	Page
Semester V					
Theory	CVSA0022	Structural Analysis II	4	DC	391
	CVDS0023	Design of Structures I	4	DC	392
	CVGE0024	Geotechnical Engineering I	4	DC	394
	CVTE0025	Transportation Engineering I	4	DC	395
	CVEE0026	Environmental Engineering I	4	DC	397
	MTFP0070	Functional Principles of Management	2	IE	685
Lab	CVGE6013	Geotechnical Engineering Lab	2	DC	438
	CVES6014	Engineering Survey Lab II	2	DC	439
Project	CVMI6015	Mini Project	2	DC	440
AP	BTEAP5	Extra Academic Programmes	NC	IC	NA
Total Credits			28		
Semester VI					
Theory	CVSA0027	Structural Analysis III	4	DC	398
	CVDS0028	Design of Structures II	4	DC	399
	CVGE0029	Geotechnical Engineering II	4	DC	401
	CVEE0030	Environmental Engineering II	4	DC	302
	CVHW0031	Hydrology and Watershed Management	4	DC	404
	MTOM0071	Production and Operations Management	2	IE	685
Lab	CVTE6016	Transportation Engineering Lab	2	DC	440
	CVEE6017	Environmental Engineering Lab	2	DC	441
	CVCS6018	Comprehensive Surveying Camp	2	DC	441
Project	CVMI6019	Minor Project	4	DC	442
AP	BTEAP6	Extra Academic Programmes	NC	IC	NA
Total Credits			32		

Semester VII					
Theory	CVEC0032	Estimation and Costing	4	DC	405
	CVIG0033	Irrigation Engineering	4	DE	406
	CVEG0034	Earthquake Engineering	4	DE	408
	CVTE0035	Transportation Engineering II	4	DC	409
	MTQM0072	Quality Management Systems	2	IE	688
	One Elective to be opted				
	CVOF0037	Open Channel Flow	3	DE	412
	CVFM0021	Finite Element Methods		DE	390
	CVBC0043	Basics of Computational Hydraulics			420
	CVTM0044	Traffic Engineering and Management			421
Lab	CVCA6020	Computer Applications in Civil Engineering	2	DC	442
Seminar	CVTS6021	Training Seminar	2	DC	443
Project	CVMP6022	Major Project (Phase I)	4	DC	443
Total Credits			29		
Semester VIII					
Theory	CVDS0038	Design of Structure III	5	DC	413
	CVWE0039	Water Resources Engineering	4	DE	415
	CVCM0040	Construction Management	2	DE	416
	PYTW0021	Thoughts That Shaped the World	2	IE	746
	MTFC0073	Financial Management and Accounting	3	IC	689
	One elective to be opted				
	CVGO0036	Elements of Geoinformatics	3	DE	410
	CVDM0041	Disaster Management		DE	417
	CVAF0042	Advanced Foundation Engineering		DE	419
Project	CVMP6023	Major Project (Phase II)	8	DC	444
Total Credits			27		

DEPARTMENT OF MECHANICAL ENGINEERING

BACHELOR OF TECHNOLOGY (BATCH 2018-19), (BATCH 2019-20)

Semester I						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	CHCE0027	Engineering Chemistry	3-1-0	4	728
	Basic Science Course/IC	MACL0012	Mathematics I - Calculus and Linear Algebra	3-1-0	4	706
	Engineering Science Course/IC	EEBE0038	Basic Electrical Engineering	3-1-0	4	338
Lab	Basic Science Course	CHCE6007	Engineering Chemistry Lab	0-0-2	2	731
	Engineering Science Course/IC	EEBL6027	Basic Electrical Engineering Laboratory	0-0-2	1	380
	Engineering Science Course/IC	MNWM6023	Workshop/Manufacturing Practice	1-0-4	3	499
	Mandatory Course/IC	BTIP7	Student Induction Program- Universal Human Values I	0-0-0	NC	
Total Credits					18	

Semester II						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science Course/IC	PSET0040	Engineering Physics: Electromagnetic Theory	3-1-0	4	723
	Basic Science Course/IC	MAIN0013	Mathematics II-Multiple Integrals, Numerical Methods and Differential Equations	3-1-0	4	707
	Engineering Science Course/IC	CSPS0079	Programming for Problem Solving	3-0-0	3	142
	Humanities & Social Sciences including Management/IC	LSEH0017	English	2-0-0	2	739
Lab	Basic Science Course/IC	PSEG6017	Physics Lab for Engineers	0-0-2	1	726
	Engineering Science Course/IC	CVED6024	Engineering Graphics and Design	1-0-4	3	444
	Humanities & Social Sciences including Management/IC	LSOC6004	Oral Communication Practice Lab	0-0-2	1	745
	Engineering Science Course/IC	CSPL6069	Programming for Problem Solving Lab	0-0-4	2	201
	Mandatory Course/IC	EDCI0100	Constitution of India	0-0-0	NC	
	Mandatory Course/IC	BTIP9	Student Induction Program- Universal Human Values II	0-0-0	NC	
Total Credits					20	

Semester III						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Basic Science course/IC	PSWO0052	Engineering Physics: Waves and Optics	3-0-1	4	
	Basic Science course/IC	MACP0029	Engineering Mathematics III-Complex Variables, PDE and Probability and statistics	3-1-0	4	715
	Basic Science course/IC	BOBE0002	Biology for Engineering	3-0-0	3	734
	Engineering Science Course/IC	ECEE0052	Basic Electronics Engineering	3-1-0	4	252
	Engineering Science Course/IC	MNEM0034	Engineering Mechanics	3-1-0	4	479
	Professional core course/DC	MNBT0035	Basic Thermodynamics	3-1-0	4	481
	Audit Course	MNMD6024	Machine Drawing Lab	0-0-2	NC	NA
	Internship	BTIA8	Internship Activity		3	
	Mandatory Course/IC	BTIP10	Student Induction Program-Universal Human Values III	0-0-0	NC	
Total Credits					26	

Semester IV						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional core course/DC	MNAP0036	Applied Thermodynamics	3-1-0	4	482
	Professional core course/DC	MNFM0037	Fluid Mechanics	3-1-0	4	484
	Professional core course/DC	MNSM0038	Strength of Materials	3-1-0	4	485
	Engineering Science Course/IC	MNSE0039	Materials Science and Engineering	3-0-0	3	486
	Professional core course/DC	MNIC0040	Instrumentation and Control	3-0-0		487
	Mandatory Course	CHES0029	Environmental Science	0-0-0	NC	727
	Lab		MNMF6025	Mechanical Engineering Lab1: Materials and Manufacturing Lab	0-0-4	2
Mandatory Course/IC		BTIP11	Student Induction Program-Universal Human Values IV	0-0-0	NC	
Total Credits					20	

Semester V						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional core course/DC		Heat Transfer	3-1-0	4	
	Professional core course/DC		Design of Machine Elements	3-1-0	4	
	Professional core course/DC		Manufacturing Processes	3-1-0	4	
	Professional core course/DC		Kinematics & Theory of Machine	3-1-0	4	
	Humanities		Economics	3-0-0	3	
Lab	Professional core course/DC		Mechanical Engineering Lab2: Fluid and Thermal	0-0-4	2	
	Internship		Internship Seminar		3	
			Mini Project	0-0-2	1	
	Mandatory Course/IC		Constitution of India		NC	
Total Credits					25	

Semester VI						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional core course/DC		Manufacturing Technology	4-0-0	4	
	Professional core course/DC		Machine Design and Dynamics	3-1-0	4	
	Professional Elective Courses I/DE		a) Hydraulic Machines b) Advance Manufacturing Processes	3-0-0	3	
	Professional Elective Courses II/DE		a) Composite Materials b) Internal Combustion Engines	3-0-0	3	
	Open Elective Humanities and Social Sciences including Management courses/IC		Production and Operation Management	3-0-0	3	
Lab	Professional core course/DC		Mechanical Engineering Lab3: Design	0-0-4	2	
Total Credits					19	

Semester VII						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional core course/DC		Automation in Manufacturing	3-0-0	3	
	Professional Elective courses III /DE		a) Refrigeration and Air Conditioning b) Non-con ventional Sources of energy c) Solid Mechanics	3-0-0	3	
	Professional Elective courses IV/DE		a) Energy Conservation and Waste Heat Recovery b) Automobile Engineering	3-0-0	3	
	Open Elective courses/IE		a) Power Plant Engineering b) Total Quality Management	3-0-0	3	
Project	Professional core course/DC		Major Project Phase I	0-0-2	1	
Internship			Industrial Training		3	
Total Credits					16	

Semester VIII						
Type	Type of Course/ Category	Course Code	Course Title	L-T-P	Credits	Page
Theory	Professional Elective courses V /DE		a) CAD/CAM b) Surface Engineering	3-0-0	3	
	Professional Elective courses VI / DE		a) Welding Technology b) Gas Turbines and Jet Propulsion	3-0-0	3	
	Open Elective courses/IE		Numerical Methods and Optimization	3-0-0	3	
	Open Elective courses/IE		Robotics and Automation	3-0-0	3	
Project	Professional core course/DC		Major Project Phase II	0-0-8	4	
	Mandatory Course/IC		Essence of Indian Traditional Knowledge		NC	
Total Credits					16	
Total Programme Credits					160	

BACHELOR OF TECHNOLOGY (BATCH 2017-18, 2016-17)

Semester V					
Type	Course Code	Course Name	Credits	Category	Page
Theory	MNHM0010	Hydraulics Machinery	3	DC	454
	MNDM0011	Dynamics of Machines	4	DC	455
	MNMT0012	Manufacturing Technology II	4	DC	456
	MNAT0013	Applied Thermodynamics	3	DC	457
	MNMD0014	Machine Design I	4	DC	458
	MTFP0070	Functional Principles of Management	2	IE	685
Lab	MNTM6008	Theory of Machines Lab	2	DC	491
	MNTD6021	Thermodynamics Lab	2	DC	492
	MNHY6010	Hydraulics Lab	2	DC	492
	MNMI6011	Mini Project I	2	DC	493
AP	BTEAP5	Extra Academic Programmes	NC	IC	
		Total Credits	28		
Semester VI					
Theory	MNOR0015	Operations Research	4	DE	459
	MNMM0016	Mechanical Measurement	3	DC	461
	MNHT0031	Heat Transfer	4	DC	476
	MNMD0018	Machine Design II	4	DC	462
	MNMT0019	Engineering Metrology	2	IE	463
	MTOM0071	Production and Operations Management			686
Lab	MNHT6022	Heat Transfer Lab	2	DC	498
	MNMM6013	Engineering Metrology and Measurement Lab	2	DE	493
	MNMD6014	Machine Design and Drawing Lab	2	DC	494
Project	MNMP6015	Minor Project	2	DC	
		Total Credits	29		
Semester VII					
Theory	MNMS0020	Manufacturing Methods	4	DC	468
	MNIC0033	Internal Combustion Engines	3	DC	478
	MNVC0022	Vibration of Mechanical Systems and Control	4	DC	468
	MNHT0032	Heat Transfer II	3	DC	479
	One Elective to be opted				
	MNNM0023	Numerical Methods in Mechanical Engineering	3	DE	467
	MNPP0024	Power Plant Engineering		DE	468
	MTQM0072	Quality Management Systems	2	IE	468
Lab	MNVC6016	Vibration of Mechanical Systems and Control Lab	2	DC	495
	MNIC6017	Internal Combustion Engine Lab	2	DC	496
Seminar	MNTS6018	Training seminar	2	DC	496
Project	MNMP6019	Major Project (Phase I)	4	DC	497

Total Credits			29			
Semester VIII						
Theory	MNIE0025	Industrial Engineering	5	DE	469	
	MNRA0026	Refrigeration and Air Conditioning	4	DE	471	
	PYTW0021	Thoughts That shaped the World	2	IE	746	
	MTFC0073	Financial Management and Accounting	3	IC	689	
	One Elective to be opted					
	MNDM0027	Computer Aided Design and Manufacturing	3	DE	473	
	MNAE0028	Automobile Engineering		DE	474	
Project	MNMP6020	Major Project (Phase II) and Viva Voce	8	DC	497	
Total Credits			25			

DEPARTMENT OF COMPUTER APPLICATIONS
BACHELOR OF COMPUTER APPLICATIONS (BCA)

Type	Course Code	Course Name	Credits	Category	Page
Semester I					
Theory	LSCE0001	Communicative English I	2	IC	736
	CACF0008	Computer Fundamentals	4	DC	514
	CACP0009	Computer Programming in C Language	3	DC	516
	CAIF0010	Information Security Fundamentals	4	DC	518
	MABM0006	Basic Mathematics	4	IC	704
Lab	LSCE6001	Communication Practice Lab I	1	IC	743
	CACF6007	Computer Fundamentals Lab	2	DC	565
	CACP6008	Computer Programming in C lab	2	DC	566
AP	ICEAP1	Extra Academic Programmes	NC	IC	
Total Credits			22		
Semester II					
Theory	LSCE0002	Communicative English II	2	IC	737
	CADS0011	Data Structures Using C	4	DC	519
	CANW0012	Computer Network Fundamentals	3	DC	520
	CAWT0013	Web Technologies	4	DC	521
	CALD0001	Digital Logic Design	4	DC	504
Lab	LSCE6002	Communicative English II lab	1	IC	744
	CADS6009	Data Structures using C lab	2	DC	567
	CANW6010	Computer Networks Fundamentals lab	2	DC	567
	CAWT6011	Web Technologies Lab	2	DC	568
	CADL6002	Digital Logic Design Lab	2	DC	561
AP	ICEAP2	Extra Academic Programmes	NC	IC	
Total Credits			26		

Semester III					
Theory	CAOA0007	Computer Organization and Architecture	4	DC	513
	CAOS0025	Introduction to Operating Systems	4	DC	540
	CASD0026	System Analysis and Design	4	DC	541
	MTFP0070	Functional Principles of Management	2	IE	685
	CAIG0027	Introduction to Computer Graphics	2	DC	542
	MADM0002	Discrete Mathematics	4	IC	703
Lab	CAOA6006	Computer Organization and Architecture Lab	2	DC	564
	CAOS6020	Introduction to Operating Systems Lab	2	DC	576
	CAIG6021	Introduction to Computer Graphics Lab	2	DC	576
AP	ICEAP3	Extra Academic Programmes	NC	IC	
Total Credits			26		
Semester IV					
Theory	CADB0028	Relational Database Management Systems	4	DC	543
	CASE0029	Basic Software Engineering	4	DC	544
	MAPT0008	Probability theory	3	IC	705
	CATC0003	Theory of computation	3	DC	507
	CAOP0005	Object Oriented Programming and Design	4	DC	510
Lab	CADB6022	Relational Database Management Systems Lab	2	DC	577
	CASE6023	Basic Software Engineering Lab	2	DC	578
	CAOP6004	Object Oriented Programming and Design Lab	2	DC	563
AP	ICEAP4	Extra Academic Programmes	NC	IC	
Total Credits			24		
Semester V					
Theory	MTOB0001	Organizational Behavior	4	IC	681
	MTAF0002	Accounting and Financial management	4	IC	682
	CADC0037	Data Communication	4	DC	554
	CAIJ0038	Introduction to Java Programming	4	DC	555
Lab	CADC6028	Data Communication Lab	2	DC	581
	CAIJ6029	Introduction to Java Programming Lab	2	DC	581
Project	CAMI6030	Mini Project - BCA	4	DC	582
Total Credits			24		
Semester VI					
	CAPM0042	Python and Machine Learning			559
Theory	CHES0002	Environmental Studies	2	IC	727
	Electives : One elective to be opted for				
	CACL0039	Cloud Computing	4	DE	556
	CANS0040	Network Security		DE	557
	CAMC0041	Mobile Communication		DE	558
	CAPM6032	Python and Machine Learning IAB			583

Project	CAMP6031	Major Project - BCA	16	DC	582
Total Credits			22		
Total Programme Credits			144		

MASTER OF COMPUTER APPLICATIONS (MCA)

Type	Course Code	Course Name	Credits	Category	Page
Semester I					
Theory	CALD0001	Digital Logic Design	4	DC	504
	CAPC0002	Programming and Problem Solving through C	4	DC	505
	MTOB0001	Organisational Behaviour	4	IC	681
	MTAF0002	Accounting and Financial Management	4	IC	682
	MADM0002	Discrete Mathematics	4	IC	703
Lab	CAPC6001	Programming and Problem Solving Through C Lab	2	DC	561
	CADL6002	Digital Logic Design Lab	2	DC	561
AP	MCEAP1	Extra Academic Programmes	NC	IC	
Total Credits			24		
Semester II					
Theory	CATC0003	Theory of Computation	3	DC	507
	CADS0004	Data Structures Using C ++	4	DC	508
	CAOP0005	Object Oriented Programming and Design	4	DC	510
	CADM0006	Database Management Systems I	4	DC	512
	CAOA0007	Computer Organisation and Architecture	4	DC	513
	MAPT0008	Probability Theory	3	IC	705
Lab	CADS6003	Data Structures Using C++ Lab	2	DC	562
	CAOP6004	Object Oriented Programming and design Lab	2	DC	563
	CADM6005	Database Management Systems I Lab	2	DC	563
	CAOA6006	Computer Organisation and Architecture lab	2	DC	564
AP	MCEAP2	Extra Academic Programmes	NC	IC	
Total Credits			30		
Semester III					
Theory	CACG0014	Computer Graphics	3	DC	523
	CADC0015	Data Communication and Networks I	4	DC	524
	CAOS0016	Operating Systems	4	DC	526
	CADA0017	Design and Analysis of Algorithms	4	DC	527
	CAPJ0018	Programming Through Java	4	DE	569
Lab	CAOS6012	Operating Systems Lab	2	DC	569
	CADA6013	Design and Analysis of Algorithms Lab	2	DC	570
	CAPJ6014	Programming Through Java Lab	2	DE	571
	CACG6015	Computer Graphics Lab	2	DC	571
AP	MCEAP3	Extra Academic Programmes	NC	IC	
Total Credits			27		

Semester IV					
Theory	CASE0019	Software Engineering	4	DC	531
	CADC0020	Data Communication and Networks II & Network Programming using Linux	4	DC	533
	CADM0021	Database Management Systems II	4	DC	535
	CAIT0022	Internet Technology and Applications	3	DE	536
	CASG0023	System Programming	3	DC	537
	CAEP0024	Enterprise Resource Planning	3	DE	538
Lab	CADC6016	Data Communication and Networks II and Network programming Using Linux Lab	2	DC	572
	CAIT6017	Internet Technology and Applications Lab	2	DE	573
	CADM6018	Database Management Systems II Lab	2	DC	574
	CASG6019	System Programming Lab	2	DC	575
AP	MCEAP4	Extra Academic Programmes	NC	IC	
Total Credits			29		
Semester V					
Theory	CAPA0030	Principles of Artificial Intelligence	4	DE	545
	CAET0031	Emerging Trends in Cloud Computing	4	DE	546
	CARM0032	Introduction to Research Methodology and Statistical Tools	3	DC	548
	Electives: One elective to be opted for				
	CACL0033	Cyber Law and IT Security	4	DE	549
	CAEC0034	E-Commerce and Data Security		DE	550
	CADW0035	Data Warehousing and Data Mining		DE	551
	CAAD0036	Android Application Development Fundamentals		DE	553
	Audit Courses				
	LSCS0016	Communication Skills	NC	IE	739
CMES0023	Entrepreneurship	NC	IE	600	
Lab	CAPA6024	Principles of Artificial Intelligence Lab	2	DE	578
	CARM6025	Introduction to Research Methodology and Statistical Tools Lab	2	DC	579
Project	CAMN6026	Minor Project - MCA	4	DC	579
Total Credits			19		
Semester VI					
Project	CAMP6027	Major Project - MCA	12	DC	580
Total Credits			12		
Total Programme Credits			145		

SCHOOL OF COMMERCE AND MANAGEMENT
DEPARTMENT OF COMMERCE
BACHELOR OF COMMERCE (2019 Batch)

Type of Course/Category	Course Code	Course Name	Credits (L-T-P)	Page
Semester I				
Core Paper1/ DC	CMFA0067	Financial Accounting	(5-1-0)	647
Core Paper2/DC	CMBL0068	Business Law	(5-1-0)	649
Ability Enhancement compulsory Course -1/IC	CHES0002	Environmental Studies	(2-0-0)	727
General Elective -I/IE/SE	CMME0069	Micro Economics	(5-1-0)	651
		Insurance and Risk Management		
		Principles of Management		
Total Credits			20	
Semester II				
Core Paper3/DC	CMCA0070	Corporate Accounting	(5-1-0)	653
Core Paper4/DC	CMCL0071	Corporate Laws	(5-1-0)	655
Ability Enhancement compulsory Course -1/IC	LSBC0039	Business Communication	(2-0-0)	740
General Elective -II/IE/SE	CMMC0072	Macro Economics	(5-1-0)	656
		Investing in Stock Markets		
Total Credits			20	
Semester III				
Core Paper5/DC		Human Resource Management	(5-1-0)	
Core Paper6/DC		Income-tax Law and Practice	(5-1-0)	
Core Paper7/DC		Management Principles and Applications	(5-1-0)	
Skill Enhancement Course 1/IE		E-Commerce	(2-0-0)	
General Elective -III/IE/SE		Business Statistics		
		Project Management		
Total Credits			26	
Semester IV				
Core Paper8/DC		Cost Accounting	(5-1-0)	
Core Paper9/DC		Business Mathematics	(5-1-0)	
Core Paper10		Computer Applications in Business	(5-1-0)	
Skill Enhancement Course 2/IE		Entrepreneurship	(2-0-0)	
General Elective -IV/IE/SE		Indian Economy		
		Indian Financial System		
<p>*At the end of fourth semester, students have to compulsorily undergo 4 weeks (100-120 hours) of non-credited internship which will be graded as Pass/No Pass. The internship will be evaluated at the end of 6th semester based on the following parameters –</p> <ul style="list-style-type: none"> • Internship Diary • Internship Report • Internship Presentation 				
Total Credits			26	

Semester V				
Core Paper11/DC		Principles of Marketing	(5-1-0)	
Core Paper12/DC		Fundamentals of Financial Management	(5-1-0)	
Discipline Specific Elective I/DE and Discipline Specific Elective II/DE (Any two Group A)		a. Management Accounting	(5-1-0)	
		b. Corporate Tax Planning		
		c. Advertising		
		d. Banking and Insurance	(5-1-0)	
		e. Computerized Accounting System		
		f. Financial Markets, Institutions and Financial Services		
Total Credits			24	
Semester VI				
Core Paper13/DC		Auditing and Corporate Governance	(5-1-0)	
Core Paper14/DC		Indirect Tax Law	(5-1-0)	
Discipline Specific Elective III/DE and Discipline Specific Elective IV/DE (Any two Group B)		a. Fundamentals of Investment	(5-1-0)	
		b. Consumer Affairs and Customer Care		
		c. Business Tax Procedures and Management		
		d. International Business	(5-1-0)	
		e. Industrial Relations and Labour Laws		
		f. Business Research Methods and Project Work		
Total Credits			24	
Total Programme Credits			140	

BACHELOR OF COMMERCE (2018, 2017)

Type	Course Code	Course Name	Credits	Category	Page
Semester III					
Theory	CMMA0005	Management Accounting	4	DC	585
	CMMK0012	Marketing Management	4	DC	586
	CMFS0013	Indian Financial System	4	DC	587
	CMBI0014	Practice of Banking and Insurance	4	DC	588
	CMTX0015	Taxation	4	DC	590
	CMFR0016	Financial Reporting	4	DC	591
AP	CMEAP3	Extra Academic Programmes	NC	IC	NA
Total Credits			24		
Semester IV					
Theory	CMAA0017	Audit and Assurance	4	DC	592
	CMGR0018	Governance, Risk and Ethics	4	DC	593
	CMFG0019	Financial Management	4	DC	594
	CMBL0020	Banking Law and Practice	4	DC	595
	CMCA0021	Cost Accounting	4	DC	597
	CMED0022	Entrepreneurship Development	3	DC	598
	CMAS6002	Accounting Software Lab	3	DC	658
AP	CMEAP4	Extra Academic Programmes	NC	IC	

Semester V					
Theory	CMCO0025	Capital Market Operations	3	DC	600
	CMPI0026	Financial Planning and Investment	3	DC	601
	CHES0002	Environmental Studies	2	DC	727
	Specialisation: International Accounting and Finance				
	CMRP0027	Corporate Reporting	4	DE	602
	CMAY0028	Business Analysis	4	DE	603
	CMSP0029	Accounting for Service and Public Finance	4	DE	604
	Specialisation: Finance and Investment				
	CMIB0030	Investment Banking	4	DE	606
	CMIM0031	Investment Management	4	DE	607
CMCF0032	Corporate Finance	4	DE	608	
Project	CMPJ6003	Project Phase I	1	DC	659
Total Credits			21		
Semester VI					
Theory	CMFN0033	Advanced Financial Management	4	DC	608
	CMFS0034	Financial Securities and Derivatives	2	DC	609
	Specialisation: International Accounting and Finance				
	CMPT0035	Advanced Performance Management	4	DE	610
	CMAT0036	Advanced Taxation	4	DE	611
	CMAU0037	Advanced Audit and Assurance	4	DE	603
	659Specialisation: Finance and Investment				
	CMFX0038	Commodities and Forex Management	4	DE	614
	CMPF0039	Portfolio Management	4	DE	615
	CMAL0040	Alternative Investments	4	DE	616
Internship	CMIN6004	Internship	2	DC	659
Project	CMPJ6005	Project Phase II	2	DC	659
Total Credits			26		
Total Programme Credits			141		

MASTER OF COMMERCE

Type	Course Code	Course Name	Credits	Category	Page
Semester I					
	CMOT0041	Organizational Theory and Behavior	4	DC	617
Theory	CMBD0042	Business Statistics and Decisions	4	DC	618
	CMFY0043	Financial Statement Analysis	4	DC	619
	CMMG0044	Managerial Economics	4	DC	620
	CMAG0045	Cost and Management Accounting	4	DC	622
Total Credits			20		

Semester II					
	CMRC0046	Research Methodology in Commerce	4	DC	623
Theory	CMBE0047	Business Environment	3	DC	624
	CMBL0048	Business Law	3	DC	625
	CMFI0049	Corporate Finance	4	DC	627
	CMPG0050	Principles of Marketing	4	DC	628
	CMBS0051	International Business	4	DC	
Total Credits			22		
Semester III					
	CMSH0052	Strategic Human Resource Management	4	DC	630
Theory	CMCR0053	Consumer Behaviour	4	DC	631
	CMDS6006	Dissertation-I	4	DC	661
Specialisation: Accounting and Taxation					
	CMTM0054	Corporate Tax Management	4	DE	633
	CMAF0055	Accounting Theory and Financial Reporting	4	DE	634
Specialisation: Finance and Investment					
	CMCR0056	Advanced Corporate Finance	4	DE	635
	CMBK0057	Investment Banking	4	DE	636
Specialisation: Management					
	CMIG0058	International Marketing	4	DE	637
	CMBC0059	Business Ethics and Corporate Governance	4	DE	638
Total Credits			20		
Semester IV					
	CMEM0060	Entrepreneurship Management and E-Commerce	4	DC	639
Theory	CMDS6007	Dissertation-II	6	DC	661
Specialisation: Accounting and Taxation					
	CMMD0061	Modern Accounting	4	DE	640
	CMAV0062	Advanced Accounting	4	DE	641
Specialisation: Finance and Investment					
	CMFI0063	Financial Institution Management	4	DE	643
	CMPN0064	Portfolio Management	4	DE	644
Specialisation: Management					
	CMIL0065	Management of Industrial Laws	4	DE	645
	CMSM0066	Supply Chain Management and Logistics	4	DE	646
Total Credits			18		
Total Programme Credits			80		

DEPARTMENT OF ECONOMICS
BACHELOR OF ARTS - HONOURS IN ECONOMICS

Type of Course/Category	Course Code	Course Name	Credits (L-T-P)	Page
Semester I				
Core Paper1/ DC	ENME0001	Micro Economics-I	(5-1-0)	663
Core Paper2/DC	ENQM0002	Quantitative Methods in Economics-I	(5-1-0)	664
Ability Enhancement compulsory Course -1/IC	LSEC0018	English Communication	(2-0-0)	740
General Elective -I/IE/SE	ENMB0003	Money, banking and Finance	(5-1-0)	665
	MACD0105	Calculus and Differential Equations		717
Total Credits			20	
Semester II				
Core Paper3/DC	ENQS0011	Quantitative Methods in Economics-II	(5-1-0)	670
Core Paper4/DC	ENMS0010	Micro Economics-II	(5-1-0)	669
Ability Enhancement compulsory Course -1/IC	CHES0002	Environmental Studies	(2-0-0)	727
General Elective -II/IE/SE	ENIM0008	Indian Monetary System	(5-1-0)	667
	MALG0106	Algebra		718
Total Credits			20	
Semester III				
Core Paper5/DC	ENSM0009	Statistical Methods for Economics-I	(5-1-0)	668
Core Paper6/DC	ENMC0007	Macro Economics-I	(5-1-0)	666
Core Paper7/DC	ENDE0012	Development Economics-I	(5-1-0)	671
Skill Enhancement Course 1/IE	ENIC0013	Introduction to Computer Applications Theory/ Lab	(2-0-0)	672
General Elective -III/IE/SE	ENBE0014	Business Environment		674
	MAAL0107	Algebra and Numerical methods		719
Total Credits			26	
Semester IV				
Core Paper8/DC	ENSE0015	Statistical Methods for Economics-II	(5-1-0)	675
Core Paper9/DC	ENMS0016	Macro Economics-II	(5-1-0)	676
Core Paper10	ENDS0017	Development Economics-II	(5-1-0)	677
Skill Enhancement Course 2/IE	ENOB0018	Organisational Behaviour	(2-0-0)	678
General Elective -IV/IE/SE	ENFA0019	Fundamentals of Accounting	5-1-0	679
	MADV0108	Differential Equations, Vector Calculus and Geometry		720
Total Credits			26	
Semester V				
Core Paper11/DC		Public Finance	(5-1-0)	
Core Paper12/DC		Indian Economy-I	(5-1-0)	
Discipline Specific Elective I/DE		History of Economic Thought	(5-1-0)	
		Investment and Risk Management		
		Financial Market Operations		

■ COURSE STRUCTURE

Discipline Specific Elective II/DE		Industrial Economics	(5-1-0)	
		Welfare Economics		
		Econometrics-I		
Total Credits			24	
Semester VI				
Core Paper13/DC		International Economics	(5-1-0)	
Core Paper14/DC		Indian Economy-II	(5-1-0)	
Discipline Specific Elective III/DE		Environmental Economics	(5-1-0)	
		Advertising and Consumer Behaviour		
		Demography		
Discipline Specific Elective IV/DE		Agricultural Economics	(5-1-0)	
		Financial Economics		
		Econometrics-II		
Total Credits			24	
Total Programme Credits			140	

DEPARTMENT OF MANAGEMENT

BACHELOR OF BUSINESS ADMINISTRATION (FINANCIAL INVESTMENT ANALYSIS)

Type of Course/Category	Course Code	Course Name	Credits	Page
Semester I				
Core Paper1/ DC	MTAA0088	Financial Accounting and Analysis	6	692
Core Paper2/DC	MTMG0089	Managerial Economics	6	694
Ability Enhancement compulsory Course -1/IC	CHES0002	Environmental Studies	2	727
General Elective -I/IE/SE	MTED0090	Entrepreneurship Development	6	695
		Economic Legislation		
Total Credits			20	
Semester II				
Core Paper3/DC	MTSB0091	Statistics for Business Decisions	6	696
Core Paper4/DC	MTCM0092	Cost & Management Accounting	6	697
Ability Enhancement compulsory Course -1/IC	LSBC0039	Business Communication	2	740
General Elective -II/IE/SE	MTOG0093	Organizational Behavior	3	698
		Principles of Management		
Total Credits			20	
<p>*At the end of second semester, students have to compulsorily undergo 6-8 weeks internship of 4 credit. The internship will be evaluated at the end of 4th semester based on the following parameters –</p> <p>Internship Diary Internship Report Internship Presentation</p>				
Semester III				
Core Paper5/DC		Income Tax	6	
Core Paper6/DC		Corporate Finance	6	
Core Paper7/DC		Financial Markets & Institutions	6	

Skill Enhancement Course 1/IE		IT Tools for Business	2	
General Elective -III/IE/SE		Business Ethics and Corporate Governance		
		Production & Operations Management		
Total Credits			26	
Semester IV				
Core Paper8/DC		Macro Economics	6	
Core Paper9/DC		Quantitative Techniques	6	
Core Paper10		Financial Econometrics	6	
Skill Enhancement Course 2/IE		Summer Internship	2	
General Elective -IV/IE/SE		Research Methodology		
		Indirect Taxes		
Total Credits			26	
Semester V				
Core Paper11/DC		Investment Analysis & Portfolio Management	6	
Core Paper12/DC		Financial Derivatives	6	
Discipline Specific Elective I/DE		Business Tax Planning	6	
		Investment Banking and Financial Services		
Discipline Specific Elective II/DE		Strategic Corporate Finance	6	
		Corporate Analysis and Valuation		
Total Credits			24	
Semester VI				
Core Paper13/DC		Corporate Restructuring	6	
Core Paper14/DC		International Finance	6	
Discipline Specific Elective III/DE		Management of Financial Institutions	6	
		International Trade Blocks and Multilateral Agencies		
Discipline Specific Elective IV/DE		Research Project	6	
		Corporate Accounting		
Total Credits			24	
Total Programme Credits			140	

DETAILED SYLLABUS

SCHOOL OF TECHNOLOGY

MANDATORY STUDENT INDUCTION PROGRAM FOR B.TECH STUDENTS

(Duration: 3 Weeks at the beginning of the 1st semester and 3 days in the subsequent semesters till the 4th semester)

The AICTE in its model curriculum proposed an induction programme of three-weeks duration for all students to help them adjust to the new environment of Engineering courses. It aims to equip students with communication skills, human values, and acquaint them with the culture of the institution.

Group Discussions on Universal Human Values (UHV) are an important part of the Induction Program. It is a mandatory non- credited course which continues up to the fourth semester.

Every student has to maintain a register for this course which will be evaluated by the mentor till the fourth semester.

Attendance criteria remains the same as per the other courses i.e. in principle, a student is expected to attend all the classes.

If the attendance is less than 75% - whatever may be the circumstances – the course has to be repeated.

A certificate will be issued by the institution at the completion of the course with ‘Satisfactory(s)’ or ‘Unsatisfactory(x)’ grades.

At the start of the subsequent semesters till the 4th semester 3 full days are to be set aside for activities related to the follow up of the Induction program.

The following list presents the topics covered in the Mandatory Induction Program conducted at Don Bosco College of Engineering and Technology:

1. Physical activity – Yoga and sports activity (indoor and outdoor)
2. Creative arts through Extra-curricular clubs e.g., music & singing, dance, drama, debating & quiz, art & craft, photography
3. Universal Human Values – group discussions on the following topics:
 - a. Aspirations and family expectations
 - b. Gratitude
 - c. Competition and cooperation
 - d. Competition and excellence
 - e. Peer pressure
 - f. Self-confidence
 - g. Relationships in family
 - h. Trust and respect
 - i. Anger management
 - j. Happiness and prosperity
 - k. Interaction and ragging

- l. Dealing language barriers – tests on communication skill for future follow up.
- m. Sexual orientation / courting / sexual harassment
4. Literary exposure through Literary Club
5. Proficiency Modules – Psychological tests and orientation, introduction to Co-curricular clubs and innovations.
6. Lectures by eminent people – in-campus invited Guests and over SKYPE
7. Visit to local areas – visit to industry and institutions of repute
8. Familiarization to departments and common facilities
9. Mentoring system – introduction and assignment of mentors
10. Selection / election of Class Representatives for college association
11. Health check-up for all with documentation for future reference
12. Library Orientation, Introduction to ERP and e-Resources, filling up “Online anti-ragging affidavit” by all.

INTERNSHIP POLICY FOR B.TECH CURRICULUM

(AS PER MODIFIED AICTE CURRICULUM)

The modified AICTE Curriculum for B.Tech program prescribes a maximum of 160 credits for 4 year B.Tech degree with an optional provision of additional 20 credits through MOOCs for awarding B.Tech. (Hons.) degree.

Further, this new scheme has mandated Internship Activities of 600-700 hours carrying 14-20 credits, where 1 credit means 40-45 hours of work or 1 week of activity as mentioned below:

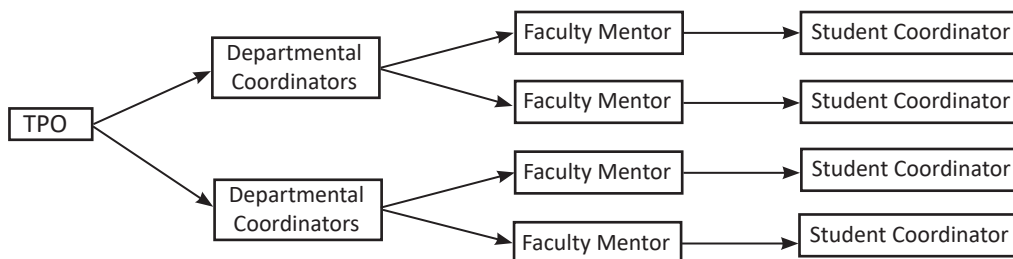
1. 1st year – during and immediately after 2nd semester examination i.e. in the summer vacation 3-4 credits (120-180 hrs.)
2. Summer vacation after 4th Semester : 4-6 credits (4-6 weeks)
3. Summer Vacation after 6th Semester : 4-6 credits (4-6 weeks)
4. During 8th Semester : 6-8 credits

The General Guidelines suggest the following sort of activities:

1. 2nd Semester – Inter/Intra Institutional Activities
2. After 4th semester – Internship / Innovation / Entrepreneurship Activities.
3. After 6th Semester – Internship / Innovation / Entrepreneurship Activities.
4. During 8th Semester – Project work; Seminar (Excluding credits from Advanced courses).

Responsibilities of Internship Activity at the Institutional level:

AICTE states that in all AICTE approved institutions, it is essential to have dedicated Training & Placement cell headed by Training and Placement Officer (TPO). The organizational structure of this cell will be as follows:



The Training and Placement cell with the help of the departmental coordinators will organize all Internship training, in addition to the placement activities.

Every institute may allocate 1% of their total budget to facilitate the functioning of Training and Placement cell and meet the funding requirements for various activities. The Purpose of TPO is to guide students to choose the right career and to plan for programs and activities to enhance knowledge, skill, attitude and right kind of aptitude to meet the manpower requirements of the industry.

To assist students for Industrial Training at the end of 4th and 6thSemester, the Training & Placement Cell shall also design and implement internal curriculum, take classes, arrange experts and agencies for students' Personality Development, Communication Skills, prepare students for Resume and E-mail writing, group discussion, interview skills, aptitude tests, technical report writing, presentation skills, foreign language proficiency etc. The TPO will be supported by a departmental coordinator and faculty mentors designated by the HOD or the Principal at the start of the academic year. Each department will have a student committee comprising of 1-3 members from each class, for supporting the training and placement activities headed by the student coordinator (Departmental Student Coordinator). Student Coordinator, being representative of students will be selected by the students with the help of TPO.

MONITORING AND EVALUATION OF INTERNSHIP

1. For Internship during and after 2nd Semester –

AICTE recommends inter/Intra Institutional activities for the 1st Phase of internship activity with the Sub- Activity Heads such as Workshop training, Working for consultancy or Research project, Festival (Technical/Business/other events), contribution in incubation/innovation/ Entrepreneurship cell and Learning at departmental Labs, Tinkering Labs, Institutional Workshop etc.

The student's shall be evaluated by the programme head or the cell in charge as the case may be. Certificates shall be given as the document of evidence to prove completion of internship. Performance appraisal shall be done in terms of 3 qualitative grades viz., Satisfactory/Good / Excellent. Institute may device their own evaluation sheets in order to meet the requirements.

2. Internship during the summer vacation after 4th – 6th semester –

At this stage the students are ready for Industrial experience; therefore, they may choose to undergo Internship/Innovation or Entrepreneurship related activities. Incase students want to pursue his family business and does not want to undergo Internships, a declaration by a parent may be directly submitted to the TPO.

The Training and placement Cell will arrange internship for the students in Industry / organizations after 4th and 6th/7th semesters as per AICTE or University Guidelines. General procedure given in Chapter 2.3 in AICTE Internship policy may be followed. Chapter -3 of the same document also puts forward “Guidelines for Industry for providing Internship.” After a student enrolls in some industry as an Intern, monitoring and evaluation shall be done properly as indicated below:

2.1 Monitoring – TPO/Staff/Faculty mentor of the Institutes will make surprise visits to the internship sites to check the student’s presence physically. If the student is found absent without prior intimation to the Training and Placement Cell, entire training will be cancelled. Student should inform the TPO, faculty mentor as well as the Industry supervisor at least 1 day prior to availing leave by email. Students are eligible to avail one day leave in 4 weeks and 2 days Leave in 6 weeks of the Internship Period.

2.2 Evaluation – Interns in the Industry will be evaluated in three stages

2.2.1 Evaluation by the Industry – The Industry will evaluate the students based on punctuality, eagerness to learn, maintenance of daily diary and skill test in addition to any other remarks.

2.2.2 Evaluation through Seminar Presentation/Viva Voce at the Institute – The student will give a seminar based on his/her training report before an expert committee constituted by the concerned department as per the norms of the institute. The evaluation will be based on the following criteria:

- Quality of content presented
- Proper planning of presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills
- Attendance Record, Daily Diary and Departmental reports shall also be Analysed along with the Internship report.

Students Diary and Internship Report should be submitted by the students along with the attendance Record and an Evaluation sheet duly signed and stamped by the Industry to the Institute immediately after completion of the training.

Diary will be evaluated on the basis of following criteria –

- Regularity in maintenance of the diary
- Adequacy and quality of information recorded.
- Drawing, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

Internship Report – After completion of internship the student should prepare a comprehensive report to indicate what he/she has observed and learned. The student may contact the industrial supervisor/faculty mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. This report shall be evaluated on the basis of following criteria:

- Originality
- Adequacy and purposeful write up.
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience.
- Practical applications and relationships with basic theory and concepts taught in the course.

2.2.3 Evaluation by Faculty Supervisor on the basis of Industrial site visits– The faculty supervisor shall award some score based on his/ her observation during site visit.

3. Project work and seminar during 8th semester

Project work and seminar for (6 – 8) credits shall be as specified in the curriculum of the University.

PROPOSED STRATEGY FOR EXAMINATION DEPARTMENT:

1. On completion of Internship after 2nd,4th and 6th semester, a completion certificate with qualitative performance appraisal grade viz., satisfactory/good/excellent shall have to be awarded to every student. Alternative activities to be suggested for those who fail to attend or complete the Internship Activity.
2. All the project works (mini/ Minor / Major etc.) and seminars over the eight semesters shall be considered part of Internship Activities along with other components including industry internship and Entrepreneurship activities within a total prescribed 14 – 20 credits which is part of the maximum permissible 160 credits. Therefore, over and above the qualitative completion certificate, we have to assign a letter grade against internship so as to incorporate it in the SGPA calculation. Thus, in the Grade sheet, internship will carry credits/marks and letter grades as in any other courses of the curriculum. Finally, this credit and letter grade scored in the 10 point scale shall be accounted for SGPA and CGPA calculation.

4. Additional Non Credit Requirement for earning B.Tech Degree.(100 activity points)

Apart from technical knowledge and skills, to be successful as professionals, students should have excellence in soft skills, leadership qualities and team spirit. They should have entrepreneurial capabilities and societal commitment. In order to match these multifarious requirements, AICTE has created a unique mechanism of awarding minimum 100 activity points over and above the academic and internship grades. Every student of 4 year degree programme is required to earn 100 activity points by doing 300 -400 hours of activity in addition to the required academic credentials. Students under lateral entry category are required to earn 75 activity points. These activities will be coordinated by NSS/ NCC / SPORS / SAGY coordinator [campus minister] or TPO. On completion, the student will be provided a certificate from the concerned coordinator and Institutional Head.

Every student is required to prepare a file containing documentary proof of activities done by him/her. This file will be duly verified by the concerned evaluator (coordinator). Thereby the student should earn at least 100 activity points before appearing the final examination. The points earned by the student will be reflected on the students' transcript. However, there will be neither grades /marks for these points nor there will be any effect on CGPA. These activities can be done any time during the semester, weekends or holidays. These activities are in the form of Community service and allied activities suggested in Table 4 (P.18/38) of AICTE Internship Policy (ref. www.aicte-india.org). Each activity carries 20 points; thus any student completing any 5 activities during the 4year term for regular and 3 year term for Lateral Entry will be eligible to appear for the 8th semester final examination to finally earn the degree.

SCHOOL OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Vision

Creating an intense teaching and research environment that moulds individuals into competent professionals who are innovative and committed to meet real world challenges.

Mission

1. To produce competent Computer Science professionals by promoting excellence in education and training.
2. To inculcate the spirit of self-sustainability through research, consultancy, development activities and lifelong learning.
3. To extend technical expertise to meet real world challenges and play a leading role in technical innovation, creativity and application development.
4. To infuse a sense of commitment in individuals for the betterment of the society through technology.

Programme Educational Objectives (PEOs)

1. To prepare the students to have strong foundation in computer science engineering with impetus to higher studies, consultancy, research and development.
2. To prepare the students to be self-sustainable and proficient to meet the real world challenges ethically and responsibly, in service to socio-economic development of the society.
3. To inculcate the spirit of life-long learning, understanding, and applying new ideas and technologies to provide novel engineering solutions in the rapidly changing environment.

Programme – M.Tech. (CSE) (Data Science)

Programme Outcomes (PO):

M.Tech. programme has been designed to prepare graduates for attaining the following programme outcomes:

- PO 1: Impart knowledge and equip with necessary technical skills in the relevant discipline to make them employable in industry/academics/research and development or self sustainable with entrepreneur initiatives.
- PO 2: To provide a platform for enthusiastic learners and engage in collaborative research and innovation for the benefit of the society.
- PO 3: An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems.

Programme Specific Outcomes (PSO):

The PSO for Data Science specialization is listed below.

- PSO 1: Apply statistics and computational analysis for data to make predictions.
- PSO 2: Implement data mining techniques even on large set of data for clustering, classification and ranking of data.
- PSO 3: Apply evolutionary computing techniques to create an intelligent data management system.

PSO 4: Use data analysis tools for big data analysis.

PSO 5: Use programming languages to clean and process the data.

PSO 6: Implement data intensive computing technique using cloud infrastructure.

Programme – M.Tech. (CSE) (Internet of Things)

Programme Outcomes (PO):

PO 1: An ability to undertake original research at the cutting edge of computer science & its related areas.

PO 2: An ability to design, develop and evaluate new computer based systems for novel applications which meet the desired needs of industry and society.

PO 3: An understanding of the impact of IT related solutions in an economic, social and environment context.

Programme Specific Outcomes (PSO):

PSO 1: Effective usage of Sensor technology through IoT deployment for different sectors.

PSO 2: Designing and developing code for various sensor based applications using wireless sensor network.

PSO 3: Analysing and exploring the data collected by IoT devices from environment.

PSO 4: Applications of Machine learning technique for data prediction, verifications, transmission etc.,.

Programme – M.Tech. (CSE) (Information Security)

Programme Outcomes (PO):

PO1. An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems.

PO2. Understanding and ability to use advanced computing techniques and tools for information security.

PO3. An understanding of professional and ethical responsibility.

Programme Specific Outcomes (PSO):

PSO 1: To understand the concept digital forensic

PSO 2: Concept of ethical hacking, intrusion detection and malware analysis

PSO 3: Application of machine learning based tools to secure data

PSO 4: Learning different data protection technique like encryption, decryption, Steganograph, Digital Watermarking etc.

PSO 5: To know about secure coding, Security Assessment and Risk Analysis

DETAILED SYLLABUS

THEORY COURSES

CSMA0047: MICROPROCESSORS AND APPLICATIONS

(4 credits – 60 hours)

Objective: This course helps to develop an in-depth understanding of the operation of microprocessors, 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.

Module I: Introduction (12 hours)

Microprocessor evolution and types, microprocessor architecture and operation of its components, addressing modes, interrupts, data transfer schemes, instruction and data flow, timer and timing diagram. Interfacing devices. Architectural advancement of microprocessor. Typical microprocessor development schemes.

Module II: 8-bit Microprocessors (13 hours)

8-bit Microprocessors: Pin diagram and internal architecture of 8085 microprocessor, registers, ALU, Control and status, interrupt and machine cycle. Instruction sets. Addressing modes. Instruction formats Instruction Classification: data transfer, arithmetic operations, logical operations, branching operations, machine control and assembler directives.

Module III: 16-bit Microprocessor (7 hours)

Architecture of 8086 microprocessor: register organization, bus interface unit, execution unit, memory addressing, and memory segmentation. Operating modes. Instruction sets, instruction format, Types of instructions. Interrupts: hardware and software interrupts.

Module IV: Programming (8 hours)

Assembly language programming based on Intel 8085/8086. Instructions, data transfer, arithmetic, logic, branch operations, looping, counting, indexing, programming techniques, counters and time delays, stacks and subroutines, conditional call and return instructions

Module V: Peripheral Interfacing (15 hours)

Peripheral Devices: 8237 DMA Controller, 8255 programmable peripheral interface, 8253/8254 programmable timer/counter, 8259 programmable interrupt controller, 8251 UART and RS232C.

Module VI: Pentium processor (Only features) (5 hours)

Introduction to Pentium Processors, Memory system, I/O system, Pipelining, Floating point module, Cache structure, superscalar architecture.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the parts of a microprocessor. (Remembering)
- CO2:** Classify the architecture of 8085/8086 microprocessors. (Understanding)
- CO3:** Develop peripherals such as 8255, 8253/8254, 8259, 8251, 8237 with 8086/8085 microprocessors. (Applying)
- CO4:** Analyse the timing diagrams for different 8086/8085 instructions. (Analysing).
- CO5:** Evaluate given 8086/8085 assembly language programs in terms of time required to execute them. (Evaluating)
- CO6:** Construct 8086/8085 assembly language programs for tasks such as arithmetic operation, logic operation, looping, counting etc. (Creating)

Suggested Readings

1. Gaonkar, Ramesh S, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing.
2. Ray A K, Bhurchandi K M, Advanced Microprocessors and Peripherals, TMH
3. Hall D V, Microprocessor Interfacing, TMH
4. Liu and Gibson G A, Microcomputer System: The 8086/8088 family, PHI
5. Aditya P Mathur, Introduction to Microprocessor, TMH
6. Brey, Barry B, INTEL Microprocessors, PHI
7. Renu Singh and B.P.Singh, Microprocessor, Interfacing and Applications
8. M Rafiqzaman, Microprocessors, Theory and Applications

CSOC0048: OPERATING SYSTEMS AND CONCEPTS**(4 credits – 60 hours)**

Objective: *This course provides an overview of operating systems along with the concepts of process management, memory management, deadlocks, file systems and input-output systems. After completing this course, the student should be able to recognize the underlying concepts and principles of operating systems, understand the structure and components of traditional OSs and acquire skills to deal with common operating systems like UNIX, Linux and Windows.*

Module I (15 hours)

- a) Introduction to operating systems, Simple batch system, Multiprogramming and time sharing systems, Personal computer systems, Parallel systems, Distributed systems and Real time systems.
- b) Operating system structures: System components, protection system, OS services, System calls.
- c) Process management: Process concept, Process scheduling, Operation on processes, Cooperating processes, Interprocess communication, Threads CPU scheduling: Basic concepts, scheduling criteria, scheduling algorithms.

Module II (15 hours)

- a) Deadlocks: System model, Deadlock characterization methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, recovery from Deadlock.
- b) Memory Management: Background, Logical versus physical address space, Swapping, Contiguous allocation, Paging, Segmentation.
- c) Virtual Memory: Background, Demand paging, Performance of demand paging, Page replacement, Page replacement algorithms, Allocation of frames, Trashing.

Module III (15 hours)

File-system Interface: File concept, Access methods, Allocation methods, Directory implementation, Recovery.

Module IV (15 hours)

- a) I/O Systems: Overview, I/O hardware, Application of I/O interface, Kernel I/O - subsystem, Transforming I/O requests to hardware operations.
- b) Secondary storage structure: Disk structure, Disk scheduling, Disk management, Swap space management, Disk reliability, Case studies LINUX, WINDOW NT.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define process concept like process scheduling, inter-process communication, process synchronization and concurrency. (Remembering)
- CO2:** Explain different memory management schemes, relate various approaches to memory management and effectiveness of a particular algorithm. (Understanding)
- CO3:** Show and explain how the file system, mass storage and I/O are handled in a modern computer system. (Remembering, Understanding)
- CO4:** Identify different page replacement algorithms to solve problems. (Applying)
- CO5:** Analyse the mechanisms necessary for the protection and security of computer systems. (Analysing)
- CO6:** Evaluate the concepts learned with case studies of Linux and Windows. (Evaluating)
- CO7:** Elaborate what operating systems are, what they do and how they are designed and constructed. (Creating)

Suggested Readings

1. Abraham Silberschatz, Peter Bear Galvin, Operating system concepts, Addison Wesley.
2. Madnik and Donovan, Operating systems, McGraw Hill.
3. Andrew, S. Tannenbaum, Modern operating system, PHI.
4. Harvey M. Deitel, Operating Systems, Second Edition, Pearson Education Pvt. Ltd.
5. William Stallings, Operating Systems, Prentice Hall of India.
6. Pramod Chandra P. Bhatt – An Introduction to Operating Systems, Concepts and Practice, PHI.

CSFL0049: FORMAL LANGUAGE AND AUTOMATA THEORY

(4 credits – 60 hours)

Objective: The purpose of this course is to understand the power and limitations of abstract computational devices and to study various models including finite automata, grammars, pushdown automata, and Turing machines. The course will help in study of methods for classifying computational devices according to their computational power, and tools which will allow ascertaining the capability of a device to solve a given computational problem.

Module I: Theory of Automata (10 Hours)

Definition of an Automaton, Description of a Finite Automaton, Transition Systems, Properties of Transition Functions, Acceptability of a String by a Finite Automaton, Nondeterministic Finite State Machines, The Equivalence of DFA and NFA, Mealy and Moore Models, Minimization of Finite Automata.

Module II: Formal Languages, Regular Sets and Regular Grammars (15 Hours)

Definition of formal languages, Chomsky Classification of Languages, Languages and Their Relation, Recursive and Recursively Enumerable Sets, Operations on Languages, Languages and Automata; Regular Expressions, Finite Automata and Regular Expressions, Pumping Lemma for Regular Sets, Application of Pumping Lemma, Regular Sets and Regular Grammars Exercises.

Module III: Context-free Languages (17 Hours)

Context-free Languages and Derivation tree, Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars, Pumping Lemma for Context-free Languages, Decision Algorithms for Context-free Languages Exercises

Module IV: Pushdown Automata Turing Machines and Linear Bounded Automata (18 Hours)

Basic Definitions, Acceptance by pda, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata; Turing machine Model, Representation of Turing Machine, Language Acceptability by Turing Machines, Design of Turing Machines, Universal Turing Machine and Other Modification, The Model of Linear Bounded Automaton, Turing Machines and Type 0 Grammars, Linear Bounded Automata and Languages, Halting Problem of Turing Machines, NP-Completeness.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define basic terminology like Deterministic and Non deterministic automata, Pushdown Automata, Parse Tree, Regular Languages, Turing Machines etc. (Remembering)
- CO2:** Explain the concepts, core terms and tools used in automata theory (Understanding)
- CO3:** Choose the techniques, components and tools of a typical automated machine and apply it in designing new machines (Applying)
- CO4:** Identify which input pattern would be accepted by a Turing Machine, Pushdown Automata, Finite Automata etc. (Applying)
- CO5:** Compare and contrast various types of machines in Automata theory and relate it to everyday appliances like washing machines, fans, etc. (Analysing)
- CO6:** Design an automata and evaluate it in terms of correctness, computation cost and complexity. (Evaluating)
- CO7:** Design new automata for given problems by using most appropriate algorithmic strategy considering the problem domain. (Creating)

Suggested Readings

1. K.L.P. Mishra, N. Chandrasekaran, Theory of Computer Science, BPB Publication, Prentice-Hall of India, Second Edition.
2. H.R. Lewis and C.H.Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall of India.
3. H.E. Hopcraft and J.D. Ullamn, Introduction to Automata Theory, Languages and Computation, Narosa Publications.
4. J.C. Martin, Introduction to Languages and the Theory of Automata, Tata McGraw-Hill International, 2003..
5. C.H. Papadimitriou, Computation Complexity, Addison-Wesley.
6. Linz Peter, An Introduction to Formal Languages and Automata, Narosa.
7. Kain, Theory of Automata and Formal Language, McGraw Hill.

CSDC0050: DATA COMMUNICATION

(4 credits – 60 hours)

Objective: *The main objective of this course is to make the students understand the characteristics of signals propagated through different transmission media, including concepts of attenuation and noise, error-detection, and error-correction techniques and interfacing and synchronization issues.*

Module I (16 hours)

- a) Introduction to data communications: A communications model, Data communications, Networking, Protocols and Protocol architecture, Characteristics of data transmission: Concepts and Terminology, Analog and digital data transmission, Transmission impairments.

- b) Transmission media: Guided transmission media, Wireless transmission data encoding, Digital data-Digital signals, Digital data- Analog signals, Analog data-Digital signals, and Analog data-Analog signals.

Module II (13 hours)

Data communication interface: Asynchronous and Synchronous transmission, Line configurations, Interfacing. Data link control, Flow control, Error detection, Error control, High-level data link control (HDLC), Other data link control protocols.

Module III (16 hours)

Data communications hardware: Terminals- Introduction, Basic terminal components, Enhanced terminal components, General-purpose terminals, Remote job entry terminals, Transaction terminals, Clustering of terminal devices. Communications processing hardware introduction, Switching processors, Multidrop lines, Multiplexers, Concentrators, Front-end processors.

Module IV (15 hours)

Modems: Network attachment and regulations, Line conditioning and leased lines, Modems and modem circuits. Multiplexing: Frequency-division multiplexing, Synchronous time-division multiplexing: Characteristics, TDM Link control, Digital carrier systems statistical time-division multiplexing: Characteristics.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the fundamentals of data communication and various techniques of communications and recall the layered structure of computer network. (Remembering)
- CO2:** Explain about different network topology and the type of protocol required for different communication technique. (Understanding)
- CO3:** Identify the requirements of various networking devices and make use of the network accordingly. (Applying)
- CO4:** Compare different networking devices and Analyse different network behavior depending on performance parameters. (Analysing)
- CO5:** Establish and evaluate a computer network either Wired or Wireless. (Applying, Evaluating)
- CO6:** Compose a type of network required for an organization depending on availability of hardware and software. (Creating)

Suggested Readings

1. William Stallings, Data and Computer Communications, Sixth Edition, Pearson Education Asia.
2. Prakash C. Gupta, Data Communications and Computer Networks, PHI
3. B.A. Forouzan, Data Communications and Networking, TMH.
4. William L.Sweber, Data Communication, McGraw Hill.
5. Tenenbaum, A. S., Computer Networks (Fourth Edition), New Delhi: Prentice-Hall India
6. Larry L. Peterson and Bruce S. Davie, Computer Networks: A systems approach, 3rd Edition, Morgan Kaufmann Publishers.
7. Mary E.S. Loomis, Data Communications, PHI.

CSIS0051: INFORMATION SYSTEM DESIGN**(4 credits – 60 hours)**

Objective: The course is aimed at familiarizing the student with the techniques, applications and control of modern information systems. The course will also provide working knowledge of the types of information systems and their strengths and weaknesses in solving various business and organization problems. It also gives the fundamentals of Rational Rose and skills of designing using Rose tools.

Module I (10 hours)

- a) Introduction to Information systems development: overview of system analysis and design, Categories of Information systems, Systems development strategies, Implementation and evaluation, Tools for systems development, Information systems planning methodologies, Managing project- review and selection, Preliminary Investigation, Project feasibility, selecting the project development strategy;
- b) Requirement analysis and determinations: Activities in requirements determination, Fact finding techniques: Interview, questionnaire, Record review, observation, tools for documenting procedures and decisions: Decision trees, Decision tables, Structured analysis, Dataflow analysis, Tools for dataflow strategy, Developing data flow diagrams, Leveling, Data dictionary.

Module II (10 hours)

Prototype development strategy: purpose of prototyping, steps in prototype method, use of prototypes, tools for prototyping, Prototyping strategies. Computer Aided System Tools: Benefits of computer Assisted Tools, Categories of computer assisted system Engineering (CASE) Tools.

Module III (15 hours)

System Design: Objectives, Features to be designed, managing the design process, managing end-user development system Design of output, Design of input and control, Design of online dialogue, Design of files and databases.

Module IV (15 hours)

Fundamentals of Rational rose, Object oriented design using UML, Design of software development diagram using rose, Functional Testing using rose

Module V (10 hours)

- a) System Engineering and Quality assurance: Designing reliable and maintainable system, Program structure charts, Software Modules, Coupling and Cohesion.
- b) Software design and documentation tools: Structured flowchart, HIPO, Warnier/Orr diagrams. Managing quality assurance, Assessing system Reliability, Testing strategies, Documentation. Managing system implementation: Training conversion methods, Data and file preparation, and post implementation review. Managing information system development: Estimation and management of development time, Personnel and Development management, structured walkthroughs requirements, Computer evaluation, Financial factors, Maintenance and support, Software selection.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define and describe the phases of the system development life cycle. (Remembering)
- CO2:** Explain the purpose of prototyping and also will be able to summarize the benefits of CASE tools. (Understanding)

- CO3:** Construct design diagrams like use case, activity, sequence diagram etc. using rational ROSE. (Applying)
- CO4:** Solve realistic systems Analysing problems by preparing technical documentations and also make presentations on various aspects of a software development project, including the technical aspects and the managerial aspects. (Applying)
- CO5:** Analyse the use of different types of design diagrams. (Analysing)
- CO6:** Evaluate the performance of small projects by applying software testing and quality assurance techniques at the module level, and interpret these techniques at the system and organization level. (Evaluating).
- CO7:** Develop data flow diagrams and data dictionary, decision tree, decision tables. (Creating)

Suggested Readings

1. James A. Senn, Analysis and Design of Information Systems, Tata McGraw Hill
2. Essentials of Visual Modeling with UML 2.0, IBM Manual
3. Essentials of Rational Software Architect, IBM Manual
4. Ram Bansal, Information Systems Analysis and Design A Modern Approach To Systems Development, New Age International.
5. Rajaraman, Analysis and Design of Information Systems, Prentice Hall
6. A.M. Langer, Analysis and Design of Information Systems, Springer.

CSEC0055: E-COMMERCE AND DATA SECURITY

(4 credits – 60 hours)

Objective: *The objective of the course is to introduce the main concepts related to electronic commerce (e-commerce), their forms common applications and the threat and vulnerabilities associated with them. The subject also introduces the security techniques that can be used to protect e-commerce transactions.*

Module I: Introduction to E-Commerce (15 hours)

Definition, Scope of E-Commerce, Hardware requirements, E- Commerce and Trade Cycle, Electronic Markets, Electronic Data Interchange and Internet Commerce. Business toBusiness E-Commerce: Electronic Markets, Electronic Data Interchange (EDI): Technology, Standards (UN/EDIFACT), Communications, Implementations, Agreements, Security, EDI and Business, Inter-Organizational E-commerce.

Module II: Legal issues (20 hours)

Risks - Paper Document vs. Electronic document, Authentication of Electronic document, Laws, Legal issues for Internet Commerce: Trademarks and Domain names, Copyright, Jurisdiction issues, Service provider liability, Enforceable online contract. Security Issues: Security Solutions- Symmetric and Asymmetric Cryptosystems, RSA, DES, AES and Digital Signature, Protocols for secure messaging, Secure Electronic Transaction (SET) Protocol, Electronic cash over internet, Internet Security.

Module III: Business to Consumer E-Commerce (10 hours)

Consumer trade transaction, Internet, Page on the Web, Elements of E-Commerce with VB, ASP, SQL.

Module IV: E-business (15 hours)

Internet bookshops, Software supplies and support, Electronic Newspapers, Internet Banking, Virtual Auctions, Online Share Dealing, Gambling on the net, E-Diversity, Case studies through internet.

COURSE / LEARNING OUTCOMES

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

- CO1:** Find the scopes of e-commerce and their association with different trade cycles. (Remembering)
- CO2:** Summarize the concept of business to consumer mode of transaction in e-commerce. (Understanding)
- CO3:** Define and interpret the legal issues associated with electronic documents, jurisdiction issues, copyrights etc. (Remembering/Understanding)
- CO4:** Develop and classify a value chain of an organization with their suppliers. (Applying/Analysing)
- CO5:** Explain and categorize the in-depth knowledge of EDI and its constituent elements. (Understanding/Analysing)
- CO6:** Explain and compare symmetric and asymmetric cryptosystem implementations on e-commerce. (Understanding / Evaluating)
- CO7:** Elaborate the above knowledge on certain case studies like internet bookshops, electronic newspapers, virtual auctions etc. (Creating)

Suggested Readings

1. D. Whitley, E-Commerce-Strategy, Technologies and Applications, TMH.
2. K.K.Bajaj, E-Commerce - The Cutting Edge of Business, TMH.
3. W. Clarke, E-Commerce through ASP, BPB.
4. M.Reynolds, Beginning E-Commerce with VB, ASP, SQL Server 7.0 and MTS, Wrox.

CSDW0056: DATA WAREHOUSING AND DATA MINING**(4 Credits – 60 hours)**

Objective: *The main purpose of the course is to develop and gain an understanding of the principles, concepts, functions and uses of data warehouses, data modeling and data mining in business.*

Module I: Data warehousing (15 hours)

Definitions and characteristics, Multi-dimensional data model, Warehouse schema. Data Marts: Data marts, types of data marts, loading a data mart, metadata, data model, maintenance, nature of data, software components; external data, reference data, performance issues, monitoring requirements and security in a data mart. Online Analytical Processing: OLTP and OLAP systems, Data Modeling, LAP tools, State of the market, Arbor Essbase web, Microstrategy DSS web, Brio Technology, star schema for multi dimensional view, snowflake schema; OLAP tools.

Module II: Developing a Data Warehouse (15 hours)

Building of a Data Warehouse, Architectural strategies and organizational issues, design considerations, data content, distribution of data, Tools for Data Warehousing Data Mining: Definitions; KDD (Knowledge Discovery database) versus Data Mining; DBMS versus Data Mining, Data Mining Techniques; Issues and challenges; Applications of Data Warehousing and Data mining in Government.

Module III: Association Rules (20 hours)

A priori algorithm, Partition algorithm, Dynamic inset counting algorithm, FP – tree growth algorithm; Generalized association rule. Clustering Techniques: Clustering paradigm, Partition algorithms, CLARA, CLARANS; Hierarchical clustering, DBSCAN, BIRCH, CURE; Categorical clustering, STIRR, ROCK, CACTUS. Decision Trees: Tree construction principle, Best split, Splitting indices, Splitting criteria, Decision tree construction with presorting.

Module IV: Web Mining (10 hours)

Web content Mining, Web structure Mining, Web usage Mining, Text Mining. Temporal and Spatial Data Mining: Basic concepts of temporal data Mining, The GSP algorithm, SPADE, SPIRIT, WUM.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the principles, concepts, functions and various applications of data warehouse. (Remembering)
- CO2:** Explain the concepts related to Online Analytical Processing. (Understanding)
- CO3:** Identify the association rules and can implement various Data Mining algorithms. (Applying)
- CO4:** Analyse the pros and cons of various data mining techniques. (Analysing)
- CO5:** Compare and assess different approaches of data ware housing and data mining with various technologies. (Evaluating)
- CO6:** Elaborate the various concepts of Web Mining for practical applications. (Creating)

Suggested Readings

1. C.S.R.Prabhu, Data Warehousing- Concepts, Techniques, Products, Application, PHI.
2. AK Pujari, Data Mining Techniques, Universities Press.
3. Berson and S.J.Smith, Data Warehousing, Data Mining and OLAP, TMH.
4. M.H.Dunham, Data Mining Introductory and Advanced Topics, Pearson

CSNS0057: COMPUTER NETWORKS

(4 credits – 60 hours)

Objective: *The course provides an understanding of the overriding principles of computer networking, including protocol design, protocol layering, algorithm design, and performance evaluation along with principles embodied in the protocols designed for the application layer, transport layer, network layer, and link layer of a networking stack.*

Module I (10 hours)

Review of OSI, TCP/IP models, Switching Techniques: Circuit Switching, Switching Techniques: Packet Switching, Multiple Accesses –RANDOM ACCESS-ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization.

Module II (12 hours)

X.25, ATM, LAN - Ethernet IEEE 802.3 - IEEE 802.4 - IEEE 802.5 - IEEE 802.11 – FDDI - SONET – Bridges.

Module III (15 hours)

Network Layer: IP addressing methods, Subnetting, ARP, RARP, BOOTP, DHCP – Routing – Distance Vector Routing – Link State Routing – Routers.

Module IV (12 hours)

Transport layer: Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QoS) – Integrated Services.

Module V (11 hours)

Application Layer: Domain Name Space (DNS), EMAIL, Network Security-PLAYFAIR CIPHER, AES, DES, Public key cryptosystem and RSA, Message authentication code using Hash Function, Introduction to Kerberos.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define topology implementing different routing protocols that best suits a real time demand, Application, network and transport layer. (Remembering)
- CO2:** Define different networking terminologies such as TCP/OSI, protocols, routing, link errors etc. (Remembering)
- CO3:** Explain the different network topologies, network, transport and application layer design issues and the importance of QoS in a network. (Understanding)
- CO4:** Illustrate the theory and designing of a network model and the role of routing protocols in different network structure. (Understanding)
- CO5:** Solve different problems related to subnetting, configuring working routing protocols in some model network topology and implement presentation layer security. (Applying)
- CO6:** Distinguish TCP from OSI and Analyse different layer protocols, subnetting and application layer security. (Analysing)
- CO7:** Judge which protocols operates in which layer and why. (Evaluating).
- CO8:** Formulate the pros, cons and implementation of different routing protocols, IEEE standards, packet header value analysis under different circumstances. (Creating)

Suggested Readings

1. Andrew S. Tanenbaum , Computer Networks, PHI
2. Larry L. Peterson and Bruce S. Davie, Computer Networks –A system approach.
3. Behrouz A. Forouzan, Data communication and Networking, Tata McGraw-Hill.
4. William Stallings, Data and Computer Communication, Pearson Education.
5. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Pearson Education.

CSSD0058: SOFTWARE ENGINEERING AND DESIGNING CONCEPTS**(3 credits – 45 hours)**

Objective: *The objective of the course is to introduce the methodologies involved in the development and maintenance of software over its entire life cycle and make aware of different life cycle models, requirement dictation process, implementation and testing strategies and planning and management of software.*

Module I (12 hours)

- a) Software Process: Introduction –S/W Engineering Paradigm – life cycle models (water fall, incremental, spiral, WINWIN spiral, evolutionary, prototyping, object oriented), system engineering – computer based system – verification – validation – life cycle process – development process –system engineering hierarchy.

- b) Software Requirements: Functional and non-functional - user – system –requirement engineering process, feasibility studies – requirements – elicitation – validation and management, software prototyping – prototyping in the software process – rapid prototyping techniques – user interface prototyping -S/W document. Analysis and modeling – data, functional and behavioral models – structured analysis and data dictionary.

Module II (5 hours)

Design Concepts and Principles: Design process and concepts, modular design, design heuristic, design model and document. Architectural design – software architecture

Module III (8 hours)

Data design – architectural design – transform and transaction mapping, user interface design – user interface design principles. Real time systems - Real time software design – system design, real time executives – data acquisition system - monitoring and control system. SCM – Need for SCM – Version control – Introduction to SCM process – Software configuration items. Introduction- Use case diagram, Class diagram, Activity diagram and Sequence diagram.

Module IV (10 hours)

Testing: Taxonomy of software testing, Levels, test activities, types of s/w test – black box testing –testing boundary conditions – structural testing – test coverage criteria based on data flow mechanisms, regression testing – testing in the large. S/W testing strategies– strategic approach and issues, unit testing, integration testing, validation testing, system testing and debugging.

Module V (10 hours)

Software Project Management: Measures and measurements – S/W complexity and science measure – size measure – data and logic structure measure – information flow measure. Software cost estimation – function point models – COCOMO model- Delphi method. Defining a Task Network – Scheduling – Earned Value Analysis – Error Tracking - Software changes – program evolution dynamics – software maintenance – Architectural evolution. Taxonomy of CASE tools.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall and define the life cycle models of a software. (Remembering)
- CO2:** Explain and differentiate various software complexities. (Understanding)
- CO3:** Experiment with different software architectures and identify the best feasible one. (Applying)
- CO4:** Analyse and design any software Applying or software product. (Analysing)
- CO5:** Appraise and validate a practical solution towards a software applying development and also deploy a product of their own. (Evaluating)
- CO6:** Develop and create various design diagrams and find solutions to problems. (Creating)

Suggested Readings

1. Roger S.Pressman, Software Engineering- A practitioner’s Approach, MGH.
2. Ian Sommerville, Software Engineering, Pearson Education.
3. Rajib Mall, Fundamentals of Software Engineering–, PHI.
4. Ali Behforooz and Frederick J Hudson, Software Engineering Fundamentals, Oxford University Press.
5. Pankaj Jalote, An Integrated Approach To Software Engineering, Narosa
6. Ghezzi, C.; M. Jazayeri; D. Mandrioli, Fundamentals Of Software Engineering (Second Edition), New Delhi: Prentice-Hall India, 2002

7. Fairley, R. E., Software Engineering Concepts, New Delhi: Tata McGraw-Hill, 1997
8. Vilet, H. V., Software Engineering Principles and Practice (Second Edition), New York: John Wiley and Sons

CSAA0059: ANALYSIS AND DESIGN OF ALGORITHMS

(4 credits – 60 hours)

Objective: To create analytical skills, to enable the students to design algorithms for various applications and to Analyse the algorithms with the objective to introduce mathematical aspects, design and analysis of algorithms.

Module I (18 hours)

- a) Basic Concepts of Algorithms: Introduction, Notion of Algorithm, Fundamentals of Algorithmic Solving, Important Problem types, Fundamentals of the Analysis Framework – Asymptotic Notations and Basic Efficiency Classes.
- b) Mathematical Aspects and Analysis of Algorithms: Mathematical Analysis of Non-recursive Algorithm, Mathematical Analysis of Recursive Algorithm – Example: Fibonacci Numbers, Empirical Analysis of Algorithms, Algorithm Visualization. (12 hours)

Module II (15 hours)

Analysis of Sorting and Searching Algorithms: Brute Force – Selection Sort and Bubble Sort – Sequential Search and Brute-force string matching – Divide and conquer – Merge sort – Quick Sort – Binary Search – Binary tree- Traversal and Related Properties – Decrease and Conquer – Insertion Sort – Depth first Search and Breadth First Search.

Module III (15 hours)

Algorithmic Techniques: Transform and conquer – Presorting – Balanced Search trees – AVL Trees – Heaps and Heap sort – Dynamic Programming – Warshall’s and Floyd’s Algorithm – Optimal Binary Search trees – Greedy Techniques – Prim’s Algorithm – Kruskal’s Algorithm – Dijkstra’s Algorithm – Huffman trees.

Module IV (12 hours)

Algorithm Design Methods: Backtracking – n-Queen’s Problem – Hamiltonian Circuit problem – Subset-Sum problem – Branch and bound – Assignment problem – Knapsack problem – Traveling salesman problem.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define algorithms, importance of analysis of an algorithm and their asymptotic bounds and relate the different types of problem and their solutions. (Remembering)
- CO2:** Explain different design strategies such as brute force, divide and conquer, dynamic programming, greedy and backtracking used for the design of algorithms. (Understanding)
- CO3:** Build an algorithms for given problems. (Applying)
- CO4:** Compare and analyse different design strategies. (Analysing)
- CO5:** Assess various algorithms in terms of correctness, computation cost and memory space used. (Evaluating)
- CO6:** Formulate new algorithms for given problems by using most appropriate algorithmic strategy considering the problem domain. (Creating)

Suggested Readings

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, PHI.
2. A.V.Aho, J.E. Hopcroft and J.D.Ullman, The Design and Analysis Of Computer Algorithms, Pearson Education.
3. Anany Levitin, Introduction to the Design and Analysis of Algorithm, Pearson Education.
4. Sara Baase and Allen Van Gelder, Computer Algorithms - Introduction to Design and Analysis, Pearson Education.

CSCD0060: COMPILER DESIGN

(4 credits – 60 hours)

Objective: *The objectives of the course are to understand, design and implement a lexical Analyser, a parser, and generation schemes and to understand optimization of codes and runtime environment.*

Module I (12 hours)

Introduction to compiling: Compilers – Analysis of the source program – Phases of a compiler – Cousins of the Compiler – Grouping of Phases – Compiler construction tools – Lexical Analysis – Role of Lexical Analyser – Input Buffering – Specification of Tokens.

Module II (12 hours)

Syntax Analysis: Role of the parser –Writing Grammars –Context-Free Grammars – Top Down parsing – Recursive Descent Parsing – Predictive Parsing – Bottom-up parsing – Shift Reduce Parsing – Operator Precedent Parsing – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser. Syntax Directed translation: Syntax Directed definition, Construction of syntax trees, Bottom Up Evaluation of S-Attributed Definitions.

Module III (20 hours)

- a) Intermediate Code Generation: Intermediate languages – Declarations – Assignment Statements – Boolean Expressions – Case Statements – Back patching – Procedure calls.
- b) Code Generation: Issues in the design of code generator – The target machine – Runtime Storage management – Basic Blocks and Flow Graphs – Next-use Information – A simple Code generator – DAG representation of Basic Blocks – Peephole Optimization.

Module IV (16 hours)

Code Optimization and Run time Environments: Introduction – Principal Sources of Optimization – Optimization of basic Blocks – Introduction to Global Data Flow Analysis – Runtime Environments – Source Language issues – Storage Organization – Storage Allocation strategies – Access to non-local names – Parameter Passing.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the different phases of compiler design, their functionalities and the compiler design tools and techniques. (Remembering)
- CO2:** Interpret various types of parser and their merits and demerits and illustrate the error handling techniques in compiler construction. (Understanding)
- CO3:** Experiment with the different parsing techniques to input string. (Applying)
- CO4:** Compare and Analyse different techniques of parsing. (Analysing)

- CO5:** Decide upon the suitable parsing technique for any given input and examine how to convert the given grammar to its respective non-left recursive grammar. (Evaluating)
- CO6:** Adapt to handle with code optimization, run time environment etc. during compilation. (Creating)

Suggested Readings

1. Cozmpilers Principles, Techniques and Tools- Alfred Aho, Ravi Sethi, Jeffrey D Ullman, Pearson Education.
2. Introduction to Compiler Techniques- J.P. Bennet, Tata McGraw-Hill.
3. Compiler Construction: Principles and Practice Learning. - Kenneth C. Louden, Thompson.
4. Practice and Principles of Compiler Building with C- Henk Alblas and Albert Nymeyer, PHI.

CSAI0061: ARTIFICIAL INTELLIGENCE

(4 credits – 60 hours)

Objective: *The course objective is to make the students understand the principles of problem solving, search techniques and AI techniques for representation and manipulation of complex information and knowledge. The course also makes aware of several advanced AI applications and topics such as intelligent agents, planning and scheduling, machine learning and expert systems.*

Module I (15 hours)

Overview of Artificial intelligence: Problems of AI, AI technique, Tic -Tac-Toe problem. Intelligent Agents: Agents and environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Problem Solving: Problems, Problem Space and search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs. Search techniques: Solving problems by searching: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies.

Module II (18 hours)

Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms and optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. Adversarial search: Games, optimal decisions and strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening. Knowledge and reasoning: Knowledge representation issues, representation and mapping, approaches to knowledge representation, issues in knowledge representation. Using predicate logic: Representing simple fact in logic, representing instant and ISA relationship, computable functions and predicates, resolution, natural deduction.

Module III (15 hours)

Representing knowledge using rules: Procedural versus declarative knowledge, logic programming, forward versus backward reasoning, matching, control knowledge. Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets and fuzzy logics. Planning: Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques. Natural Language processing: Introduction, Syntactic processing, semantic analysis, discourse and pragmatic processing.

Module IV (12 hours)

Learning: Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning and genetic learning. Expert Systems: Representing and using domain knowledge, expert system shells, knowledge acquisition. Basic knowledge of programming language like Prolog and Lisp.

COURSE / LEARNING OUTCOMES

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

- CO1:** Show the need of incorporating human intelligence into machine and define the basic terms related to the concept of knowledge and representation, learning and reasoning, communication and language processing. (Remembering, Understanding)
- CO2:** Define problem state space, design algorithms to solve problems, generalized schema for knowledge interpretation and planning and language processing. (Remembering, Understanding)
- CO3:** Compute and demonstrate the problem in terms of state space and apply different AI algorithms to solve problems and construct logic to represent knowledge in computational domain and also to interpret the natural language. (Applying)
- CO4:** Compare and Analyse the performance of algorithms based on problem domain. (Analysing)
- CO5:** Judge and assess the algorithms based on completeness, optimality, and space and time complexity for solving a problem in an intelligent manner. (Evaluating)
- CO6:** Design and create new intelligent algorithm for application development by integrating experience based learning. (Creating)

Suggested Readings

1. Ritch and Knight, Artificial Intelligence, TMH.
2. S. Russel and P. Norvig, Artificial Intelligence A Modern Approach, Pearson.
3. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI.
4. S. Kaushik, Logic and Prolog Programming, New Age International.

CSGM0062: COMPUTER GRAPHICS AND MULTIMEDIA

(3 credits – 45 hours)

Objective: *The objective of the course is to provide the understanding of the fundamental graphical operations and the implementation on computer, the mathematics behind computer graphics and to build a virtual environment and situation using animation and multimedia.*

Module I (10 hours)

Introduction to computer graphics and graphics systems: Overview of computer graphics, representing pictures, preparing, presenting and interacting with pictures for presentations; Visualization and image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active and Passive graphics devices; Computer graphics software; Scan Conversion: Points and lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Module II (12 hours)

2D transformation and viewing: Basic transformations: translation, rotation, scaling ; Matrix representations and homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to viewport co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons and ellipse. 3D transformation and viewing:

3D transformations: translation, rotation, scaling and other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, viewport clipping, 3D viewing.

Module III (10 hours)

Curves: Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B- spline curves, rational B-spline curves. Hidden surfaces: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry. Color and shading models: Light and color model; interpolative shading model, Texture.

Module IV (13 hours)

Introduction to Multimedia: Concepts, uses of multimedia, hypertext and hypermedia. Image, video and audio standards. Audio: digital audio, MIDI, processing sound, sampling, compression. Video: MPEG compression standards, compression through spatial and temporal redundancy, inter-frame and intra-frame compression. Animation: types, techniques, key frame animation, utility, morphing. Virtual Reality concepts.

COURSE / LEARNING OUTCOMES

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

- CO1:** Find out different graphics and multimedia systems comprising of software and hardware. (Remembering)
- CO2:** Interpret the fundamentals of graphical operations and the mathematics behind computer graphics. (Understanding)
- CO3:** Experiment with programmes to design various applications of computer graphics. (Applying)
- CO4:** Compare and Analyse different graphical systems and their application. (Analysing)
- CO5:** Evaluate different techniques used to design various applications of computer graphics. (Evaluating)
- CO6:** Synthesize methods to design computationally efficient multimedia and graphical application. (Creating)

Suggested Readings

1. Hearn and Baker, Computer Graphics (C version 2nd Ed.), Pearson.
2. Mukherjee, Fundamentals of Computer graphics and Multimedia, PHI.
3. D. F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, TMH.
4. J. K. Buford, Multimedia Systems, Pearson Education

CSPM0063: PERSONAL AND MOBILE COMMUNICATION

(4 credits – 60 hours)

Objective: *The course on mobile communications introduces the principles of mobile systems and its technical aspects and services. The evolution of services related to technical aspects is emphasized for both public and professional mobile telephony standards (GSM, UMTS, etc.). Indoor access standards as Wireless LAN and ad hoc networks based on Bluetooth are also considered in the frame of the migration to wireless of wired applications. The course also emphasizes on cellular networks.*

Module I: Introduction to Personal Communications Services (PCS) (12 hours)

PCS Architecture, mobility management, Networks signaling, Global System for Mobile Communication (GSM) System overview: GSM Architecture, Mobile management, Network signaling. General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. W-CDMA, CDMA, 3G services

Module II: Wireless LANs (15 hours)

Characteristics, IEEE 802.11: Architecture, Physical Layer, MAC Layer, MAC Management, 802.11a and 802.11b. HIPERLAN: History, WATM, BRAN and HiperLAN2. Bluetooth: Architecture, Radio Layer, Baseband Layer, Link Management Protocol, L2CAP and Security.

Module III: Mobile Transport and Network Layer (18 hours)

Introduction, Traditional TCP: Congestion Control, Slow Start, Fast Retransmit and Implications of Mobility. Classical TCP Improvements: Indirect TCP, Snooping TCP, Mobile TCP and Fast Retransmit. Mobile IP: Introduction, IP Packet Delivery, Agent Discovery, Registration, Tunneling and Encapsulation, Optimizations and Reverse Tunneling. Mobile Ad-hoc Networks: Routing, Destination Sequence Distance Vector, Dynamic Source Routing and Alternative Metrics.

Module IV: Cellular Networks (15 hours)

Cellular Concept, Frequency Reuse, Channel Allocation Management, Call Setup, Location Management, Cell Handoffs, Interference: Co-channel and Adjacent Interference. System Capacity, Improving Cell Capacity and Coverage: Cell Splitting, Sectoring, Repeaters and Microcell Zone Concept. Wireless Application Protocol: Introduction, Protocol Stack, Connections.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall and define different mobile communication terminologies such as GSM, GPRS, CDMA, W-CDMA etc. (Remembering)
- CO2:** Explain different wireless LAN, Mobile transport and network layer and basics of cellular network. (Understanding)
- CO3:** Explain the theory behind designing a GSM network, wireless LAN and building mobile communication protocols. (Understanding)
- CO4:** Distinguish GSM from CDMA/W-CDMA, mobile communication from 802.11, mobile communication transport and network layer protocols from TCP/IP (Understanding)
- CO5:** Apply the knowledge to solve problems like but not specific to frequency reuse problems, DSDV etc. (Applying)
- CO6:** Analyse the pros, cons and implementation of different routing protocols in Mobile communication, IEEE standards, for 802.11, and distinguish the working principle of mobile communication from 802.11 (Analysing)

- CO7:** Judge which protocols operates in which layer and the corresponding pros and cons. (Evaluating).
- CO8:** Design and analysis of theoretical mobile communication model and develop routing protocols for packet delivery. (Creating)

Suggested Readings

1. J. Schiller, Mobile Communications, Addison-Wesley.
2. T. S. Rappaport, Wireless Communications: Principle and Practices, Pearson.
3. R. Pandya, Mobile and Personal Communication Systems and Services, PHI.
4. J. Burkhardt, Pervasive Computing: Technology and Architecture, Pearson.

CSIR0064: IMAGE PROCESSING AND PATTERN RECOGNITION

(4 credits – 60 hours)

Objective: The objective of the course is to be familiar with Image acquisition, digital image representation, various image processing operations for improving image quality through enhancement, segmentation and representation. The course also focuses on pattern recognition and extraction of image features.

Module I (15 hours)

- a) Introduction: Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.
- b) Digital Image Formation: A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling and Quantization - Uniform and Non uniform.
- c) Mathematical Preliminaries: Neighbour of pixels, Connectivity, Relations, Equivalence and Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine and Sine Transform.

Module II (20 hours)

- a) Image Enhancement Techniques: Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging – Spatial filtering: Smoothing, sharpening filters – Laplacian filters – Frequency domain filters : Smoothing – Sharpening filters – Homomorphic filtering.
- b) Image Segmentation and Representation: Edge detection – Thresholding - Region Based segmentation – Boundary representation: chain codes- Polygonal approximation – Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors – Simple descriptors- Texture

Module III (10 hours)

Basic Concepts, Pattern Recognition Systems, Fundamental Problems in pattern recognition system design, Design concepts and Methodologies – Character recognition – Speech recognition – Fingerprint Recognition – Pattern Recognition Model. Decision Functions – Linear Decision functions – Distance functions. Minimum distance classification, clustering concepts, Cluster seeking algorithms, Maximum distance, K- means Algorithms.

Module IV (10 hours)

Bayes classifier, decision function for Baye's classifier, Baye's Classifier for normal patterns. Trainable pattern classifiers - deterministic approach, perception approach reward- punishment concept. Gradient approach- Gradient Descent algorithms, LMSE Algorithms, Multi category classification. Introduction to statistical approach – stochastic approximation methods

Module V (5 hours)

Introduction to Image processing toolbox in MATLAB: MATLAB Basics, Image processing toolbox, Importing and displaying images, Converting between image types, Exporting images, Importing and playing video files, obtaining pixel intensity values, Extracting a region of interest, Computing pixel statistics on a region of interest, Measuring object sizes, Preprocessing Images, Adjusting image contrast, reducing noise in an image Using sliding neighborhood operations, Using block processing operations, Spatial Transformation and Image Registration, Geometric transformations, Edge and Line Detection, Segmenting object edges, Detecting straight lines, performing batch analysis over sets of images, Detecting circular objects, Color space transformation, Color Segmentation, Texture segmentation, Texture based image classification, using morphological operations.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall fundamentals of digital image processing, mathematical modeling of digital images, various image enhancement filters, methods for image segmentation and representation, basic concepts of pattern recognition, design concepts and methodologies used for recognition of characters, speech etc., various clustering and classification techniques. (Remembering)
- CO2:** Recall the knowledge of programming in MATLAB (syntax and semantics) and MATLAB library for processing images. (Remembering)
- CO3:** Illustrate the process of image acquisition, image enhancement, image segmentation and classification. (Understanding)
- CO4:** Interpret the need of various image processing filters and pattern recognition approaches depending on the application. (Understanding)
- CO5:** Apply image processing filters and pattern recognition methods to images using MATLAB. (Applying)
- CO6:** Analyse different available methods for performing image processing and pattern recognition operations. (Analysing)
- CO7:** Evaluate the suitability of image processing filters and pattern recognition approaches depending on the image quality, expected outcome of the application and also considering the performance of the method/filter. (Evaluating)
- CO8:** Design new methods to perform image enhancement, image segmentation and pattern recognition. (Creating)

Suggested Readings

1. R.C.Gonzalez and R.E.Wood, Digital Image Processing, Addison Wesley.
2. J.T. Tou, R.C. Gonzalez, Pattern Recognition Principles, Addison Wesley.
3. Anil Ku Jain, Fundamentals of Digital Image Processing, PHI.
4. B.Chanda and D.Dutta, Digital Image Processing and Analysis, Prentice Hall.

CSRE0065: REAL TIME AND EMBEDDED SYSTEMS**(4 credits – 60 hours)**

Objective: This course will discuss the design issues in an embedded system and the technologies needed to support such systems, with the focus on the software aspects. This course will discuss the design issues in an embedded system and technologies needed to support such systems.

Module I (12 hours)

Embedded Architecture: Embedded Computers, Characteristics of Embedded Computing Applications, Challenges in Embedded Computing system design, embedded system design process- Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration, Formalism for System Design-Structural Description, Behavioral Description, Design Example: Model Train Controller.

Module II (18 hours)

Embedded Processor and Computing Platform: ARM processor, processor and memory organization, Data operations, Flow of Control, SHARC processor- Memory organization, Data operations, Flow of Control, parallelism with instructions, CPU Bus configuration, ARM Bus, SHARC Bus, Memory devices, Input/output devices, Component interfacing, designing with microprocessor development and debugging, Design Example : Alarm Clock.

Module III (10 hours)

Networks: Distributed Embedded Architecture- Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, SHARC link ports, Ethernet, Myrinet, Internet, Network-Based design- Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.

Module IV (10 hours)

Real-Time Characteristics: Clock driven Approach, weighted round robin Approach, Priority driven Approach, Dynamic Versus Static systems, effective release times and deadlines, Optimality of the Earliest deadline first (EDF) algorithm, challenges in validating timing constraints in priority driven systems, Off-line versus On- line scheduling.

Module V (10 hours)

System Design Techniques: Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design, Quality Assurance, Design Example: Telephone PBX-System Architecture, Ink jet printer- Hardware Design and Software Design, Personal Digital Assistants, Set-top Boxes.

COURSE / LEARNING OUTCOMES

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

- CO 1:** Recall computer embedded components, software components, architecture etc. (Remembering)
- CO 2:** Explain embedded processor and computing platforms. (Understanding)
- CO 3:** Applying Network based applications. (Applying)
- CO 4:** Analysing the concept of embedded system through various applications. (Analysing)
- CO 5:** Evaluate design methodologies and determine some feasible method. (Evaluating and Creating)

Suggested Readings

1. Frank Vahid and Tony Givargis, Embedded System Design, John Wiley and sons, Inc.
2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kauffman publishers, 2001
3. Alan C. Shaw, Real-Time Systems and software, John Wiley and Sons Inc
4. Daniel W. Lewis, Fundamentals of Embedded Software, Pearson
5. J. W. S. Liu, Real time Systems, Pearson
6. S. V. Iyer and P. Gupta, Embedded Real-time System Programming, TMH
7. David E. Simon, An Embedded System Primer, Addison-Wesley Publishers
8. Steve Heath, Embedded System Design, Butterworth-Heinemann Publishers
9. Graham Wilson, Embedded System Computer Architecture, Butterworth-Heinemann

CSAP0066: ADVANCED COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

(3 credits – 45 hours)

Objective: *This course is intended to introduce the students to the field of modern computer architecture design stressing parallel processing techniques. The course is a comprehensive study of parallel processing techniques and their application from basic concepts to state-of-the-art parallel computer systems.*

Module I (12 hours)

Introduction to Parallel Processing: Shared Memory Multiprocessing, Distributed Memory, Parallel Processing Architectures- Introduction-Parallelism in sequential Machines, Abstract Model of Parallel Computer, Multiprocessor Architecture, Array Processors.

Module II (10 hours)

Pipelining and Super Scalar Techniques, Linear Pipeline Processors, Non-Linear Pipeline processors, Instruction pipeline design, Arithmetic pipeline Design, Super Scalar and Super pipeline Design.

Module III (11 hours)

Programmability Issues - An Overview, Operating system support, Types of Operating Systems, Parallel Programming models, Software Tools-Data Dependency Analysis- Types of Dependencies, Program Transformations, Shared Memory Programming.

Module IV (12 hours)

Thread-based Implementation, thread Management, Attributes of Threads, Mutual Exclusion with Threads, Mutex Usage of Threads, Thread implementation, Events and Conditions variables, Deviation Computation with Threads, Java Threads, Distributed Computing: Message Passing Model, General Model, Programming Model, PVM-Algorithms for Parallel Machines, Debugging Parallel programming, Other Parallelism Paradigms. Analysis of parallel algorithm, Matrix operations

COURSE / LEARNING OUTCOMES

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

- CO1:** Relate the architecture and organization major components of modern computer systems. (Remembering)
- CO2:** Explain the functioning and interconnection of major components of computer systems. (Understanding)
- CO3:** Apply different design issues associated with the design of any architecture. (Applying)
- CO4:** Apply their logic in designing simple control unit, instruction sets, instruction format, buses and register set etc. (Applying)

- CO5:** Compare and Analyse different styles, strategies and formats adopted for designing the instruction set, register set, memory organization etc.(Analysing)
- CO7:** Assess various architectures and their design considerations. (Evaluating)
- CO6:** Construct and organize a new architecture by considering various design issues in order to make it more efficient with less overhead. (Creating)

Suggested Readings

1. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill.
2. M. Sasikumar, D. Sikhare and P. Ravi Prakash, Introduction to Parallel Processing, PHI.
3. W. Stallings, Computer Organization and Architecture, PHI.
4. K. Parthasarathy, Advanced Computer Architecture, Thomson Business Information.

CSET0067: EMERGING TRENDS IN COMPUTING- CLOUD COMPUTING

(3 credits – 45 hours)

Module I (10 hours)

Introduction to Cloud Computing, the Evolution of Cloud Computing, Hardware Evolution, Internet Software Evolution, Server Virtualization, Web Services Deliver from the Cloud, Communication- as-a-Service, Infrastructure-as-a-Service, Monitoring-as-a-Service, Platform- as-a-Service, Software-as- a-Service, Building Cloud Network

Module II (13 hours)

Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Map-reduce.

Module III (14 hours)

Putting Security on the Spot with Questions: Understanding Security Risks, Reducing Cloud Security Breaches, Implementing Identity Management, Benefits of identity management, Aspects of identity management, Playing Detective: Detection and Forensics, Activity logs, HIPS and NIPS, Data audit, Encrypting Data, Creating a Cloud Security Strategy

Module IV (8 hours)

Virtualization and the Cloud: Visualizing Virtualization, Characteristics, Using a hypervisor in virtualization, Abstracting hardware assets, Managing Virtualization, Foundational issues, Abstraction layer, Provisioning software, Virtualizing storage, Hardware provisioning, Security issues, Taking Virtualization into the Cloud

COURSE / LEARNING OUTCOMES

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

- CO1:** Define and relate the various evolutionary steps of computation. (Remembering)
- CO2:** Define and compare the web services delivered via cloud. (Remembering/ Understanding)
- CO3:** Illustrate the use of management console for virtualization using hypervisors. (Understanding)
- CO4:** Construct a virtual private cloud using Amazon web service as IaaS. (Applying)
- CO5:** Model an application using map reduce program. (Applying)
- CO6:** Analyse the concepts of Big data and Hadoop components. (Analysing)

CO7: Develop and assess a real time application deployed on cloud platform. (Creating/Evaluating)

CO8: Design a vulnerability assessment tool for cloud computation (Creating)

Suggested Readings

1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kaufman, F.Halper, (Wiley India Edition)
2. Enterprise Cloud Computing by Gautam Shroff,Cambridge
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
4. Google Apps by Scott Granneman,Pearson
5. Cloud Security and Privacy by Tim Malhar, S.Kumaraswamy, S.Latif (SPD,O'REILLY)
6. Cloud Computing : A Practical Approach, Anthony T Velte, et.al McGraw Hill,
7. Cloud Computing Bible by Barrie Sosinsky, Wiley India

CSDG0068: DISTRIBUTED COMPUTING

(3 credits – 45 hours)

Objective: *This course provides an introduction to the fundamentals and structure of distributed computer systems including distributed memory, distributed file systems, distributed databases, security, protection and process management.*

Module I (10 hours)

Fundamentals: Introduction, Models and Features, Concept of distributed operating system, Issues in design of a distributed operating system. Message Passing: Good message passing system, IPC, Synchronization, Buffering, Multi-datagram messages, Encoding and decoding techniques, Process addressing, Failure handling, Group communication; Remote procedure calls (RPC) - Models, Communication protocols, RPC, Lightweight RPC.

Module II (12 hours)

Distributed Shared Memory: Architecture, Thrashing, Granularity, Advantages. Synchronization: Introduction, Clock Synchronization, Event handling, Mutual Exclusion; Deadlock – Conditions, Avoidance, Prevention, Recovery.

Module III (11 hours)

Resource and Process Management: Features of a good scheduling algorithm, Task assignment approach, Load balancing and load sharing approach, Introduction to process management, Process migration, Threads. Distributed File Systems: Introduction, Features, Models, Accessing models; sharing Semantics and caching schemes, replication, Fault Tolerance, Atomic transactions.

Module IV (12 hours)

Naming: Introduction, Features, Fundamental Terminologies and concepts, System oriented names, Human oriented names, Name caches. Security: Potential attacks to computer system, Cryptography, Authentication, digital signatures, Access Control.

COURSE / LEARNING OUTCOMES

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

CO1: Define and relate the various evolutionary steps of distributed computing. (Remembering)

CO2: Classify and define the various distributed computing system models. (Understanding/Remembering)

- CO3:** Identify the purpose of using message passing mechanisms and illustrate the various synchronization techniques used in distributed computing. (Applying/Understanding)
- CO4:** Define and Analyse the concepts of Big data and Hadoop components. (Remembering/Analysing)
- CO5:** Categorize distributed computing systems based on load balancing and load sharing approaches. (Analysing)
- CO6:** Explain the use of replication and fault tolerance to Analyse the efficiency of a distributed computing system. (Evaluating/Analysing)
- CO7:** Discuss the necessity of having a global naming system and explain why security is such an essential component in designing a trustable distributed system. (Evaluating)
- CO8:** Design an application using map reduce program. (Creating)

Suggested Readings

1. P.K.Sinha, Distributed Operating Systems: Concepts and Design, PHI.
2. A.S. Tanenbaum, Distributed Operating Systems, Pearson.
3. G. Coulouris, J. Dollimore and T. Kindberg, Distributed Systems: Concepts and Design, Pearson.
4. A. Silberschatz and P. Galvin, Operating System Concepts, John Wiley.

CSNC0069: NETWORK SECURITY AND CRYPTOGRAPHY

(3 credits – 45 hours)

Objective: *The course is intended to understand network security threats and countermeasures, fundamentals of cryptography and techniques of key encryption, authentication, IP security, network security and web security.*

Module I (8 hours)

Introduction to the concepts of Security: Introduction, The Need for Security, Security approaches, Principles of Security, Types of Attacks. Cryptographic Techniques: Introduction, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Possible Types of attacks.

Module II (15 hours)

Computer Based Symmetric Key Cryptographic Algorithms: Introduction, Algorithm Types and modes, An Overview of Symmetric Key Cryptography, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), RC5, Blowfish, Advanced Encryption Standard (AES). Computer Based Asymmetric Key Cryptographic Algorithms: Introduction, Brief history of Asymmetric Key Cryptography, An Overview of Asymmetric Key Cryptography, the RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm.

Module III (12 hours)

Public Key Infrastructure: Introduction, Digital Certificates, the PKIX, Public Key Cryptography Standards (PKCS) XML, PKI and Security. Internet Security Protocols: Basic Concepts, Secure Socket Layer (SSL), Secure Hyper Text Transfer Protocols (SHTTP), Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), PGP, IPsec, 3-D Secure Protocol, Email Security, Security in GSM.

Module IV (10 hours)

User Authentication Mechanisms: Introduction, Authentication Basics, Passwords, Authentication Tokens, Certificate-based Authentication, Biometric Authentication, Kerberos, Single Sign On (SSO) Approaches. Network and System Security: Brief Introduction to TCP/IP, Vulnerability, Monitoring/

Sniffing, Spoofing, Firewalls, Intrusion Detection, others (DNS, DoS etc). Wireless Application Protocol (WAP), Security in UMTS. Introduction to Operating System security: Computer systems overview, Buffer overflow. Introduction to Securing UNIX.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the concept and significance of network security, types of attacks and also recognize the different encryption techniques adopted in both traditional modern cryptographic mechanisms. (Remembering)
- CO2:** Infer the logic adopted in different cryptographic algorithms, and their countermeasures. (Understanding)
- CO3:** Apply the concepts gathered from the fundamentals of cryptographic and security approaches in solving related problems. (Applying)
- CO4:** Compare and contrast the need and working of different network security protocols, services and mechanisms. (Analysing)
- CO5:** Assess and criticize references to computer security appearing in any other academic or non-academic curriculum. (Evaluating)
- CO6:** Propose techniques, algorithms related to IP security, network security and web security. (Creating)

Suggested Readings

1. A. Kahate, Cryptography and Network Security, PHI.
2. W. Stallings, Cryptography and Network Security, PHI.
3. B. A. Forouzan, Cryptography and Network Security, McGraw Hill.
4. W. Stallings, Network Security Essentials: Applications and Standards, Pearson.

CSAO0070: CONCEPTS OF ADVANCED OPERATING SYSTEMS

(3 credits – 45 hours)

Objective: *The objective of the course is to expose students to advanced concepts and design issues of operating systems which will give a basic understanding of the industry's leading advanced operating systems. Students should be able to identify each system and know the operational and administrative requirements of them.*

Module I (10 hours)

Concepts of processes, Concurrent processes, Threads, Overview of different classical synchronization problems, Monitors, Communicating Sequential processes (CSP), Process deadlocks: Introduction, causes of deadlocks, Deadlock handling strategies, Models of deadlock.

Module II (11 hours)

Distributed operating system: Architectures, Issues in Distributed operating systems, Limitations of Distributed Systems, Lamport's logical clock, Global states, Chandy-Lampert's global state recording algorithm, Basic concepts of Distributed Mutual Exclusion, Lamport's Algorithm, Ricart-Agrawala Algorithm; Basic concepts of Distributed deadlock detection, Distributed File system, Architecture, Design issues, SUN Network File system, Basic concepts of Distributed shared memory, Basic concepts of Distributed Scheduling, Load balancing, Load sharing

Module III (12 hours)

Multiprocessor System: Motivation, Classification, Multiprocessor Interconnections, Types, Multiprocessor OS functions and requirements; Design and Implementation Issue; Introduction

to parallel programming; Multiprocessor Synchronization. Performance, Coprocessors, RISC and data flow: Introduction, Necessity, Measures, Techniques, Bottlenecks and Saturation, Feedback loops, Coprocessors, RISC.

Module IV (12 hours)

Analytic Modeling: Introductions, Queuing Theory, Markov Process. Security and Protection: Security-threats and goals, Penetration attempts, Security Policies and mechanisms, Authentication, Protections and access control Formal models of protection, Cryptography, worms and viruses.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the concepts of concurrent processes, deadlock, process synchronization and list the various conditions for identifying these scenarios. (Remembering)
- CO2:** Define and relate the advanced terms like distributed deadlock, distributed mutual exclusion and distributed file system etc. (Remembering)
- CO3:** Explain the concept of Lamport's logical clock, global state and give example of consistent, transit and inconsistent global state. (Understanding)
- CO4:** Illustrate the Chandy-Lampert's algorithm for consistent global state recording. (Understanding)
- CO5:** Apply various algorithms like Lamport's algorithm and Ricart- Agarwala algorithm to solve the problem of distributed mutual exclusion. (Applying)
- CO6:** Identify distributed deadlocks using various algorithm. (Applying)
- CO7:** Compare techniques of implementing distributed file system, distributed shared memory, different load scheduling algorithms like- load balancing and load sharing. (Analysing)
- CO8:** Determine the requirements of security and protection for a computer system and estimate the efficiency of different security models. (Evaluating)
- CO9:** Discuss the design and implementation issues of multiprocessor operating system. (Creating)

Suggested Readings

1. Milan Milenkovic, Operating Systems Concepts and Design, TMH.
2. H.M. Deitel, Operating System, Pearson.
3. M. Singhal and N. G. Shivaratri, Advanced Concepts in Operating Systems, TMH.
4. A. Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts, John Wiley and Sons.

CSAD0075: ANDROID APPLICATION DEVELOPMENT FUNDAMENTALS

(4 credits - 60 hours)

Objective: This course is designed to enable students to get complete understanding of the android applications development. On completion of this course, students will be able to design, develop, debug and deploy various real-time applications.

Module I: Get started (2 hours Theory and 8 hours Lab)

- a) Get started: Build your first app, Introduction to Android, Create Your First Android App, Layouts, Views and Resources, Text and Scrolling Views.
- b) Activities: Understanding Activities and Intents, the Activity Lifecycle and Managing State, Activities and Implicit Intents.
- c) Testing, debugging, and using support libraries: The Android Studio Debugger, Testing your App, The Android Support Library

Module II: User experience (3 hours Theory and 10 hours Lab)

- a) User interaction: User Input Controls, Menus, Screen Navigation, RecyclerView,
- b) Delightful user experience: Drawables, Styles, and Themes, Material Design, Providing Resources for Adaptive Layouts
- c) Testing your UI: Testing the User Interface

Module III: Working in the background (2 hours Theory and 8 hours Lab)

- a) Background Tasks: AsyncTask and AsyncTaskLoader, Connect to the Internet, Broadcast Receivers, Services
- b) Triggering, scheduling and optimizing background tasks: Notifications, Scheduling Alarms, Transferring Data Efficiently

Module IV: All about data (4 hours Theory and 16 hours Lab)

- a) Preferences and Settings: Storing Data, Shared Preferences, App Settings b) Storing data using SQLite: SQLite Primer, SQLite Database,
- c) Sharing data with content providers: Share Data Through Content Providers d) Loading data using loaders: Loaders

Module V: What's Next? (1 hour Theory and 6 hours Lab)

- a) Permissions, Performance and Security
- b) Firebase and AdMob c) Publish

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the various features and functionalities of Android operating system. (Remembering)
- CO2:** Illustrate the various methods of the Android development framework. (Understanding)
- CO3:** Incorporate different features to design user friendly and interactive Android Applications. (Applying)
- CO4:** Analyse various aspects of commercializing an application. (Analysing)
- CO5:** Evaluate effectiveness of different products for real time problems. (Evaluation)
- CO6:** Design Android application for different requirements. (Creating)

Suggested Readings

- 1. Android Developer Fundamentals Course – E-book by the Google Developer Training team.
- 2. The practical workbook: Android Developer Fundamentals Course—Practical's E-book.
- 3. Slide decks & Videos of lectures for reference provided by Google.

CSPS0079: PROGRAMMING FOR PROBLEM SOLVING

(3 credits-45 Hours) (L-T-P:3-0-0)

Objectives: This first course in Programming for Problem solving aims to develop the analytical skills of the students for creative problem solving using computers. Specifically, this course will

- Discuss simple algorithms and flowcharts for arithmetic and logical problems
- Familiarize the student with the grammar and syntax of C language
- To translate algorithm/pseudo-code into C programs and understanding the steps involved in the execution of a C program.

- *Enable the student to use C program to find solutions for common problems.*
- *Get introduced to functions, pointers, arrays, structures and files in C.*

Module I (8 Hours)

Introduction to Programming, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), and Idea of Algorithm: steps to solve logical and numerical problems. Types of Algorithm: Sequentially executed, Conditional Based, repetitive structure, Representation of Algorithm: Flowchart/Pseudocode with examples, from algorithms to programs; source code, variables (with data types) variables and memory, locations, Syntax and Logical Errors in compilation, object and executable code.

Module II (12 Hours)

Operators, precedence of operators, Arithmetic expressions, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Module III (5 Hours)

Arrays, Arrays (1-D, 2-D), Character arrays and Strings

Module IV (5 Hours)

Basic Algorithm Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Module V (8 Hours)

Functions (including built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference, Recursion.

Module VI (7 Hours)

Structures, Defining structures and Array of Structures, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation), File handling.

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:** Compare and interpret information based on their understanding of the concepts of C language's syntax, data types, control statements, functions, pointers, arrays, structures, pointers, files, graphics and hardware programming using C. (Understanding)
- CO3:** Solve problems using standard algorithms and translate pseudo-codes into C programs and implement them. (Applying)
- CO4:** Analyse their skills for choosing the right data 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. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

CSOP0080: OBJECT ORIENTED PROGRAMMING

(3 credits – 45 hours)(L-T-P:3-0-0)

Objectives: *The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, an appropriate framework for automated unit and integration tests.*

Module I (10 hours)

Abstract data types and their specification.

How to implement an ADT. Concrete state space, concrete invariant, abstraction

function. Implementing operations, illustrated by the Text example.

Module II (10 hours)

Features of object-oriented programming. Encapsulation, object identity, polymorphism – but not Inheritance in OO design.

Module III (15 hours)

Design patterns. Introduction and classification. The iterator pattern. Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features.

Module IV (10 hours)

Memory management. Generic types and collections GUIs. Graphical programming with Scala and Swing. The software development process.

The concepts should be practiced using C++ and Java. Pearl may also be introduced wherever possible.

COURSE / LEARNING OUTCOMES

After successful completion of the course, students will be able to:

- CO1:** Define the basic OOP syntax and semantics to write programs. (Remembering)
- CO2:** Illustrate the theoretical concepts such as data type, variables, conditional statements, iterations, etc., for various programming technologies. Students can also explain and relate the principles of interfaces, inheritance and packages in OOP. (Understanding)
- CO3:** select the various access modifiers and apply them for granting restricted access to class, methods and variables while developing any applications. (Applying)
- CO4:** Students can examine user requirements for software functionality required to decide whether basic Java concepts can meet user requirements. (Analysing)
- CO5:** Choose an engineering approach to solving problems, starting from the various ways of giving an input through a program, choosing an optimal method of problem solving and getting the desired output. (Evaluating)
- CO6:** Get the theory behind the basic Java concepts like polymorphism, inheritance, method overloading and method overriding and choose them in solving real life problems. (Creating)

Suggested Readings

1. Barbara Liskov, *Program Development in Java*, Addison-Wesley, 2001
2. Any book on Core Java
3. Any book on C++

CSDC0081: DIGITAL COMPUTER DESIGN**(3 credits – 45 hours) (L-T-P:3-0-0)**

Objective: *The objective of the course is to introduce the fundamental concepts of digital systems and basic tools used in the design and implementation of digital circuits.*

Module I: Data representation and arithmetic operations (5 Hours)

Introduction, numbering systems, decimal to binary conversion, binary coded decimal numbers, hamming code for error correction, alphanumeric codes.

Module II: Algebra for Digital systems (8 Hours)

Binary addition, binary subtraction, complement representation of numbers, addition/subtraction of numbers in 1's complement Notation, addition/subtraction of numbers in 2's complement Notation, binary multiplication, multiplication of signed numbers, binary division, arithmetic with binary coded decimal numbers, representation of integers, Floating point representation of numbers, Floating point arithmetic.

Module III: Logic gates and Boolean Algebra (7 Hours)

Introduction to Basic logic gates (AND, OR, NOT, NOR, NAND), Truth tables, simplification of truth tables, the K-map method, SOP and POS simplifications, Quine-McCluskey tabulation method.

Module IV: Combinational logic and Sequential logic (15 Hours)

- a Combinational logic: Introduction, Combinational circuits, Analysis procedure, design procedure Binary Adder-Subtractor, Decimal adder, binary multiplier, Magnitude comparator, decoders, encoders, multiplexers, HDL models and Combinational Circuits
- b Sequential logic: Introduction, Sequential circuits, Storage elements: Latches, Storage elements: Flip-flops, Analysis of clocked sequential circuits, State reduction and Assignment, Design procedure.

Module V: Digital integrated circuits (10 Hours)

Introduction, Special characteristics, Bipolar-Transistor characteristics, RTL and DTL circuits, Transistor- Transistor Logic, Emitter-Coupled logic, Metal-oxide semiconductor, complementary MOS, CMOS transmission gate circuits, Switch-level Modeling with HDL

Module VI: Memories (5 Hours)

Memory types and terminology, read only memory, Semiconductor RAMs, Non-volatile RAMs, Sequential memories, Programmable logic Devices, Magnetic memories, Optical disk memory, Charge coupled devices.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define the fundamental concepts of digital systems and basic tools used in the design and implementation of digital circuits. (Remembering)
- CO2:** Explain the various concepts of Boolean algebra, Microprocessor, Digital Integrated Circuits and Memory unit. (Understanding)

- CO3:** build the Boolean expressions using Logic gates to construct combinational and sequential circuits. (Applying)
- CO4:** Analyse the Boolean expressions and circuit diagrams. They will be able to provide the simplified expression to implement circuit diagrams with minimum number of logic gates. (Analysing)
- CO5:** evaluate various Boolean algebra/ expressions derived from truth tables. (Evaluation)
- CO6:** propose and design simplified Boolean function to develop logic circuits. (Creating)

Suggested Readings

- 1 M.Morris Mano, Digital Logic and Computer Design, Pearson Education, 2009
- 2 V.Rajaraman, An Introduction to Digital Computer Design, 5th ed., PHI
- 3 R. P Jain, Modern Digital Electronics, 4th ed., TMH
- 4 William Stallings, Computer Organization, PHI

CSDS0082: DATA STRUCTURE

(3 credits – 45 hours) (L-T-P:3-0-0)

Objective: *The objective of this course is to enable the student of Engineering to*

- *make him/her well conversant with managing functions, pointers, arrays, structures etc.*
- *apply abstract data structures in problem solving and make comparative analysis of algorithms to obtain efficient program design.*

Module I: Pointers and Structures (6 hours)

- a Pointers: chain of pointers, pointers and arrays, array of pointers, pointer to functions- passing parameters by value and by reference, dynamic memory allocation; Recursion.
- b Structures: pointers and structures.
- c Files: Sequential file handling, Indexed Sequential files, Reading and writing in random access files.

Module II: Preliminaries (3 hours)

Introduction to Data Structures; Development and analysis of algorithms.

Module III: Linear Data Structures (8 hours)

Arrays; Stacks and stack application; Queues; Linked lists, circular and doubly linked lists.

Module IV: Non-linear Data structures (8 hours)

- a Binary trees; representation in memory, traversals and operations.
- b Introduction to graphs, sequential representation of graphs, graph traversals- BFS, DFS, Shortest path algorithms -(Dijkstra's) Minimum Spanning trees - (Kruskal's, Prim's)

Module V: Advanced Data Structures (10 hours)

Binary search trees, AVL trees, B trees.

Module V: Sorting and Searching (10 hours)

Searching and data modification: Linear search, binary search, hashing techniques and collision resolution

Sorting techniques: selection, insertion, quick, radix, merge, merge-sort and heap sort.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define the different data structures and list the applications of different data structure. (Remembering)
- CO2:** Explain the concept of various data structure like stack, queue, linked list, tree, graph etc. and demonstrate their working mechanism. (Understanding)
- CO3:** Apply their knowledge to solve practical problems like- expression conversion using stack, process management using queue and memory management using linked list and B tree. (Applying)
- CO4:** Survey and Analyse the efficiency of various data structure related algorithms with respect to time and space complexity. (Analysing)
- CO5:** Choose the appropriate data structure and will be able to justify their decision to use a particular data structure by evaluating the required parameters based on the problem domain and input patterns. (Evaluating)
- CO6:** Develop algorithms based on the knowledge they have gained to design cost effective and user friendly application. (Creating)

Suggested Readings

- 1 Lipschutz, S., Data structures, Indian Adapted Ed, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006
- 2 Gilberg, Richard F. Forouzan, and Behrouz A., Data Structures, 2nd Ed, Course Technology, Cengage Learning, New Delhi, 2005.
- 3 Pai, G A, Data Structures and Algorithms, 1st Ed, Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2008.
- 4 Langsam, Augenstein, and Tanenbaum, Data Structures Using C And C++, 2nd Ed, Phi Publication, New Delhi, 2007.
- 5 Krishnamoorthy R., Kumaravel, and G . Indirani, Data Structures Using C, 1st Ed., Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2008.
- 6 Horowitz, Sahni, Susan Freed, Fundamentals of Data Structures in C, 2nd Edition, University press, 1997
- 7 Amiya Kumar Rath, Alok Kumar Jagdev, Data Structures using C, 2nd Edition, Scitech Publication, New Delhi, 2009

CSOA0083: COMPUTER ORGANIZATION & ARCHITECTURE

(3 credits – 45 hours)(L-T-P:3-0-0)

Objective: *This course covers the organization of modern computer systems. It helps in learning how to program computers at the assembly level as well as how to design the main components of a Von Neumann computer system, including its instruction set architecture, data path, control unit, memory system, input/output interfaces, and system buses.*

Module I Introduction (8 hours)

Number representation; fixed and floating point number representation, IEEE standard for floating point representation. Error detection and correction codes: Hamming code. Digital computer generation, computer types and classifications, functional units and their interconnections, buses, bus architecture, types of buses and bus arbitration. Register, bus and memory transfer. Introduction to x86 architecture.

Module II Central Processing Unit (8 hours)

Addition and subtraction of signed numbers, look ahead carry adders. Multiplication: Signed operand multiplication, Booth's Multiplication Algorithm; Division Algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Processor organization, general register organization, stack organization and addressing modes.

Module III Control Unit (10 hours)

Instruction types, formats, instruction cycles and subcycles (fetch and execute etc), micro-operations, execution of a complete instruction. Hardwire and microprogrammed control: microprogramme sequencing, wide branch addressing, and microinstruction with next address field, pre-fetching microinstructions, concept of horizontal and vertical microprogramming.

Module IV Memory (8 hours)

Basic concept and hierarchy, semiconductor RAM memories, 2D and 2 1/2D memory organization. ROM memories. Cache memories: concept and design issues (performance, address mapping and replacement) Auxiliary memories: magnetic disk, magnetic tape and optical disks Virtual memory: concept implementation.

Module V Input / Output (8 hours)

Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access., I/O channels and processors. Serial Communication: Synchronous and asynchronous communication, standard communication interfaces.

Module VI Pipelining (8 hours)

Basic Concepts, performance, floating point arithmetic, operations, instruction pipelining in RISC, pipelining in computer arithmetic, Data Hazard, Instruction hazard, Influence on Instruction set, datapath and controls consideration, Superscalar Operation.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Relate the architecture and organization major components of modern computer systems. (Remembering)
- CO2:** Explain the functioning and interconnection of major components of computer systems. (Understanding)
- CO3:** Apply different design issues associated with the design of any architecture. (Applying)
- CO4:** Apply their logic in designing simple control unit, instruction sets, instruction format, buses and register set etc. (Applying)
- CO5:** Compare and Analyse different styles, strategies and formats adopted for designing the instruction set, register set, memory organization etc.(Analysing)
- CO6:** Assess various architectures and their design considerations. (Evaluating)
- CO7:** Construct and organize a new architecture by considering various design issues in order to make it more efficient with less overhead. (Creating)

Suggested Readings

1. William Stallings, Computer Organization, PHI
2. Vrunesic, Hamacher and Zaky, Computer Organization, TMH
3. M. Morris Mano, Computer System Architecture, PHI
4. Patterson, Computer Organisation and Design, Elsevier Pub. 2009
5. John P Hayes, Computer Organization, McGraw Hill

6. K.K Tripathi, Rajesh K. Gangawar, Microprocessor and its Applications, Acme Learning, New Delhi, 2010
7. Brey, Barry B, INTEL Microprocessors, PHI

CSR0084: RELATIONAL DATABASE MANAGEMENT SYSTEMS

(credits – 45 hours)(L-T-P:3-0-0)

Objective: *The objectives for this course are to give students an in-depth understanding of the relational model for establishing fundamental skills with SQL and the operation of an RDBMS. The course also provides concept of data modelling, design and management for solving realistic problems.*

Module I (10 hours)

- a Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages.
- b Data models - Entity Relationship(ER), Enhanced Entity Relationship (EER): specialization, Aggregation, Mapping ER Model to Relational Model, Network. Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

Module II (18 hours)

Relation Query Languages, SQL queries for retrieval and data changing commands, Relational Algebra, Tuple and Domain Relational Calculus, SQL and QBE. Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.

Module III (8 hours)

Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Optimization Algorithms.

Module IV (10 hours)

- a Storage Strategies: Indices, B-Trees, Hashing, Transaction processing: Recovery and Concurrency Control, Locking and Timestamp based Schedulers, Multiversion and Optimistic Concurrency Control Schemes.
- b Advanced topics: Object-Oriented and Object Relational databases. Logical Databases, Web Databases, Distributed Databases, Data Warehouse and Data Mining.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define the fundamental concepts necessary for designing, using and implementing database systems and applications (Remembering)
- CO2:** Explain the core terms, concepts, and tools of relational database management systems (Understanding)
- CO3:** Apply the techniques, components and tools of a typical database management system to build a comprehensive database information system (Applying)
- CO4:** Apply relational algebra, TRC, and SQL to solve queries related to database tables. (Applying)
- CO5:** Compare and contrast all the physical file storage techniques and various facilities provided by database management systems (Analysing)

CO6: Evaluate and justify the database-related design diagrams related to any database project. (Evaluating)

CO7: Design ER-diagrams and corresponding schema diagrams for handling database projects (Creating)

Suggested Readings

- 1 Ramez Elmasri and Shamkant B Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education
- 2 Abraham Silberschatz, Henry F Korth and S Sudarshan, Database System Concepts, 5th Edition, McGraw Hill.
- 3 C.J. Date, Introduction to Database Systems, 8th ed., Pearson Education.
- 4 Bipin Desai, An introduction to Database System, Galgotia Publication.

CSAD0085: ANALYSIS AND DESIGN OF ALGORITHMS

(3 credits – 45 hours)(L-T-P:3-0-0)

Objectives:

- Analyse the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Module I (9 hours)

- a Basic Concepts of Algorithms: Introduction, Notion of Algorithm, Fundamentals of Algorithmic Solving, Important Problem types, Fundamentals of the Analysis Framework – Asymptotic Notations and Basic Efficiency Classes.
- b Mathematical Aspects and Analysis of Algorithms: Mathematical Analysis of Non-recursive Algorithm, Mathematical Analysis of Recursive Algorithm – Example: Fibonacci Numbers, Empirical Analysis of Algorithms, Algorithm Visualization. (12 hours)

Module II (9 hours)

Analysis of Sorting and Searching Algorithms: Brute Force – Selection Sort and Bubble Sort – Sequential Search and Brute-force string matching – Divide and conquer – Merge sort – Quick Sort – Binary Search – Binary tree- Traversal and Related Properties – Decrease and Conquer – Insertion Sort – Depth first Search and Breadth First Search.

Module III (10 hours)

Algorithmic Techniques: Transform and conquer – Presorting – Balanced Search trees – AVL Trees – Heaps and Heap sort – Dynamic Programming – Warshall's and Floyd's Algorithm – Optimal Binary Search trees – Greedy Techniques – Prim's Algorithm – Kruskal's Algorithm – Dijkstra's Algorithm – Huffman trees. Branch and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving

Module IV (9 hours)

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

Module V(8 hours)

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Know the formal definition of algorithms, importance of analysis of an algorithm and their asymptotic bounds; and get familiar with different types of problem and their solutions.(Remembering)
- CO2:** Explain different design strategies such as brute force, divide and conquer, dynamic programming, greedy and backtracking used for the design of algorithms. (Understanding)
- CO3:** Build algorithms for given problems. (Applying)
- CO4:** Compare and analyse different design strategies. (Analysing)
- CO5:** Assess various algorithms in terms of correctness, computation cost and memory space used. (Evaluating)
- CO6:** Build new algorithms for given problems by using most appropriate algorithmic strategy considering the problem domain. (Creating)

Suggested Readings

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

CSMF0086: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives

- To understand the mathematical fundamentals that is prerequisites for avariety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
- To developthe understanding ofthe mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
- To study various sampling and classification problems.

Module I (7 hours)

Probability mass, density, and cumulative distribution functions, parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Module II (7 hours)

Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

Module III (8 hours)

Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.

Module IV (9 hours)

Graph Theory: Isomorphism, Planar graphs, graph colorings, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.

Module V (10 hours)

Computer science and engineering applications: Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.

Module VI (4 hours)

Recent Trends in various distribution functions in mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define and Recall the basic notions of discrete and continuous probability (Remembering)
- CO2:** Explain the methods of statistical inference, and the role that sampling distributions play in those methods (Understanding).
- CO3:** Apply discrete mathematics in formal representation of various computing constructs. (Applying)
- CO4:** Analyse the recent trends in distribution functions in various inter-disciplinary fields (Analysing)
- CO5:** Evaluating the basic notions of Mathematics in the application areas of Computer Science & Engineering (Evaluating).
- CO6:** Elaborate the importance of analytical problem solving approach in engineering problems (Creating).

Suggested Readings

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

CSDT0087: ADVANCED DATA STRUCTURES**(3 credits-45Hours)(L-T-P:3-0-0)****Objectives:**

- *The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.*
- *Students should be able to understand the necessary mathematical abstraction to solve problems.*
- *To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.*
- *Student should be able to come up with analysis of efficiency and proofs of correctness.*

Module I (7 Hours)

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Module II (5 Hours)

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Module III (7 Hours)

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Module IV (11 Hours)

Text Processing: String Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Module V (10 Hours)

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadrees, k-D Trees.

Module VI (5 Hours)

Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem

COURSE/LEARNING OUTCOMES:

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

- CO1:** Recall the mathematical background and abstractions for analysis of algorithms. (Remembering)
- CO2:** Explain the implementation of symbol table using hashing techniques. (Understanding)
- CO3:** Apply amortized analysis on data structures, including binary search trees, mergeable heaps, and disjoint sets. (Applying)
- CO4:** Develop and Analyse algorithms for red-black trees, B-trees and Splay trees. (Analysing)

- CO5:** Develop and evaluate algorithms for text processing applications. (Evaluating)
CO6: Choose suitable data structures and develop algorithms for computational geometry problems. (Creating)

Suggested Readings

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

CSSC0088: DATA SCIENCE

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *Provide you with the knowledge and expertise to become a proficient data scientist.*
- *Demonstrate an understanding of statistics and machine learning concepts that are vital for data science*
- *Produce Python code to statistically analyse a dataset*
- *Critically evaluate data visualisations based on their design and use for communicating stories from data*

Module I (5 Hours)

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Module II (7 Hours)

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

Module III (10 Hours)

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Module IV (10 Hours)

Data visualisation: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Module V (6 Hours)

Applications of Data Science, Technologies for visualisation, Bokeh (Python)

Module VI (7 Hours)

Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the basics of the knowledge and expertise required to become a proficient data scientist. (Remembering)
CO2: Demonstrate an understanding of statistics and machine learning concepts that are vital for data science. (Understanding)

- CO3:** Develop Python code to statistically Analyse a dataset. (Applying)
CO4: Analyse data visualizations based on their design (Analysing)
CO5: Critically evaluate the use of communicating stories from data (Evaluating)
CO6: Design and develop analytical report (Creating)

Suggested Readings

1. Cathy O’Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O’Reilly.
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

CSDI0089: DISTRIBUTED SYSTEMS

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

Module I (8 Hours)

Introduction: Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts Distributed database management system architecture: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

Module II (10 Hours)

Distributed database design: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation Semantics data control: View management; Data security; Semantic Integrity Control Query processing issues: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

Module III (10 Hours)

Distributed query optimization: Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms

Transaction management: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models

Concurrency control: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

Module IV (7 Hours)

Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

Module V (6 Hours)

Parallel database systems: Parallel architectures; parallel query processing and optimization; load balancing

Module VI (4 Hours)

Advanced topics: Mobile Databases, Distributed Object Management, Multi-databases

COURSE/LEARNING OUTCOMES

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

- CO 1:** Recall the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment. (Remembering)
- CO 2:** Explain the distributed system architecture and its application in various fields. (Understanding)
- CO 3:** Apply network virtualization and analyse pros and cons. (Applying)
- CO 4:** Analyse design trends in distributed systems. (Analysing)
- CO 5:** Formulate and evaluate remote method invocation and objects. (Evaluating, Creating)

Suggested Readings

1. Principles of Distributed Database Systems, M.T. Oszu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

CSDP0090: DATA PREPARATION AND ANALYSIS

(3 credits-45Hours)(L-T-P:3-0-0)

Objective:

To prepare the data for analysis and develop meaningful Data Visualizations

Module I (9 Hours)

Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues

Module II (10 Hours)

Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

Module III (12 Hours)

Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation

Module IV (14 Hours)

Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity

COURSE/LEARNING OUTCOMES

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

- CO1:** List the data gathering and preparation techniques. (Remembering)
- CO2:** Explain the techniques as per utilisation. (Understanding)
- CO3:** Apply explorative analysis techniques. (Applying)
- CO4:** Analyse results after application of explorative analysis techniques. (Analysing)
- CO5:** Evaluate the data visualisation outcomes (Evaluating)
- CO6:** Formulate efficient techniques for data preparation and analysis. (Creating)

Suggested Readings

1. Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

CSRS0091: RECOMMENDER SYSTEM**(3 credits-45Hours)(L-T-P:3-0-0)****Objectives:**

- *To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering*
- *To automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations*

Module I (8 Hours)

Introduction: Overview of Information Retrieval, Retrieval Models, Search and Filtering, Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

Module II (8 Hours)

Content-based Filtering: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

Module III (8 Hours)

Collaborative Filtering: User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.

Module IV (8 Hours)

Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascad, Meta-level, Limitations of hybridization strategies

Module V (5 Hours)

Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.

Module VI (8 Hours)

Types of Recommender Systems: Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems.

COURSE/LEARNING OUTCOMES

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

- CO1:** Relate techniques for making recommendations, including non-personalized, content-based, and collaborative filtering (Remembering)
- CO2:** Illustrate automation of a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations. (Understanding)
- CO3:** Apply techniques for making recommendations, including non-personalized, content-based, and collaborative filtering (Applying)

- CO4:** Analyse the choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations. (Analysing)
- CO5:** Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity. (Evaluating)
- CO6:** Design recommendation system for a particular application domain. (Creating)

Suggested Readings

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st ed.
3. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.
4. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.

CSML0092: MACHINE LEARNING

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.*
- *To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.*
- *Explore supervised and unsupervised learning paradigms of machine learning.*
- *To explore Deep learning technique and various feature extraction strategies.*

Module I (9Hours)

Supervised Learning (Regression/Classification)

Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Na ve Bayes, Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Module II (7 Hours)

Unsupervised Learning

Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

Module III (6 Hours)

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical, Learning Theory, Ensemble Methods (Boosting, Bagging, RandomForests)

Module IV (8 Hours)

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, DeepLearning and Feature Representation Learning

Module V (8 Hours)

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Module VI (5 Hours)

Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

COURSE/LEARNING OUTCOMES

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

- CO1:** Relate how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes. (Remembering)
- CO2:** Illustrate supervised and unsupervised learning paradigms of machine learning. (Understanding)
- CO3:** Design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.(Applying, Analysing)
- CO4:** Examine the Deep learning techniques and various feature extraction strategies. (Analysing)
- CO5:** Evaluate the results and compare in different environment to have best results. (Evaluating)
- CO6:** Create applications as per the requirements in suitable environment. (Creating)

Suggested Readings

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

CSTN0093: DATA STORAGE TECHNOLOGIES AND NETWORKS

(3 credits-45Hours)(L-T-P:3-0-0)

Objective:

To provide learners with a basic understanding of Enterprise Data Storage and Management Technologies

Module I (7 Hours)

Storage Media and Technologies – Magnetic, Optical and Semiconductor Media, Techniques for read/write Operations, Issues and Limitations.

Module II (8 Hours)

Usage and Access – Positioning in the Memory Hierarchy, Hardware and Software, Design for Access, Performance issues.

Module III (7 Hours)

Large Storages – Hard Disks, Networked Attached Storage, Scalability issues, networking issues.

Module IV (8 Hours)

Storage Architecture- Storage Partitioning, Storage System Design, Caching, Legacy Systems.

Module V (10 Hours)

Storage Area Networks – Hardware and Software Components, Storage Clusters/Grids.

Storage QoS–Performance, Reliability, and Security issues.

Module VI (5 Hours)

Recent Trends related to Copy data management, Erasure coding, and Softwaredefinedstorage appliances.

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall the various data storage techniques (Remembering)
- CO2:** Explain the basic understanding of Enterprise Data Storage and Management Technologies (Understanding)
- CO3:** Experiment with Storage System Architecture (Applying)
- CO4:** Analyse the Virtualization Technologies and Storage Area Network (Analysing)
- CO5:** Evaluate and deploy an efficient technique for data storage. (Evaluating & Creating)

Suggested Readings

1. The Complete Guide to Data Storage Technologies for Network-centric Computing Paperback– Import, Mar 1998 by Computer Technology Research Corporation
2. Data Storage Networking: Real World Skills for the CompTIA Storage by Nigel Poulton

CSWA0094: WIRELESS ACCESS TECHNOLOGIES

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *Overview of wireless access technologies, Fixed wireless access networks. Terminal mobility issues regarding wireless access to Internet*
- *Introduction to various Network topologies, hotspot networks, Communication links: point-to-point, point-to-multipoint, multipoint-to-multipoint.*
- *To provide an overview of Standards for most frequently used wireless access networks: WPAN, UWB, WLAN, WMAN, WWAN. Network services. Wireless access networks planning, design and installation.*
- *To get and insight of Wireless networking security issues, Wireless access network exploitation and management, software requirements, link quality control.*

Module I (7 Hours)

Necessity for wireless terminals connectivity and networking. Wireless networking advantages and disadvantages, Overview of wireless access technologies. Narrowband and broadband networks, fixed and nomadic networks. Wireless local loop (WLL), Public Switched Telephone Network (PSTN) interfaces.

Module II (7 Hours)

Fixed wireless access (FWA) networks, frequency bands for different networks. Criteria for frequency bands allocation, Network topologies, hotspot networks. Communication links: point-to-point (PTP), point to multipoint (PMP), multipoint-to-multipoint (MTM).

Module III (9 Hours)

Standards for most frequently used wireless access networks: WPAN (802.15, Bluetooth, DECT, IrDA), UWB (Ultra-Wideband), WLAN (802.11, Wi-Fi, HIPERLAN, IrDA), WMAN (802.16, WiMAX, HIPERMAN, HIPERACCESS), WWAN (802.20), Other technologies for broadband wireless access, Local Multipoint Distribution Service (LMDS), Multichannel Multipoint Distribution Service (MMDS). Ad Hoc networks, Network services. Services types based on carrier frequency and bandwidth.

Module IV (9 Hours)

Wireless access networks planning, design and installation. Services provision, legislative and technical aspects, Technical and economical factors for network planning: expenses, coverage, link capacity, network complexity and carrier-to-interference ratio (C/I). Base station or access point allocation. Base station and access point equipment. Terminal mobility issues regarding wireless access to Internet. Wireless networking security issues.

Module V (8 Hours)

Example of laptop or handheld PC wireless connection in real environment. PC wireless interface equipment. Wireless access network exploitation and management, software requirements, link quality control. Business model, wireless network services market, market research and marketing, service providers, wireless data application service providers

(WDASP) and their role on public telecommunication services market, billing systems.

Module VI (8 Hours)

Recent trends in wireless networking and various access mechanism, new standards of wireless communication.

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall basics of wireless access technologies, Fixed wireless access networks and terminal mobility issues regarding wireless access to the Internet (Remembering)
- CO2:** Explain the various Network topologies, hotspot networks and Communication links. (Understanding)
- CO3:** Explain the standards for most frequently used wireless access networks. (Understanding)
- CO4:** Planning, design and installation of Wireless access networks (Applying)
- CO5:** Analyse and get an insight of Wireless networking security issues, Wireless access network exploitation and management, software requirements and link quality control. (Analysing)
- CO6:** Estimate the requirements of accessories to establish a network (Evaluating)
- CO7:** Establish a network as per requirements. (Creating)

Suggested Readings

1. M. P. Clark, Wireless Access Networks: Fixed Wireless Access and WLL networks -- Design and Operation, John Wiley & Sons, Chichester
2. D. H. Morais, Fixed Broadband Wireless Communications: Principles and Practical Applications, Prentice Hall, Upper Saddle River
3. R. Pandya, Introduction to WLLs: Application and Deployment for Fixed and Broadband Services, IEEE Press, Piscataway

CSMS0095: MOBILE APPLICATIONS AND SERVICES

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *This course presents the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS.*
- *It explores emerging technologies and tools used to design and implement feature-rich mobile applications for smart phones and tablets*

- *It also take into account both the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile*

Module I (7 Hours)

Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User

Module II (7 Hours)

More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, . Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider

Module III (9 Hours)

Communications via Network and the Web:State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony, Notifications and Alarms:Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics

Module IV (9 Hours)

Putting It All Together : Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia

Module V (8 Hours)

Platforms and Additional Issues : Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking , Active Transactions, More on Security, Hacking Android

Module VI (5 Hours)

Recent trends inCommunication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT

COURSE/LEARNING OUTCOMES

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

- CO1:** Relate and explain the emerging technologies and tools used to design and implement feature-rich mobile applications for smartphones and tablets (Remembering, Understanding)
- CO2:** Building the applications for different platform. (Applying)
- CO3:** Analyse the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile. (Analysing)
- CO4:** Evaluate the results and compare in different environment to have best outcome. (Evaluating)
- CO6:** Create applications as per requirements in suitable environment. (Creating)

Suggested Readings

1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

CSSI0096: SMART SENSORS AND INTERNET OF THINGS**(3 credits-45Hours)(L-T-P:3-0-0)****Objectives:**

- *Able to understand the application areas of IOT*
- *Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks*
- *Able to understand building blocks of Internet of Things and characteristics*

Module I (7 Hours)

Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT

Module II (7 Hours)

Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc

Module III (9 Hours)

Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors

Module IV (10 Hours)

Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel

Module V (7 Hours)

Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor

Module VI (5 Hours)

Recent trends in smart sensor for day to day life, evolving sensors and their architecture.

COURSE/LEARNING OUTCOMES

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

- CO1:** List and explain the different sensors and illustrate their applications in smart devices. (Remembering)
- CO2:** Explain the revolution of Internet in Mobile Devices, Cloud & Sensor Networks. (Understanding)
- CO3:** Identify the application areas of IOT. (Applying)
- CO4:** Examine the building blocks of Internet of Things and their characteristics. (Analysing)
- CO5:** Evaluate the results and compare the performance in different environment. (Evaluating)
- CO6:** Create IoT based products as per requirements for a suitable environment. (Creating)

Suggested Readings

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing
2. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

CSLF0097: LOGIC AND FUNCTIONAL PROGRAMMING

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *To further the state of the art on the theoretical and practical aspects of developing declarative programming tools in logic programming for IOT data analysis .*
- *To introduce basics of functional programming and constraint logic programming for nodes in IOT.*
- *Introduction into formal concepts used as a theoretical basis for both paradigms, basic knowledge and practical experience.*

Module I (5 Hours)

Proposition Logic: Introduction of logic and Functional Paradigm, Propositional Concepts, Semantic Table , Problem Solving with Semantic Table.

Module II (7 Hours)

Natural Deduction and Axiomatic Propositional Logic: Rules of Natural Deduction, Sequent Calculus, Axiomatic Systems, Meta theorems, Important Properties of AL, Resolution, Resolving Arguments

Module III (7 Hours)

Introduction to Predicate Logic Objects, Predicates and Quantifiers, Functions, First Order Language, Quantifiers, Scope and Binding, Substitution, An Axiomatic System for First Order Predicate Logic, Soundness and Completeness, Axiomatic Semantic and Programming

Module IV (12 Hours)

Semantic Tableaux & Resolution in Predicate Logic: Semantic Tableaux, Instantiation Rules, Problem-solving in Predicate Logic, Normal forms, Herbrand Universes and H-interpretation, Resolution, Unification, Resolution as a computing Tool, Nondeterministic Programming, Incomplete Data Structure, Second Order Programming in Prolog, Logic Grammars: Definite Clause Grammar, A Grammar Interpreter.

Module V (9 Hours)

Lazy and Eager Evaluation strategies: Evaluation Strategies, Lazy Evaluation: Evaluation Order and strictness of function, Programming with lazy evaluation, Interactive functional program, Delay of unnecessary Computation, Infinite Data Structure, Eager Evaluation and Reasoning

Module VI (5 Hours)

Recent trends in logical and functional programming, predicate logics and various evaluation strategies.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define sensors and relate their data collection technique with various criteria set by the users. (Remembering)
- CO2:** Explain the state of the art on the theoretical and practical aspects of developing declarative programming tools in logic programming for IOT data analysis. (Understanding)
- CO3:** Experiment with the basics of functional programming and constraint logic programming for nodes in IOT. (Applying)
- CO4:** Examine the formal concepts used as a theoretical basis for both paradigms, basic knowledge and practical experience. (Analysing)
- CO5:** Evaluate the results and compare in different environment to have best results. (Evaluating)
- CO6:** Create IoT based products as per requirements in suitable environment. (Creating)

Suggested Readings

1. John Kelly, "The Essence of Logic", Prentice-Hall India.
2. Saroj Kaushik, "Logic and Prolog Programming", New Age International Ltd

CSDF0098: DIGITAL FORENSICS

(3 credits-45 Hours)(L-T-P:3-0-0)

Objectives: This course

- *Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.*
- *Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.*
- *Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools*
- *E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics*

Module I (9 Hours)

Digital Forensics Science: Forensics science, computer forensics, and digital forensics.

Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics

Module II (8 Hours)

Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

Module III (9 Hours)

Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

Module IV (10 Hours)

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case, Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

Module V (8 Hours)

Mobile Forensics: mobile forensics techniques, mobile forensics tools. Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008

Module VI (4 Hours)

Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall the computer forensics related features of relevant legislations. (Remembering)
- CO2:** Explain the digital forensics related processes and procedures. (Understanding)
- CO3:** Utilize e-discovery tools to gather evidence from computers, mobiles, network, emails and the web. (Applying)
- CO4:** Analyse gathered forensics data to conduct an investigation. (Analysing)
- CO5:** Critique a digital forensics related case. (Evaluating)
- CO6:** Formulate plans for investigating real-world cyber crimes. (Creating)

Suggested Readings

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

CSEH0099: ETHICAL HACKING

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives: This course introduces the concepts of Ethical Hacking and gives the students the opportunity to learn about different tools and techniques in Ethical hacking and security and practically apply some of the tools.

Module I (9 Hours)

Introduction to Ethical Disclosure: Ethics of Ethical Hacking, Ethical Hacking and the legal system, Proper and Ethical Disclosure

Module II (8 Hours)

Penetration Testing and Tools: Using Metasploit, Using BackTrackLiveCDLinux Distribution

Module III (9 Hours)

Vulnerability Analysis: Passive Analysis, Advanced Static Analysis with IDAPro, Advanced Reverse Engineering

Module IV (10 Hours)

Client-side browser exploits, Exploiting Windows Access Control Model for Local Elevation Privilege, Intelligent Fuzzing with Sulley, From Vulnerability to Exploit

Module V (8 Hours)

Malware Analysis: Collecting Malware and Initial Analysis, Hacking Malware

Module VI (4 Hours)

Case study of vulnerability of cloud platforms and mobile platforms & devices.

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall the features of various cyber laws related to ethical hacking and the code of ethics for ethical hacking. (Remembering)
- CO2:** Explain the terms penetration testing, vulnerability analysis, and malware analysis. (Understanding)
- CO3:** Utilize various tools to gather data for penetration testing, vulnerability analysis, and malware analysis. (Applying)
- CO4:** Analyse gathered data to discover vulnerabilities. (Analysing)
- CO5:** Assess the exploitability of vulnerabilities present in a software or hardware. (Evaluating)
- CO6:** Exploit a detected vulnerability to hack a computer, mobile or network. (Creating)

Suggested Readings

1. Shon Harris, Allen Harper, Chris Eagle and Jonathan Ness, Gray Hat Hacking: The Ethical Hackers' Handbook, TMH Edition
2. Jon Erickson, Hacking: The Art of Exploitation, SPD

CSID0100: INTRUSION DETECTION

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- Compare alternative tools and approaches for Intrusion Detection through quantitative analysis to determine the best tool or approach to reduce risk from intrusion
- Identify and describe the parts of all intrusion detection systems and characterize new and emerging IDS technologies according to the basic capabilities all intrusion detection systems share.

Module I (10 Hours)

The state of threats against computers, and networked systems-Overview of computer security solutions and why they fail-Vulnerability assessment, firewalls, VPN's -Overview of Intrusion Detection and Intrusion Prevention Network and Host-based IDS

Module II (8 Hours)

Classes of attacks - Network layer: scans, denial of service, penetration Application layer: software exploits, code injection-Human layer: identity theft, root access-Classes of attackers-Kids/hackers/sop Hesitated groups-Automated: Drones, Worms, Viruses

Module III (8 Hours)

A General IDS model and taxonomy, Signature-based Solutions, Snort, Snort rules, Evaluation of IDS, Cost sensitive IDS

Module IV (10 Hours)

Anomaly Detection Systems and Algorithms-Network Behavior Based Anomaly Detectors (rate based)-Host-based Anomaly Detectors-Software Vulnerabilities State transition, Immunology, Payload Anomaly Detection

Module V (8 Hours)

Attack trees and Correlation of alerts-Autopsy of Worms and Botnets-Malware detection-Obfuscation, polymorphism-Document vectors

Module VI (4 Hours)

Email/IM security issues-Viruses/Spam-From signatures to thumbprints to zero day detection-Insider Threat issues-Taxonomy-Masquerade and Impersonation Traitors, Decoys and Deception-Future: Collaborative Security

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems. (Remembering)
- CO2:** Explain the different classes of attacks and anomaly detection systems and algorithms. (Understanding)
- CO3:** Identify and describe the parts of all intrusion detection systems and characterize new and emerging IDS technologies according to the basic capabilities all intrusion detection systems share. (Applying)
- CO4:** Compare alternative tools and approaches for Intrusion Detection through quantitative analysis to determine the best tool or approach to reduce risk from intrusion. (Analysing)
- CO5:** Evaluate the security posture of an enterprise. (Evaluating)
- CO6:** Formulate a plan to secure an enterprise network using appropriate intrusion detection system. (Creating)

Suggested Readings

1. The Art of Computer Virus Research and Defense, Peter Szor, Symantec Press ISBN 0-321-30545-3
2. Crimeware, Understanding New Attacks and Defenses, Markus Jakobsson and Zulfikar Ramzan, Symantec Press, ISBN: 978-0-321-50195-0 2008

CSMR0101: MALWARE ANALYSIS AND REVERSE ENGINEERING

(3 credits-45 Hours)(L-T-P:3-0-0)

Objectives: The objective of this course is to provide an insight to fundamentals of malware analysis which includes analysis of JIT compilers for malware detection in legitimate code. DNS filtering and reverse engineering is included.

Module I (12 Hours)

Fundamentals of Malware Analysis (MA), Reverse Engineering Malware (REM) Methodology, Brief Overview of Malware analysis lab setup and configuration, Introduction to key MA tools and techniques, Behavioral Analysis vs. Code Analysis, Resources for Reverse-Engineering Malware (REM) Understanding Malware Threats, Malware indicators, Malware Classification, Examining ClamAV Signatures, Creating Custom ClamAV Databases, Using YARA to Detect Malware

Capabilities, Creating a Controlled and Isolated Laboratory ,Introduction to MA Sandboxes, Ubuntu, Zeltser'sREMnux, SANS SIFT, SandboxSetup and Configuration New Course Form, Routing TCP/IP Connections,Capturing and Analysing Network Traffic, Internet simulation using INetSim,Using Deep Freeze to Preserve Physical Systems, Using FOG for Cloning and Imaging Disks, Using MySQL Database to Automate FOG Tasks, Introduction toPython ,Introduction to x86 Intel assembly language, Scanners: Virus Total, Jotti,andNoVirus Thanks, Analysers: Threat Expert, CWSandbox, Anubis, Joebox, Dynamic Analysis Tools: Process Monitor, Regshot, HandleDiff, AnalysisAutomation Tools: Virtual Box, VM Ware, Python , Other Analysis Tools

Module II (7 Hours)

Using TSK for Network and Host Discoveries, Using Microsoft Offline API toRegistry Discoveries , Identifying Packers using PEiD, Registry Forensics withReg Ripper Plu-gins:, Bypassing Poison Ivy's Locked Files, BypassingConficker's File System ACL Restrictions, Detecting Rogue PKI Certificates.

Module III (9 Hours)

Opening and Attaching to Processes, Configuration of JIT Debugger forShellcode Analysis, Controlling Program Execution, Setting and CatchingBreakpoints, Debugging with Python Scripts and Py Commands, DLL ExportEnumeration, Execution, and Debugging, Debugging a VMware WorkstationGuest (on Windows), Debugging a Parallels Guest (on Mac OS X). IntroductiontoWinDbg Commands and Controls, Detecting Rootkits with WinDbgScripts,Kernel Debugging with IDA Pro.

Module IV (8 Hours)

Memory Dumping with MoonSols Windows Memory Toolkit, Accessing VMMemory Files Overview of Volatility, Investigating Processes in MemoryDumps, Code Injection and Extraction, Detecting and Capturing Suspicious Loaded DLLs, Finding Artifacts in Process Memory, Identifying Injected CodewithMalfind and YARA.

Module V (7 Hours)

Using WHOIS to Research Domains, DNS Hostname Resolution, QueryingPassive DNS, Checking DNS Records, Reverse IP Search New Course Form,Creating Static Maps, Creating Interactive Maps.

Module VI (5 Hours)

Case study of Finding Artifacts in Process Memory, Identifying InjectedCode with Malfind and YARA

COURSE/LEARNING OUTCOMES

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

- CO 1:** Recall an insight of fundamentals of malware analysis (Remembering)
- CO 2:** Explain the concept of malware and reverse engineering. (Understanding)
- CO 3:** Implement tools and techniques of malware analysis (Applying)
- CO 4:** Analyse data with respect to Malware and Kernel Debugging (Analysing)
- CO 5:** Evaluate results from analysed data. (Evaluating)
- CO 6:** Create environment to protect malware. (Creating)

Suggested Readings

1. Michael Sikorski, Andrew Honig "Practical Malware Analysis: The Hands-On Guide to DissectingMalicious Software" publisher William Pollock

CSSC0102: SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *To fix software flaws and bugs in various software.*
- *To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic.*
- *Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.*
- *Methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws.*

Module I (8 Hours)

Secure Software Design Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance

Module II (11 Hours)

Enterprise Application Development Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

Module III (8 Hours)

Enterprise Systems Administration Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Module IV (8 Hours)

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

Module V (9 Hours)

Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.

Module VI (4 Hours)

Case study of DNS server, DHCP configuration and SQL injection attack.

COURSE/LEARNING OUTCOMES

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

- CO 1:** Recall the various software vulnerabilities. (Remembering)
- CO 2:** Explain the software process vulnerabilities for an organization. (Understanding)
- CO3:** Apply techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment (Applying)
- CO4:** Analyse and monitor resources consumption in a software. (Analysing)

- CO5:** Evaluate results by interrelating security and software development process. (Evaluating)
- CO6:** Create methodologies and tools to design and develop secure software containing minimum vulnerabilities and flaws. (Creating)

Suggested Readings

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise SoftwareSecurity, Addison Wesley

CSAA0103: ADVANCED ALGORITHMS

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- Introduce students to the advanced methods of designing and Analysing algorithms. The student should be able to choose appropriate algorithms and use it for a specific problem.
- To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
- Students should be able to understand different classes of problems concerning their computation difficulties.
- To introduce the students to recent developments in the area of algorithmic design.

Module I (6 Hours)

Sorting: Review of various sorting algorithms, topological sorting

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge weighted case (Dijkasra's), depth-first search and computation of strongly connected, components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Module II (7 Hours)

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.

Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Module III (8 Hours)

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute, maximum flow, Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Module IV (9 Hours)

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Module V (10 Hours)

Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Module VI (5 Hours)

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall different algorithms (Remembering)
- CO2:** Explain the applications of various algorithms (Understanding)
- CO3:** Applying computer algorithms for different purposes. (Applying)
- CO4:** Analyse the complexity/ performance of different algorithms. Categorize the different problems in various classes according to their complexity. (Analysing)
- CO5:** Evaluate the different problems in various classes according to their complexity. (Evaluation)
- CO6:** Elaborate the recent activities in the field of the advanced data structure. (Creating)

Suggested Readings

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.

CSSP0104: SOFT COMPUTING

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.*
- *To implement soft computing based solutions for real-world problems.*
- *To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.*
- *To provide student hand-on experience on MATLAB to implement various strategies.*

Module I (7 Hours)

Introduction to soft computing and neural networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Module II (8 Hours)

Fuzzy logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Module III (8 Hours)

Neural networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

Module IV (5 Hours)

Genetic algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

Module V (12 Hours)

Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Module VI (5 Hours)

Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

COURSE/LEARNING OUTCOMES

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

- CO1:** Identify and describe soft computing techniques and their roles in building intelligent machines. (Remembering & understanding)
- CO2:** Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems. (Applying)
- CO3:** Analyse genetic algorithms to combinatorial optimization problems. (Analysing)
- CO4:** Evaluate and discuss solutions by various soft computing approaches for a given problem. (Evaluating and Creating).

Suggested Readings

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, 1995.
3. MATLAB Toolkit Manual

CSDV0105: DATA VISUALISATION

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *familiarize students with the basic and advanced techniques of information visualization and scientific visualization,*
- *to learn key techniques of the visualization process*
- *a detailed view of visual perception, the visualized data and the actual visualization interaction and distorting techniques*

Module I (8 Hours)

Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.

Module II (8 Hours)

Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

Module III (8 Hours)

Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

Module IV (10 Hours)

Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization

Module V (7 Hours)

Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations

Module VI (4 Hours)

Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization.

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall the basic and advanced techniques of information and scientific visualization. (Remembering)
- CO2:** Explain the key techniques of the visualization process. (Understanding)
- CO3:** Apply detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques. (Applying)
- CO4:** Analyse the design process to develop visualization methods and visualization systems, and methods for their evaluation. (Analysing)
- CO5:** Evaluate the preparation and processing of data, visual mapping and the visualization. (Evaluating)
- CO6:** Create a process to have an understanding of large-scale abstract data. (Creating)

Suggested Readings

1. WARD, GRINSTEIN, KEIM, .Interactive Data Visualization: Foundations, Techniques, and Applications. Natick : A K Peters, Ltd.
2. E. Tufte, The Visual Display of Quantitative Information, Graphics Press

CSBD0106: BIG DATA ANALYTICS

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *Understand big data for business intelligence. Learn business case studies for big data analytics.*
- *Understand nosql big data management. Perform map-reduce analytics using Hadoop and related tools*

Module I (8 Hours)

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine,

advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

Module II (8 Hours)

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

Module III (8 Hours)

Data format, Analysing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures

Module IV (8 Hours)

MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats

Module V (7 Hours)

Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.

Module VI (6 Hours)

Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

COURSE/LEARNING OUTCOMES

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

- CO1:** Describe big data and use cases from selected business domains. (Remembering & Understanding)
- CO2:** Applying NoSQL big data management. (Applying)
- CO3:** Install, configure, and run Hadoop and HDFS and analyse the data. (Analysing)
- CO4:** Perform map-reduce analytics using Hadoop (Evaluating)
- CO5:** Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for creating big data analytics. (Creating)

Suggested Readings

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilly, 2012.
4. Eric Sammer, "Hadoop Operations", O'Reilly, 2012.
5. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilly, 2012.
6. Lars George, "HBase: The Definitive Guide", O'Reilly, 2011.
7. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilly, 2010.
8. Alan Gates, "Programming Pig", O'Reilly, 2011.

CSDD0107: DATA WAREHOUSING AND DATA MINING

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *The objective of this course is to introduce data warehousing and mining techniques.*
- *Application of data mining in web mining, pattern matching and cluster analysis is included to aware students of broad data mining areas.*

Module I (7 Hours)

Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;

Module II (7 Hours)

Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,

Module III (8 Hours)

Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;

Module IV (9 Hours)

Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;

Module V (9 Hours)

Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.

Module VI (5 Hours)

Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

COURSE/LEARNING OUTCOMES

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

- CO 1:** List the various data warehousing and data mining techniques. (Remembering)
- CO 2:** Explain the principles, concepts, functions and various applications of data warehouse. (Understanding)
- CO3:** Apply data mining techniques for classification and prediction. (Applying)
- CO4:** Perform cluster, periodicity and social network analysis. (Analysing)
- CO5:** Evaluate and compare various data mining solutions for a given problem. (Evaluating)
- CO6:** Choose appropriate data warehousing and data mining techniques to build real-world systems. (Creating)

Suggested Readings

1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques,, Second Edition, Elsevier Publication, 2011.

2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.
3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.

CSDS0108: DATA SECURITY AND ACCESS CONTROL

(3 credits-45Hours)(L-T-P:3-0-0)

Objective:

The objective of the course is to provide fundamentals of database security. Various access control techniques mechanisms were introduced along with application areas of access control techniques.

Module I (7 Hours)

Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control, Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations.

Module II (8 Hours)

Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy.

Module III (9 Hours)

Biba's integrity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multi line Insurance Company

Module IV (10 Hours)

Smart Card based Information Security, Smart card operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals.

Module V (7 Hours)

Recent trends in Database security and access control mechanisms. Case study of Role-Based Access Control (RBAC) systems.

Module VI (4 Hours)

Recent Trends related to data security management, vulnerabilities in different DBMS.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define access control in database. (Remembering)
- CO2:** Explain the purpose and fundamentals of access control. (Understanding)
- CO3:** Identify the capabilities and limitations of various access control mechanisms. (Applying)

- CO4:** Analyse the data, identify the problems, and choose the relevant models and algorithms to apply. (Analysing)
- CO5:** Assess the strengths and weaknesses of various access control models and to Analyse their behaviour. (Evaluating)
- CO6:** Design and develop access control mechanisms for enterprise IT infrastructures. (Creating)

Suggested Readings

1. Role Based Access Control: David F. Ferraiolo, D. Richard Kuhn, Ramaswamy Chandramouli.
2. <http://www.smartcard.co.uk/tutorials/sct-itsc.pdf> : Smart Card Tutorial.

CSWD0109: WEB ANALYTICS AND DEVELOPMENT

(3 credits-45Hours)(L-T-P:3-0-0)

Objective:

The course explores use of social network analysis to understand growing connectivity and complexity in the world ranging from small groups to WWW.

Module I (8 Hours)

Introduction – Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks, Information Visualization

Module II (8 Hours)

Web Analytics tools: Click Stream Analysis, A/B testing, Online Surveys

Module III (8 Hours)

Web Search and Retrieval: Search Engine Optimization, Web Crawling and indexing, Ranking Algorithms, Web traffic models

Module IV (12 Hours)

Making Connection: Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity

Module V (9 Hours)

Connection: Connection Search, Collapse, Robustness Social involvements and diffusion of innovation

COURSE/LEARNING OUTCOMES

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

- CO1:** Relate with core research communities, publications, focused on web and social media analytics and research questions engaged. (Remembering)
- CO2:** Discuss clickstream data collection techniques, their impact on metrics, and their inherent limitations. (Understanding)
- CO3:** Identify and interpret commonly used web metrics (Applying)
- CO4:** Analyse and evaluate tasks and techniques used in web analytics. (Analysis/Evaluation)
- CO5:** Elaborate the resulting insights to support website design decisions, campaign optimisation, search analytics, etc. (Creating)

Suggested Readings

1. Hansen, Derek, Ben Sheiderman, Marc Smith. 2011. Analysing Social Media Networks with NodeXL: Insights from a Connected World. Morgan Kaufmann, 304.
2. Avinash Kaushik. 2009. Web Analytics 2.0: The Art of Online Accountability.
3. Easley, D. & Kleinberg, J. (2010). Networks, Crowds, and Markets: Reasoning About a Highly Connected World. New York: Cambridge University Press.
<http://www.cs.cornell.edu/home/kleinber/networks-book/>
4. Wasserman, S. & Faust, K. (1994). Social network analysis: Methods and applications. New York: ambridge University Press. Monge, P. R. & Contractor, N. S. (2003). Theories of communication networks. New York: Oxford University Press.

CSKD0110: KNOWLEDGE DISCOVERY**(3 credits-45Hours)(L-T-P:3-0-0)*****Objective:** To conduct case studies on real data mining examples***Module I (7 Hours)**

Introduction KDD and Data Mining - Data Mining and Machine Learning, Machine Learning and Statistics, Generalization as Search, Data Mining and Ethics

Module II (8 Hours)

Knowledge Representation - Decision Tables, Decision Trees, Classification Rules, Association Rules, Rules involving Relations, Trees for Numeric Predictions, Neural Networks, Clusters

Module III (9 Hours)

Decision Trees - Divide and Conquer, Calculating Information, Entropy, Pruning, Estimating Error Rates, The C4.5 Algorithm Evaluation of Learned Results- Training and Testing, Predicting Performance, Cross-Validation

Module IV (8 Hours)

Classification Rules - Inferring Rudimentary Rules, Covering Algorithms for Rule Construction, Probability Measure for Rule Evaluation, Association Rules, Item Sets, Rule Efficiency

Module V (6 Hours)

Numeric Predictions - Linear Models for Classification and Numeric Predictions, Numeric Predictions with Regression Trees, Evaluating Numeric Predictions

Module VI (7 Hours)

Artificial Neural Networks – Perceptrons, Multilayer Networks, The Backpropagation Algorithm

Clustering - Iterative Distance-based Clustering, Incremental Clustering, The EM Algorithm

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall the basic terminologies like learning goals, concept representation, decision tree, computational learning, artificial neural network, classification. (Remembering)
- CO2:** Explain different categories of machine learning and machine learning methodologies and illustrate the theory behind designing a learning model. (Understanding)
- CO3:** Compare efficiency of different learning algorithms, classify supervised and unsupervised learning goals. (Understanding)
- CO4:** Apply different learning algorithms for real life classification problem, sketch the structure of different learning model such as neural network, support vector machine, naive bayes etc. (Applying)

- CO5:** Analyse decision tree learning, computational learning, artificial neural network and instance based learning and how one learning overcomes the drawback in the other. (Analysing)
- CO6:** Judge in terms of different complexity which algorithms better in what situation. (Evaluating).
- CO7:** Create and design ensemble based learning, propose new learning for optimizing real life problems. (Creating)

Suggested Readings

1. Data mining and knowledge discovery handbook by Maimon, Oded (et al.)
2. Data Cleansing : A Prelude to knowledge Discovery

CSNL0111: NATURAL LANGUAGE PROCESSING

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

The goals for this course are to study:

- *algorithms and methods for building computational models of natural language understanding, including syntactic analysis, semantic representations, discourse analysis, and statistical and corpus-based methods for text processing and knowledge acquisition*
- *issues involved in natural language understanding*
- *applications that can benefit from natural language processing, such as information extraction, question answering, machine translation, and spoken language understanding. By the end of the course, students will have a good understanding of and appreciation for natural language processing, and have the necessary skills to build natural language processing tools.*

Module I (10 hours)

Introduction to NLP, Knowledge in language processing, Representation and Understanding, Organization of NLP systems, Models and algorithms, Linguistic Essentials

Module II (15 hours)

Grammars and Parsing - Syntactic Processing: Collocations; Regular Expression and Automata; Morphology and Finite-State Transducers; N-grams; Word Classes and Part-of-Speech Tagging; Context-Free Grammars for English; Parsing with Context-Free Grammars: Top-down parsing, Bottom-up parsing; Features and Unification; Lexicalized and Probabilistic Parsing

Module III (10 hours)

Semantic processing :Representing Meaning; Semantic Analysis: Integrating semantic analysis to parsers, Semantic Grammars; Lexical Semantics; Word Sense Disambiguation and Information Retrieval: Selection-Restriction based disambiguation, Machine learning approaches; Dictionary based approaches, Information retrieval

Module IV (7 hours)

Pragmatics :Discourse, Dialogue and Conversational Agents: Dialogue acts, Automatic Interpretation of Dialogue acts; Natural Language Generation: Discourse Planning; Machine Translation: Direct Translations, Translation using Statistical techniques

Module V (3 hours)

NLP Applications and Tools :Sentiment Analysis, Text Summarization, Text Entailment, Machine Translation, Question Answering, Cross Lingual Information Retrieval (CLIR), NLTK, WordNet

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall algorithms and methods for building computational models of natural language processing (Remembering)
- CO2:** Explain syntactic analysis, semantic representations, discourse analysis, and statistical and corpus-based methods for text processing and knowledge acquisition. (Understanding)
- CO3:** Apply the methods of natural language processing. (Applying)
- CO4:** Analyse Issues involved in natural language processing. (Analysing)
- CO5:** Evaluate and generate applications that can benefit from natural language processing, such as information extraction, question answering, machine translation, and spoken language understanding. (Evaluating & Creating)

CSNI0112: SENSOR NETWORKS AND INTERNET OF THINGS

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *The course gives an overview of various topics related to wireless sensor networks, which are expected to be the basis for the emerging internet-of-things.*
- *The course covers topics with relation to various sub disciplines of computer science such as hardware, operating systems, distributed systems, networking, security and databases.*
- *Able to understand wireless sensor network (WSN) specific issues such as localization, time synchronization, and topology control are addressed as well.*

Module I (7 Hours)

Introduction and Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security

Module II (8 Hours)

IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Real-World Design Constraints- Introduction, Technical Design constraints hardware, Data representation and visualization, Interaction and remote control.

Module III (8 Hours)

Industrial Automation- Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation- Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.

Module IV (10 Hours)

Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases

Module V (7 Hours)

IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry , Interface and Programming & IOT Device

Module VI (5 Hours)

Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the function of sensors. (Remembering)
- CO2:** Explain how to connect sensors to the environment. (Understanding)
- CO3:** Organize and connect sensors together to have generated output. (Applying)
- CO4:** Analyse the collected data. (Analysing)
- CO5:** Evaluate results from data. (Evaluating)
- CO6:** Creating a real time applications. (Creating)

Suggested Readings

1. Mandler, B., Barja, J., MitreCampista, M.E., Cagá_ová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing

CSAC0113: IOT APPLICATIONS AND COMMUNICATION PROTOCOLS

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *Basic introduction of all the elements of IoT-Mechanical, Electronics/sensor platform, Wireless and wireline protocols, Mobile to Electronics integration, Mobile to enterprise integration*
- *Open source/commercial electronics platform for IoT-Raspberry Pi, Arduino , ArmMbedLPC*
- *Open source /commercial enterprise cloud platform for IoT-Ayla, iO Bridge, Libellium, Axeda, Cisco fog cloud*

Module I (7 Hours)

Basic function and architecture of a sensor — sensor body, sensor mechanism, sensor calibration, sensor maintenance, cost and pricing structure, legacy and modern sensor network.

Development of sensor electronics — IoT vs legacy, and open source vs traditional PCB design style Development of sensor communication protocols, Protocols: Modbus, relay, Zigbee, Zwave, X10,Bluetooth, ANT, etc. Business driver for sensor deployment — FDA/EPA regulation, fraud/tempering detection, supervision, quality control and process management Different kind of calibration Techniques: manual, automation, infield, primary and secondary calibration — and their implication in IoT Powering options for sensors: battery, solar, Witricity, Mobile and PoE

Module II (9 Hours)

Zigbee and Zwave — advantage of low power mesh networking. Long distance Zigbee. Introduction to different Zigbee chips. Bluetooth/BLE: Low power vs high power, speed of detection, class of BLE. Introduction of Bluetooth vendors & their review. Wireless protocols such as Piconet and packet structure for BLE and Zigbee Other long distance RF communication link. LOS vs NLOS links, Capacity and throughput calculation Application issues in wireless protocols: power consumption, reliability, PER, QoS, LOS

Module III (9 Hours)PCB vs FPGA vs ASIC design

Prototyping electronics vs Production electronics, QA certificate for IoT CE/CSA/UL/IEC/RoHS/IP65 Basic introduction of multi-layer PCB design and its workflow

Electronics reliability-basic concept of FIT and early mortality rate Environmental and reliability testing-basic concepts Basic Open source platforms: Arduino, Raspberry Pi, Beaglebone

Module IV (7 Hours)

Introduction to Mobile app platform for IoT: Protocol stack of Mobile app for IoT, Mobile to server integration, iBeacon in IoS, Window Azure, Linkafy Mobile platform for IoT, Axeda, Xively

Module V (8 Hours)

Database implementation for IoT : Cloud based IoT platforms, SQL vs NoSQL, Open sourced vs. Licensed Database, Available M2M cloud platform, AxedaXively, Omega NovoTech, Ayla Libellium, CISCO M2M platform, AT &T M2M platform, Google M2M platform

Module VI (5 Hours)

Recent trends in home automation, IOT-locks, Energy optimization in home

COURSE/LEARNING OUTCOMES

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

- CO1:** Define IoT and respective protocols. (Remembering)
- CO2:** Explain the functions of different layers of communication protocol. (Understanding)
- CO3:** Identify the different functions with respect to different layers. (Applying)
- CO4:** Distinguish protocol and functionalities. (Analysing)
- CO5:** Evaluate the sensor collected data in connection to communication layer. (Evaluating)
- CO6:** Create applications using different communication protocol. (Creating)

Suggested Readings

1. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley-Blackwell.

CSNY0114: NETWORK SECURITY

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *To learn the basics of security and various types of security issues.*
- *To study different cryptography techniques available and various security attacks.*
- *Explore network security and how they are implemented in real world.*
- *To get an insight of various issues of Web security and biometric authentication.*

Module I (6 Hours)

Data security: Review of cryptography. Examples RSA, DES, ECC.

Module II (7 Hours)

Authentication, non-repudiation and message integrity. Digital signatures and certificates. Protocols using cryptography (example Kerberos). Attacks on protocols

Module III (9 Hours)

Network security: Firewalls, Proxy-Servers, Network intrusion detection. Transport security: Mechanisms of TLS, SSL, IPsec.

Module IV (10 Hours)

Web security – SQL injection, XSS, etc. Software security and buffer overflow. Malware types and case studies. Access Control, firewalls and host/network intrusion detection.

Module V (8 Hours)

Other topics: Biometric authentication, Secure E-Commerce (ex. SET), Smart Cards, Security in Wireless Communication.

Module VI (5 Hours)

Recent trends in IOT security, IDS and Biometric.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain the basics of security and various types of security issues. (Remembering)
- CO2:** Explain the different cryptography techniques available and various security attacks. (Understanding)
- CO3:** Explore network security and how they are implemented in real world. (Applying)
- CO4:** Analyse available biometric techniques and how they are used in today's world. (Analysing)
- CO5:** Evaluate the security issues in web and how to tackle them. (Evaluating)
- CO6:** Elaborate the various issues of web security and biometric authentication. (Creating)

Suggested Readings

1. W. R. Cheswick and S. M. Bellovin. Firewalls and Internet Security. Addison Wesley, 1994.
2. W. Stallings. Cryptography and Network Security. Prentice Hall, 1999.
3. B. Schneier. Applied Cryptography. Wiley, 1999.

CSAM0115: ADVANCED MACHINE LEARNING

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives:

- *To introduce key concepts in pattern recognition and machine learning; including specific algorithms for classification, regression, clustering and probabilistic modeling.*
- *To give a broad view of the general issues arising in the application of algorithms to analysing data, common terms used, and common errors made if applied incorrectly.*
- *To demonstrate a toolbox of techniques that can be immediately applied to real world problems, or used as a basis for future research into the topic.*

Module I (7 Hours)

Key concepts, Supervised/Unsupervised Learning, Loss functions and generalization, Probability Theory, Parametric vs Non-parametric methods, Elements of Computational Learning Theory Ensemble Learning, Bagging, Boosting, Random Forest

Module II (7 Hours)

Kernel Methods for non-linear data, Support Vector Machines, Kernel Ridge Regression, Structure Kernels, Kernel PCA, Latent Semantic Analysis

Module III (8 Hours)

Bayesian methods for using prior knowledge and data, Bayesian inference, Bayesian Belief Networks and Graphical models, Probabilistic Latent Semantic Analysis, The Expectation-Maximisation (EM) algorithm, Gaussian Processes

Module IV (9 Hours)

Dimensionality Reduction - CCA, LDA, ICA, NMF – Canonical Variates - Feature Selection vs Feature Extraction

Module V (9 Hours)

Filter Methods - Sub-space approaches - Embedded methods, Low-Rank approaches - Recommender Systems Application areas - Security - Business - Scientific

Module VI (5 Hours)

Recent trends in supervised and unsupervised learning algorithm, dimensional reducibility, feature selection and extraction

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall and explain the key concepts in pattern recognition and machine learning; including specific algorithms for classification, regression, clustering and probabilistic modeling. (Remembering, Understanding)
- CO2:** Explain the general issues arising in the application of algorithms, commonly used terms, and the common errors made if applied incorrectly. (Understanding)
- CO3:** Demonstrate a toolbox of techniques that can be immediately applied to real world problems, or used as a basis for future research into the topic. (Applying)
- CO4:** Analyse the Kernel methods for handling high dimensional and non-linear patterns. (Analysing)
- CO5:** Evaluate the State-of-the-art algorithms such as Support Vector Machines and Bayesian networks. (Evaluating)
- CO6:** Solve real-world machine learning tasks: from data to inference. (Creating)

Suggested Readings

1. Christopher M. Bishop, Pattern Recognition and Machine Learning.
2. John Shawe-Taylor and Nello Cristianini, Kernel Methods for Pattern Analysis

CSEC0116: DATA ENCRYPTION AND COMPRESSION

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives: *This course will cover the concept of security , types of attack experienced, encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression.*

Module I (8 Hours)

Introduction to Security: Need for security, Security approaches, Principles of security, Types of attacks.

Encryption Techniques: Plaintext, Cipher text, Substitution & Transposition techniques, Encryption & Decryption, Types of attacks, Key range & Size.

Module II (10 Hours)

Symmetric & Asymmetric Key Cryptography: Algorithm types & Modes, DES, IDEA, Differential & Linear Cryptanalysis, RSA, Symmetric & Asymmetric key together, Digital signature, Knapsack algorithm. User Authentication Mechanism: Authentication basics, Passwords, Authentication tokens, Certificate based & Biometric authentication, Firewall.

Module III (9 Hours)

Case Studies Of Cryptography: Denial of service attacks, IP spoofing attacks, Secure inter branch payment transactions, Conventional Encryption and Message Confidentiality, Conventional Encryption Principles, Conventional Encryption Algorithms, Location of Encryption Devices, Key Distribution. Public Key Cryptography and Message Authentication: Approaches to Message Authentication, SHA-1, MD5, Public-Key Cryptography Principles, RSA, Digital, Signatures, Key Management.

Module IV (7 Hours)

Introduction: Need for data compression, Fundamental concept of data compression & coding, Communication model, Compression ratio, Requirements of data compression, Classification. Methods of Data Compression: Data compression-- Loss less & Lossy

Module V (10 Hours)

Entropy encoding-- Repetitive character encoding, Run length encoding, Zero/Blank encoding; Statistical encoding-- Huffman, Arithmetic & Lempel-Ziv coding; Source encoding-- Vector quantization (Simple vector quantization & with error term); Differential encoding—Predictive coding, Differential pulse code modulation, Delta modulation, Adaptive differential pulse code modulation; Transform based coding : Discrete cosine transform & JPEG standards; Fractal compression

Module VI (4 Hours)

Recent trends in encryption and data compression techniques.

COURSE/LEARNING OUTCOMES:

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

- CO1:** List the different encryption techniques adopted in both traditional and modern cryptographic mechanisms. (Remembering)
- CO2:** Infer the logic adopted in different cryptographic algorithms, and their countermeasures. (Understanding)

- CO3:** Apply the concepts gathered from the fundamentals of cryptographic approaches in solving related problems. (Applying)
- CO4:** Analyse the working of the different encryption and compression algorithms. (Analysing)
- CO5:** Compare and contrast the working of different data encryption and compression mechanisms. (Evaluating)
- CO6:** Choose appropriate encryption and compression algorithms to build real-world systems. (Creating)

Suggested Readings

1. Cryptography and Network Security by B. Forouzan, McGraw-Hill.
2. The Data Compression Book by Nelson, BPB.
3. Cryptography & Network Security by AtulKahate, TMH.

CSSW0117: STEGANOGRAPHY AND DIGITAL WATERMARKING

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives: *The objective of course is to provide a insight to steganography techniques. Watermarking techniques along with attacks on data hiding and integrity of data is included in this course.*

Module I (8 Hours)

Steganography: Overview, History, Methods for hiding (text, images, audio, video, speech etc.), Issues: Security, Capacity and Imperceptibility, Steganalysis: Active and Malicious Attackers, Active and passive steganalysis

Module II (10 Hours)

Frameworks for secret communication (pure Steganography, secret key, publickey steganography), Steganography algorithms (adaptive and non-adaptive),

Module III (9 Hours)

Steganography techniques: Substitution systems, Spatial Domain, Transform domain techniques, Spread spectrum, Statistical steganography, CoverGeneration and cover selection, Tools: EzStego, FFEncode, Hide 4 PGP, Hideand Seek, S Tools etc.)

Module IV (7 Hours)

Detection, Distortion, Techniques: LSB Embedding, LSB Steganalysis using primary sets, Texture based

Module V (10 Hours)

Digital Watermarking: Introduction, Difference between Watermarking and steganography, History, Classification (Characteristics and Applications),Types and techniques (Spatial-domain, Frequency-domain, and Vector quantization based watermarking), Attacks and Tools (Attacks by Filtering, Remodulation, Distortion, Geometric Compression, Linear Compression etc.),Watermark security & authentication.

Module VI (4 Hours)

Recent trends in Steganography and digital watermarking techniques. Case studyof LSB Embedding,

LSB Steganalysis using primary sets.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the terms Steganography, Steganalysis and Digital Watermarking. (Remembering)
- CO2:** Explain the various techniques for Steganography, Steganalysis and Digital Watermarking. (Understanding)
- CO3:** Utilize various tools available to perform Steganography. (Applying)
- CO4:** Analyse data to detect and extract hidden information. (Analysing)
- CO5:** Defend against steganography and digital watermarking attacks. (Evaluating)
- CO6:** Develop frameworks for secure communication. (Creating)

Suggested Readings

1. Peter Wayner, "Disappearing Cryptography—Information Hiding: Steganography & Watermarking", Morgan Kaufmann Publishers, New York, 2002.
2. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, TonKalker, "Digital Watermarking and Steganography", Margan Kaufmann Publishers, New York, 2008.
3. Information Hiding: Steganography and Watermarking-Attacks and Countermeasures by Neil F. Johnson, ZoranDuric, SushilJajodia.

CSIT0118: INFORMATION THEORY AND CODING

(3 credits-45Hours)(L-T-P:3-0-0)

***Objectives:** The objective of this course is to provide an insight to information coding techniques, errorcorrection mechanism. Various compression techniques for text, video and image arecovered for thorough knowledge of efficient information conveying systems*

Module I (8 Hours)

Information and entropy information measures, Shannon's concept ofInformation. Channel coding, channel mutual information capacity (BW)

Module II (10 Hours)

Theorem for discrete memory less channel, information capacity theorem, Errordetecting and error correcting codes

Module III (9 Hours)

Types of codes: block codes, Hamming and Lee metrics, description of linearblock codes, parity check Codes, cyclic code, Masking techniques

Module IV (7 Hours)

Compression: loss less and lossy, Huffman codes, LZW algorithm, BinaryImage compression schemes, run length encoding, CCITT group 3 1-DCompression, CCITT group 3 2D compression, CCITT group 42DCompression.

Module V (10 Hours)

Convolutional codes, sequential decoding. Video image Compression: CITT H261 Video coding algorithm, audio (speech) Compression. Cryptography andcipher.

Module VI (4 Hours)

Case study of CCITT group 3 1-DCompression, CCITT group 3 2Dcompression.

COURSE/LEARNING OUTCOMES

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

- CO1:** List the various coding and compression techniques. (Remembering)
- CO2:** Explain the working of lossless and lossy compression techniques. (Understanding)
- CO3:** Apply encoding techniques to encode data and perform error detection and correction. (Applying)
- CO4:** Compare the various coding and compression techniques for text, video and image. (Analysing)
- CO5:** Measure information in terms of probability and entropy. (Evaluating)
- CO6:** Combine compression and coding techniques to build end-to-end systems. (Creating)

Suggested Readings

1. Fundamentals in information theory and coding, Monica Borda, Springer.
2. Communication Systems: Analog and digital, Singh and Sapre, TataMcGraw Hill. Multimedia Communications Fred Halsall.
3. Information Theory, Coding and Cryptography R Bose.
4. Multimedia system Design Prabhat K Andleigh and Kiran Thakrar.

CSRA0119: SECURITY ASSESSMENT AND RISK ANALYSIS

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives: *The objective of this course is to -*

- *Describe the concepts of risk management Define and differentiate various Contingency Planning components*
- *Integrate the IRP, DRP, and BCP plans into a coherent strategy to support sustained organizational operations.*
- *Define and be able to discuss incident response options,*
- *and design an Incident Response Plan for sustained organizational operations.*

Module I (8 Hours)

SECURITY BASICS: Information Security (INFOSEC) Overview: critical information characteristics – availability information states – processing security countermeasures – education, training and awareness, critical information characteristics – confidentiality critical information characteristics – integrity, information states – storage, information states – transmission, security countermeasures – policy, procedures and practices, threats, vulnerabilities.

Module II (11 Hours)

Threats to and Vulnerabilities of Systems: definition of terms (e.g., threats, vulnerabilities, risk), major categories of threats (e.g., fraud, Hostile Intelligence Service (HOIS), malicious logic, hackers, environmental and technological hazards, disgruntled employees, careless employees, HUMINT, and monitoring), threat impact areas, Countermeasures: assessments (e.g., surveys, inspections), Concepts of Risk Management: consequences (e.g., corrective action, risk assessment), cost/benefit analysis of controls, implementation of cost-effective controls, monitoring the efficiency and effectiveness of controls (e.g., unauthorized or inadvertent disclosure of information), threat

and vulnerability assessment

Module III (9 Hours)

Security Planning: directives and procedures for policy mechanism, Risk Management: acceptance of risk (accreditation), corrective actions information identification, risk analysis and/or vulnerability assessment components, risk analysis results evaluation, roles and responsibilities of all the players in the risk analysis process, Contingency Planning/Disaster Recovery: agency response procedures and continuity of operations, contingency plan components, determination of backup requirements, development of plans for recovery actions after a disruptive event, development of procedures for off-site processing, emergency destruction procedures, guidelines for determining critical and essential workload, team member responsibilities in responding to an emergency situation

Module IV (8 Hours)

POLICIES AND PROCEDURES Physical Security Measures: alarms, building construction, cabling, communications centre, environmental controls (humidity and air conditioning), filtered power, physical access control systems (key cards, locks and alarms) Personnel Security Practices and Procedures: access authorization/verification (need-to-know), contractors, employee clearances, position sensitivity, security training and awareness, systems maintenance personnel, Administrative

Security Procedural Controls: attribution, copyright protection and licensing , Auditing and Monitoring: conducting security reviews, effectiveness of security programs, investigation of security breaches, privacy review of accountability controls, review of audit trails and logs

Module V (9 Hours)

Operations Security (OPSEC): OPSEC surveys/OPSEC planning INFOSEC: computer security – audit, cryptography–encryption (e.g., point-to-point, network, link), cryptography–key management (to include electronic key), cryptography–strength (e.g., complexity, secrecy, characteristics of the key)

Module VI (3 Hours)

Case study of threat and vulnerability assessment

COURSE/LEARNING OUTCOMES:

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

- CO1:** List and define the various Contingency Planning components. (Remembering)
- CO2:** Explain the escalation process from incident to disaster in case of security disaster. (Understanding)
- CO3:** Plan counter measures to threats. (Applying)
- CO4:** Analyse risks. (Analysing)
- CO5:** Recommend contingency strategies including data backup and recovery and alternate site selection for business resumption planning. (Evaluating)
- CO6:** Design Incident Response Plan, Disaster Recovery Plan and Business Continuity Plan for sustained organizational operations. (Creating)

Suggested Readings

1. Principles of Incident Response and Disaster Recovery, Whitman & Mattord, Course Technology ISBN: 141883663X
2. (Web Link) http://www.cnss.gov/Assets/pdf/nstissi_4011.pdf

CSCD0120: SECURE CODING**(3 credits-45Hours)(L-T-P:3-0-0)****Objectives:** *The objective of this course is to -*

- *Understand the basics of secure programming.*
- *Understand the most frequent programming errors leading to software vulnerabilities.*
- *Identify and Analyse security problems in software.*
- *Understand and protect against security threats and software vulnerabilities.*
- *Effectively apply their knowledge to the construction of secure software systems*

Module I (10 Hours)

Introduction to software security, Managing software security risk, Selecting software development technologies, An open source and closed source, Guiding principles for software security, Auditing software, Buffer overflows, Access control, Race conditions, Input validation, Password authentication

Module II (7Hours)

Anti-tampering, Protecting against denial of service attack, Copy protection schemes, Client-side security, Database security, Applied cryptography, Randomness and determinism

Module III (9 Hours)

Buffer Overrun, Format String Problems, Integer Overflow, and Software Security Fundamentals SQL Injection, Command Injection, Failure to Handle Errors, and Security Touchpoints

Module IV (8 Hours)

Cross Site Scripting, Magic URLs, Weak Passwords, Failing to Protect Data, Weak random numbers, improper use of cryptography

Module V (8 Hours)

Information Leakage, Race Conditions, Poor usability, Failing to protect network traffic, improper use of PKI, trusting network name resolution

Module VI (5 Hours)

Case study of Cross Site Scripting, Magic URLs, Weak Passwords Buffer overflows, Access control, Race conditions

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall the basics of secure programming. (Remembering)
- CO2:** Explain the most frequent programming errors leading to software vulnerabilities. (Understanding)
- CO3:** Identify security problems in software. (Applying)
- CO4:** Compare the solutions for handling security problems in software. (Analysing)
- CO5:** Asses the vulnerabilities present in a software. (Evaluating)
- CO6:** Design and develop secure programs. (Creating)

Suggested Readings

1. J. Viega, M. Messier. Secure Programming Cookbook, O'Reilly.
2. M. Howard, D. LeBlanc. Writing Secure Code, Microsoft
3. J. Viega, G. McGraw. Building Secure Software, Addison Wesley

CSBI0121: BIOMETRICS

(3 credits-45Hours)(L-T-P:3-0-0)

Objectives: *The objective of this course is to introduce Bio-metric and traditional authentication methods. Application of bio-metric systems in government sector and various facerecognition and finger print recognition methods are included.*

Module I (7 Hours)

Introduction and Definitions of bio-metrics, Traditional authenticated methods and technologies.

Module II (10 Hours)

Bio-metric technologies: Fingerprint, Face, Iris, Hand Geometry, Gait Recognition, Ear, Voice, Palm print, On-Line Signature Verification, 3D Face Recognition, Dental Identification and DNA.

Module III (6 Hours)

The Law and the use of multi bio-metrics systems.

Module IV (11 Hours)

Statistical measurement of Bio-metric. Bio-metrics in Government Sector and Commercial Sector.

Module V (9 Hours)

Case Studies of bio-metric system, Bio-metric Transaction. Bio-metric System Vulnerabilities.

Module VI (5 Hours)

Recent trends in Bio-metric technologies and applications in various domains. Case study of 3D face recognition and DNA matching.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define biometrics. (Remembering)
- CO2:** Explain the various modules constituting a biometric system. (Understanding)
- CO3:** Identify Biometric System Vulnerabilities. (Applying)
- CO4:** Compare the various Biometric technologies. (Analysing)
- CO5:** Evaluate the challenges and limitations associated with biometrics. (Evaluating)
- CO6:** Design security systems incorporating biometrics. (Creating)

Suggested Readings

1. Biometrics for network security, Paul Reid, Hand book of Pearson
2. D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, Handbook of Fingerprint Recognition, Springer Verlag, 2003.
3. A. K. Jain, R. Bolle, S. Pankanti (Eds.), BIOMETRICS: Personal Identification in Networked Society, Kluwer Academic Publishers, 1999.
4. J. Wayman, A.K. Jain, D. Maltoni, and D. Maio (Eds.), Biometric Systems: Technology, Design and Performance Evaluation, Springer, 2004.
5. Anil Jain, Arun A. Ross, Karthik Nanda kumar, Introduction to biometric, Springer, 2011.
6. Biometric Systems: Technology, Design and Performance Evaluation, J. Wayman, A.K. Jain, D. Maltoni, and D. Maio.

LABORATORY COURSES

CSMA6047: MICROPROCESSORS AND APPLICATIONS LAB

(2 credits)

Laboratory course will be based on 8051 microcontroller.

1. Study of 8051 microcontroller architecture
2. Study of assembly language and embedded C for 8051
3. To perform interfacing of LED.
4. To perform interfacing of LCD
5. To perform interfacing of stepper motor
6. To perform interfacing of speaker.
7. To perform serial transfer of data from PC and microcontroller board.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall the names of the 8051 registers, instructions set etc. (Remembering)
- CO2:** Explain the working of LCD, keypad, motors, interrupts etc. of 8051 microcontroller. (Understanding)
- CO3:** Utilize 8051 programs to add numbers, compare numbers, delay loops etc. (Applying)
- CO4:** Compare the performance of interrupt driven and polling based programs. (Analysing)
- CO5:** Evaluate the performance of 8051 programs in terms of time requirement. (Evaluating)
- CO6:** Combine different 8051 instructions to write complex 8051 programs such as rotating motors, displaying characters in LCD, reading characters from keypad etc. (Creating)

Suggested Readings

1. Kenneth Ayala, The 8051 Microcontroller, 3rd edition

CSOC6048: OPERATING SYSTEMS AND CONCEPTS LAB

(2 credits)

1. Simple Unix-C programs: Programs using system calls, library function calls to display and write strings on standard output device and files.
2. Programs using fork system calls.
3. Programs for error reporting using errno, perror() function.
4. Programs using pipes.
5. Shell programming.
6. Programs to simulate process scheduling like FCFS, Shortest Job First and Round Robin.
7. Programs to simulate page replacement algorithms like FIFO, Optimal and LRU.
8. Programs to simulate free space management.
9. Programs to simulate virtual memory.
10. Programs to simulate deadlock detection.
11. Study of file systems: UNIX/FAT/NTFS.
12. Study of Windows registry.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall and label the basic commands in Linux. (Remembering)
- CO2:** Classify system calls, library functions calls to write on standard output device. (Understanding)
- CO3:** Experiment with shell programs. (Applying)
- CO4:** Analyse and compare between different file systems like ext4/FAT/NTFS. (Analysing)
- CO5:** Evaluate free space management using programs. (Evaluating)
- CO6:** Construct programs on process scheduling, page replacement algorithms. (Creating)

E-resource for learning

Linux-Ubuntu, www.spoken-tutorial.org

CSDC6049: DATA COMMUNICATION LAB

(2 credits)

1. PC-to-PC communications under WinXP/Win98 direct cable connection with null modem
 - a) Using serial ports and RS-232 C cable connection, and
 - b) Using parallel ports and direct parallel cable connection.
2. PC-to-PC communications under WinXP/Win98 dial-up networking with modem and 4- line exchange.
3. PC-to-PC communications under WinXP/Win98 hyper terminal with modem and 4-line exchange.
4. Simple file transfer between two systems (without protocols): By opening socket connection to a server on one system and sending a file from one system to another.
5. Writing a Chat application:
 - a) One-One: By opening socket connection and displaying what is written by one party to the other.
 - b) Many-Many (Broad cast): Each client opens a socket connection to the chat server and writes to the socket. Whatever is written by one party can be seen by all other parties.
6. Introduction to Packet Tracer
7. Simulation of Telnet: Provide a user interface to contact well-known ports, so that client-server interaction can be seen by the user.
8. TFTP- Client: To develop a TFTP client for file transfer.
9. HTTP-Server: Develop a HTTP server to implement the commands – GET, POST, HEAD, DELETE.The server must handle multiple clients.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** relate about networking devices and various networking commands(REMEMBERING)
- CO2:** illustrate different types of network (UNDERSTANDING)
- CO3:** implement different networking protocol in different network topology. (APPLYING)
- CO4:** compare different topology and functioning of different protocols. (ANALYSING)
- CO5:** formulate the types of network required for an organization, Depending on availability of hardwares and softwares (CREATING)

CO6: determine a computer network either Wired or Wireless(EVALUATING)

Suggested Reading

1. Networking and Data Communications Laboratory manual, Frances S. Grodzinsky, PH, 1999.

CSMI6050: MINI PROJECT I

(2 credits)

Mini projects are assigned to students individually or in groups by the Department under the supervision of the designated faculty member. The objective of the mini project is to train the students to create industry oriented software or hardware applications in his/her field of interest.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Select and relate the fundamental phases of a system/Applying/software design. (Remembering)
- CO2:** Illustrate how to carry out a project work. (Understanding)
- CO3:** Outline the importance of different phases of a system design. (Understanding)
- CO4:** Organize and design to implement the project. (Applying)
- CO5:** Analyse the feasibility of a project in terms of time, effort and money. (Analysing)
- CO6:** Capable to design applications by critically examining and scientifically designing each phase of a project work. (Creating)
- CO7:** Evaluate a project based on its efficiency, applicability, robustness, user friendliness etc. (Evaluating)

CSNS6054: COMPUTER NETWORKS LAB

(2 credits)

1. Introduction to
 - a) Network Components such as GATEWAYS, ROUTER, Switches, etc. b) Various Network Software, service and application
 - c) Network Trouble shooting.
2. LAN with bus/star (switch or hub) topology with a minimum of two systems
3. Performance Evaluation of Error and Flow control protocol using LAN trainer.
4. Socket Programming (java or c).
 - a) Implementation of Protocol- ALOHA, CSMA/CD, CSMA/CA
 - b) Implementation of Applications using socket
 - i. Telnet Client ii. FTP Client iii. HTTP Client
5. Introduction to Network Simulator (NS)
 - a) Implementation and Analysis of protocol
6. Modeling of Network Architecture for an Organization (Project)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Understand and identify different basic networking commands and utilities and learn different network topologies and associated network terminologies such as routing table, arp table etc. (Remembering)
- CO2:** Distinguish different header values of different layer protocols in a packet by using tools such as wireshark, tcpdump etc. (Analysing)
- CO3:** Interpret the knowledge to view fragmentation, segmentation behavior of packets in a network. They would also be able to identify and implement dynamic routing such as RIPV1. Create different network topology using ns3. (Understanding)
- CO4:** Apply the knowledge to Analyse fragmentation, segmentation behavior of packets in a normal network and hybrid network demanding special flag value set. They would also be able to identify and Analyse problems related to some dynamic routing protocols such as RIPV1.(Applying)
- CO5:** Design network topology implementing different routing protocols that best suits a real time demand. They should also be able to synthesize a hybrid network implementing different IEEE 802.x behavior using NS3.(Creating)
- CO6:** Judge which protocols operates in which layer and why by Analysing and observing network traces.(Evaluating).

CSCD6055: COMPILER DESIGN LAB

(2 credits)

1. Introduction to LEX and YACC. Preferable on UNIX but any other version is also acceptable.
2. Writing simple scanner for accepting and validating floating point numbers and fixedpoint numbers
3. Writing simple scanners for tokenizing C or BASIC programs. The Program will output the list of token to a file and classify them by type of token
4. Writing a program to pick out comments in a C ++ program or a JAVA Program
5. Developing a rudimentary C Preprocessor capable of handling the “define, ifdef, ifndef, include” directives. More ambitious students can implement substitution of Macros with arguments.
6. Converting simple finite Automata into program.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Find out about different syntax of compiler construction tools like LEX and YACC. (Remembering)
- CO2:** Experiment with regular expression to match the pattern. (Applying)
- CO3:** Solve various problem using LEX and YACC.(Creating)
- CO4:** Interpret the techniques of parsing practically. (Understanding)
- CO5:** Analyse different rules using standard parser generator YACC.(Analysing)
- CO6:** Evaluate problems using both LEX and YACC together.(Evaluating)

CSAA6056: ANALYSIS AND DESIGN OF ALGORITHMS LAB**(2 credits)**

1. Using Graph notation to prove that bubble sort algorithm has time complexity (n^2)
2. Implement the Dynamic programming technique and Analyse the algorithm using the graph notation.
3. Implement the Greedy programming technique and Analyse the algorithm using the graph notation.
4. Implement the Divide and Conquer technique and Analyse the algorithm using the graph notation.
5. Design a small file compressor and de-compressor by using Huffman coding technique

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall existing algorithms and relate how to analyse them using graph notation. (Remembering)
- CO2:** Demonstrate the existing algorithms. (Understanding)
- CO3:** Apply existing algorithms in designing different applications. (Applying)
- CO4:** Analyse execution time of standard algorithms. (Analysing)
- CO5:** Evaluate an algorithm in terms of time and space efficiency. (Evaluating)
- CO6:** Create efficient applications by using right algorithm depending on input pattern and size. (Creating)

CSMI6057: MINI PROJECT II**(2 credits)**

Mini projects are assigned to students individually or in groups by the Department under the supervision of the designated faculty member. The objective of the mini project is to train the students to create Industry oriented software or hardware applications in his/her field of interest. The mini projects taken up by the students in the sixth semester are expected to be more advanced than the projects taken up in the fifth semester.

COURSE / LEARNING OUTCOMES

At the end of Mini Project II students will be able to:

- CO1:** Relate with the fundamental phases of a system/application/software design. (Remembering)
- CO2:** Explain how to carry out a project work. (Understanding)
- CO3:** Identify the importance of different phases of a system design. (Applying)
- CO4:** Analyse the feasibility of a project in terms of time, effort and money. (Analysing)
- CO5:** Evaluate a project based on its efficiency, applicability, robustness, user friendliness etc. (Evaluating)
- CO6:** Design and implement a system. (Creating)

CSAI6059: ARTIFICIAL INTELLIGENCE LAB

(2 Credits)

List of Experiments

1. Write a LISP Program to solve the water-jug problem using heuristic function.
2. Create a compound object using Turbo Prolog.
3. Write a Prolog Program to show the advantage and disadvantage of green and red cuts.
4. Write a prolog program to use of BEST-FIRST SEARCH applied to the eight puzzle problem.
5. Implementation of the problem solving strategies: Forward Chaining, Backward Chaining, Problem Reduction.
6. Write a Lisp Program to implement the STEEPEST-ASCENT HILL CLIMBING.
7. Write a Prolog Program to implement COUNT PROPAGATION NETWORK.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall the need of two basic programming language very specific to AI viz., LISP and Prolog, learning and search algorithm like (A*, DFS, BFS), knowledge representation using Propositional and predicate logic. (Remembering)
- CO2:** Explain problem state space, design algorithms to solve problems, generalized schema for knowledge interpretation and planning and language processing using the syntax and semantics of Prolog and LISP. (Understanding)
- CO3:** Compute and demonstrate the problem in terms of state space and apply different AI search algorithms(A*, DFS, BFS) to solve problems and construct a logic(Propositional and Predicate) to represent knowledge and interpret the natural language in computational domain by developing expert system using Prolog and LISP. (Applying)
- CO4:** Compare and Analyse the performance of algorithms based on problem domain. (Analysing)
- CO5:** Judge and assess the algorithms based on completeness, optimality, space and time complexity for solving a problem in intelligent manner. (Evaluating)
- CO6:** Design and create new intelligent algorithm for application development by integrating experience based learning. (Creating)

CSGM6060: COMPUTER GRAPHICS AND MULTIMEDIA LAB

(2 Credits)

COMPUTER GRAPHICS

Mandatory exercises

1. Learning graphics functions in C, C++.
2. Bresenham's line drawing algorithm.
3. DDA line drawing algorithm.
4. Polygon filling algorithm (FLOODFILL / SEEDFILL)
5. Cohen-Sutherland clipping algorithm.
6. 3D Transformations such as translation, rotation and scaling.

Any One exercise from the following

7. Reflection of a given point about a given axis.
8. Polygon clipping using Sutherland Hodgeman algorithm.

Any One exercise from the following

9. A straight line, rotating about the perimeter of a given circle.
10. Z-buffer algorithm for hidden surface elimination.

MULTIMEDIA

1. To visualize projections of 3D images.
2. To convert between color models.
3. To implement text compression algorithm.
4. To implement image compression algorithm.
5. To perform animation using any Animation software.
6. To perform basic operations on image using any image editing software.
7. Multimedia Sound: Create 2 soundtracks and 2 EFX sounds for a project.
8. Digital Video: Use video capture to digitize video shoot or another video source to create short production (15-45 seconds).

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Define and create animation, drawing using mathematical logics and transformations. (Remembering)
- CO2:** Explain the functioning of inbuilt functions of graphics packages. (Understanding)
- CO3:** Design and develop computer graphics algorithms using graphics packages. (Applying)
- CO4:** Analyse various graphics packages and their applicability. (Analysing)
- CO5:** Evaluate mathematical logics used to design graphics applications. (Evaluating)
- CO6:** Implement and modify programming with graphics packages. (Creating)

E-resource for learning

Blender, GIMP, www.spoken-tutorial.org

CSTS6061: TRAINING SEMINAR

(2 credits)

Objective: During the semester break at the end of the third year, students are required to undergo an Industrial Training. The purpose of the Industrial Training is to expose students to real-life industry situations, so that they may be able to apply the engineering knowledge and skills that they have gained through class-room teaching and lab activities, in an on-the-job situation. After the period of training, students are to present their experience in the form of reports and seminar presentations. Students will be evaluated on the seminar, viva voce examination and written reports.

COURSE / LEARNING OUTCOMES

At the end of Training Seminar students will be able to:

- CO1:** Identify various real world problems. (Knowledge)
- CO2:** Develop and enhance leadership skills. (Comprehension)

- CO3:** Get the opportunity to work with live projects. (Application) **CO4:** Increase exposure to industries. (Analysis)
- CO5:** Be accustomed with working environment in industries. (Synthesis)
- CO6:** Improve communication skills, presentation skills and other soft skills. (Evaluation)

CSMP6062: MAJOR PROJECT (PHASE I)

(4 credits)

During the last year of their study, B. Tech. students are required to take up a major project. This may be an individual project or a group project. The Major Project is an integral learning experience that encourages students to break away from the compartmentalization of the different courses they have studied during the three years of their study and aims to provide opportunities to explore the inter-relationships and inter-connectedness of the various courses and gather them together into a single learning experience.

The major project focuses upon the following:

- **Interdisciplinary:** The major project provides a platform for students to apply the knowledge and skills acquired from different courses.
- **Collaboration:** It encourages students to work in groups over an extended period of time. They clarify the task, plan their work, share the responsibilities and work towards the successful completion of the project.
- **Process and Product:** Project work focuses on both process and product. The process would include collaboration, gathering and processing of information. The product may take the form of a working model, a complete software package, etc.
- **Written and Oral presentation:** Project work provides students with opportunities to present their findings as a written thesis in a prescribed format and orally with an intended audience and purpose in mind.

During the first phase in the seventh semester, students are expected to choose the project, prepare a synopsis under the guidance of a project supervisor appointed by the department, present the synopsis to the committee set up for the purpose, get approval for the synopsis and start the project work. Students are expected to submit weekly activity reports and present a progress seminar during this phase. They will also undergo a viva voce examination, in which they will be examined on all the basic areas of the discipline in which they have chosen their project.

COURSE / LEARNING OUTCOMES

At the end of Major Project I students will be able to:

- CO1:** Recall the Software Development Life Cycle and fundamental phases of system/application/software design and research. (Remembering)
- CO2:** Illustrate how to carry out a project work and explain the importance of different phases of a system design, workflow and time estimation with research outlook. (Understanding)
- CO3:** Design and implement a system and plan how to perform research for real time application. (Applying)
- CO4:** Analyse the feasibility of a project in terms of time, effort and money. (Analysing)
- CO5:** Evaluate a project based on its efficiency, applicability, robustness, user friendliness etc., with socio-economic impact. (Evaluating)
- CO6:** Design applications by critically examining and scientifically designing each phase of the project work. (Creating)

E-resource for learning

LaTeX, www.spoken-tutorial.org

CSMP6063: MAJOR PROJECT (PHASE II) AND VIVA VOCE**(8 credits)**

During the second phase students are expected to focus on the process and completion of the projects and prepare project reports under the guidance of the Supervisors. Internal assessment shall be done by the DPEC and the external assessment shall be done by the external examiner(s) assisted by the DPEC and the supervisor. The modality and components of the internal assessment and their weightages shall be notified at the beginning of each semester. The External assessment shall have the following components:

- Project Implementation : 40 marks
- Seminar presentation : 20 marks
- Viva voce examination : 20 marks
- Project documentation : 20 marks

COURSE / LEARNING OUTCOMES

At the end of Major Project II students will be able to:

- CO1:** Define and choose the Software Development Life Cycle and fundamental phases of system / application / software design and research. (Remembering)
- CO2:** Demonstrate how to carry out a project work and understand the importance of different phases of a system design, workflow and time estimation with research outlook. (Understanding)
- CO3:** Construct a system and identify how to perform research for real time application. (Applying)
- CO4:** Analyse the feasibility of a project in terms of time, effort and money. (Analysing)
- CO5:** Evaluate a project based on its efficiency, applicability, robustness, user friendliness etc., with socioeconomic impact. (Evaluating)
- CO6:** Design applications by critically examining and scientifically designing each phase of a project work. (Creating)

CSPL6069: PROGRAMMING FOR PROBLEM SOLVING LAB**(2 Credits) (L-T-P:0-0-4)**

(The laboratory is preceded by a teaching to explain the approach or algorithm to be implemented for the problem given)

1. Lab 1: (Teaching on Problem solving using computers) Familiarization with programming environment
2. Lab 2: (Teaching on Variable types and type conversions) Simple computational problems using arithmetic expressions
3. Lab 3: (Teaching on Branching and logical expressions) Problems involving if-then-else structures
4. Lab 4: (Teaching on Loops, while and for loops) Iterative problems e.g., sum of series
5. Lab 5: (Teaching on 1D Arrays: searching, sorting) 1D Array manipulation
6. Lab 6: (Teaching on 2D arrays and Strings) Matrix problems, String operations

7. Lab 7: (Teaching on Functions, call by value) Simple functions
8. Lab 8 and 9: (Teaching on Numerical methods-Root finding, numerical differentiation, numerical integration) Programming for solving Numerical methods problems
9. Lab 10: (Teaching on Recursion, structure of recursive calls) Recursive functions
10. Lab 11: (Teaching on Pointers, structures and dynamic memory allocation) Pointers and structures
11. Lab 12: (Teaching on File handling) File operations

COURSE / LEARNING OUTCOMES

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

- CO1:** Relate the programming logic. (Remembering)
- CO2:** Illustrate the theoretical concepts learned in C programming language. (Understanding)
- CO3:** Apply existing algorithms in writing programs using C language and also do graphics programming. (Applying)
- CO4:** Analyse their skills for choosing the right data structure, function, data types and develop logic to write programs in C. (Analysing)
- CO5:** Evaluate the sorting and searching algorithms through implementation 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)

CSOP6070: OBJECT ORIENTED PROGRAMMING LAB

(2 credits) (L-T-P:0-0-4)

List of Experiments

1. Program on concept of classes and objects.
2. Programs on use of memory management.
3. Programs using polymorphism – i) operator overloading ii) Dynamic binding
4. Programs on use of operator overloading.
5. Programs on exception handling and use of templates.
6. Programs on file handling
7. Design problem on stock and accounting of a small organization, railway reservation, payroll preparation and optimization problem.

COURSE / LEARNING OUTCOMES

On successful completion of Object Oriented Programming LAB the students will be able to:

- CO1:** List various GUI and thus will be able to select the suitable GUI to resolve a given problem. (Remembering)
- CO2:** Compare the various utility class like vector, stack, Hash Table, String Tokenizer, etc. (Understanding)
- CO3:** Apply their knowledge to solve practical problems like reading from a dataset, writing into a file and develop games using JAVA program. (Applying)
- CO4:** Analyse the efficiency of various programs with respect to time and space complexity. They will also be able to modify a weak program into a more efficient one. (Analysing)

- CO5:** Evaluate the performance of various swing GUI components and design various applications using Swings, depending upon the problem domain. (Evaluating)
- CO6:** Design various methods for drawing lines, rectangles, polygons and ovals and based on their practical knowledge will be able to develop cost effective and user friendly applications. (Creating)

CSDC6071: DIGITAL COMPUTER DESIGN LAB

(2 credits)(L-T-P:0-0-4)

List of Experiments

- 1 To study the Truth tables of logic gates
- 2 To realize half/full adder and half/full adder subtractor
- 3 Simulation with VDHL
 - I) Adders
 - II) Subtractors
 - iii) Logic gates
 - iV) MUX and DEMUX

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** List the various logic gates used in the digital circuits. (Remembering)
- CO2:** Relate and illustrate the Truth tables of logic gates. (Understanding)
- CO3:** Build and experiment with half/full adder and half/full subtractor. (Applying)
- CO4:** Experiment with complex circuits with VDHL. (Applying)
- CO5:** Analyse and classify counters, registers, encoders and decoders. (Analysing)
- CO6:** Explain and evaluate the truth table of multiplexer and de-multiplexer. (Evaluating)
- CO7:** Design circuits using Analog Digital Trainer kits. (Creating)

CSDS6072: DATA STRUCTURE LAB

(2 credits)(L-T-P:0-0-4)

Solution of problems on

- 1 dynamic memory allocation
- 2 structures and pointers to structures
- 3 Arrays
- 4 Stacks and Stack application, Queues
- 5 Linked Lists, Circular and Doubly Linked Lists.
- 6 Binary Trees
- 7 Searching and data modification: Linear Search, Binary Search, Hashing.
- 8 Sorting Techniques: Selection, Insertion, Bubble, Merge, Heap, Quick, Radix, and Merge-Sort.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** List various data structures and thus select the suitable data structure to relate a given problem for solution. (Remembering)
- CO2:** Translate a given mathematical expression to various forms like – infix to postfix or prefix.(Understanding)
- CO3:** Apply their knowledge to solve practical problems like- expression conversion using stack, tower of hanoi using stack and recursion, process management using queue and memory management using linked list and B tree. (Applying)
- CO4:** Analyse the efficiency of various programs with respect to time and space complexity. They will also be able to inspect a weak program and convert it into a more efficient one. (Analysing)
- CO5:** Depending on the problem domain, input pattern and size of the input, students will be able to evaluate the performance of various sorting and searching techniques and will also be able to justify their decision by doing complexity analysis. (Evaluation)
- CO6:** Design code for simulating the working of various data structures like- stack, queue, linked list, tree, graph etc. and based on their practical knowledge will be able to develop cost effective and user friendly applications. (Creating)

CSOA6073: COMPUTER ORGANIZATION AND ARCHITECTURE LAB

(2 credits)(L-T-P:0-0-4)

(10 classes for 10 different Programs along with some hardware exposure)

- 1 Some experiments using hardware trainer kits for floppy drive, dot matrix printer etc.
- 2 Dismantling and assembling a PC along with study of connections, ports, chipsets, SMPS etc.
- 3 Assembly language programming using IA32(gcc)
 - I Introduction gcc assembly programming
 - II Verification of Instruction Set.
 - III Arithmetic operation –
 - a Addition, Subtraction, Multiplication and Division of two 8-bit numbers.
 - b Multi byte Addition and Subtraction, Multiplication and Division – Signed and unsigned Arithmetic operation, ASCII – arithmetic operation.
 - IV Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
 - V By using string operation and Instruction prefix: Move Block, Reverse string, Sorting, Inserting, Deleting, Length of the string, String comparison.
 - VI DOS/BIOS programming: Reading keyboard (Buffered with and without echo) – Display characters, Strings.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Get introduced to 8086 instruction set and define and relate the overview of its architecture. (Remembering)
- CO2:** Demonstrate 8086 assembly programmes in TASM. (Understanding)

- CO3:** Utilize the meaning of each 8086 assembly instruction and also will be able to understand the use of assembler directives. (Applying)
- CO4:** Analyse different instructions based on number of clock cycle it takes in order to write an efficient program. (Analysing)
- CO5:** Evaluate the output of 8086 assembly programmes. (Evaluating)
- CO6:** Build efficient programs by using minimal number of instruction as well as using relatively faster and simple instructions. (Creating)

CSRD6074: RELATIONAL DATABASE MANAGEMENT SYSTEMS LAB

(2 credits)(L-T-P:0-0-4)

(10 different Programs to be created and executed on the following areas)

- 1 Use of SQL Syntax: Insertion, Deletion Join), Updating using SQL.
- 2 Program segments in embedded SQL using C as host language to find average grade point of a student, etc.
- 3 Program for Log based data recovery technique.
- 4 Program on data recovery using check point technique.
- 5 Concurrency control problem using lock operations.
- 6 Use of package (ORACLE) for programming approaches.
- 7 Use of package (DB2) for programming approaches.
- 8 Programs on JDBC/ODBC to employee's / student's information of a particular department.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** define various types of SQL commands and structure of PL/SQL programming (Remembering)
- CO2:** identify and explain which command would be used for a given query (Understanding)
- CO3:** Apply correctly use the techniques, components and tools of a typical database management system to build a comprehensive database information system (Applying)
- CO4:** Apply SQL commands and PL/SQL programs to solve problems related to database tables. (Applying)
- CO5:** Compare and contrast the various ways of solving a query for optimization. (Analysing)
- CO6:** Evaluate and justify the database designed for any database project (Evaluating)
- CO7:** Design schema diagrams for handling database projects (Creating)

CSAD6075: ANALYSIS AND DESIGN OF ALGORITHMS LAB

(2 credits)(L-T-P:0-0-4)

1. Using Graph notation to prove that bubble sort algorithm has time complexity (n^2)
2. Implement the Dynamic programming technique and Analyse the algorithm using the graph notation.
3. Implement the Greedy programming technique and Analyse the algorithm using the graph notation.

4. Implement the Divide and Conquer technique and Analyse the algorithm using the graph notation.
5. Design a small file compressor and de-compressor by using Huffman coding technique

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Get introduced to existing algorithms and how to analyse them using graph notation. (Remembering)
- CO2:** Demonstrate the existing algorithms. (Understanding)
- CO3:** Apply existing algorithms in designing different applications. (Applying)
- CO4:** Analyse execution time of standard algorithms. (Analysing)
- CO5:** Evaluate an algorithm in terms of time and space efficiency. (Evaluating)
- CO6:** Create efficient applications by using right algorithm depending on input pattern and size. (Creating)

CSDT6076: ADVANCED DATA STRUCTURES LAB

(2 credits-30 Hours)(L-T-P:0-0-4)

Objectives:

Students will be able to understand the necessary mathematical abstraction to solve Problems. Students will implement the advanced paradigms and data structure used to solve algorithmic problems.

1. Implementation of BST and AVL trees.
2. Implementation of 2-3 trees, B-trees.
3. Implementation of Red Black Trees.
4. Pattern matching using Boyer-Moore algorithm.
5. Knuth-Morris-Pratt algorithm for pattern matching.
6. Huffman Algorithm for data compression.
7. Finding Longest Common Subsequence using a dynamic programming technique.
8. Implementation of Standard tries, Suffix tries and Compressed tries.
9. Construction of Priority search trees, searching in a Priority Search Tree.
10. Construction of Priority range trees.
11. Implementation of Quad Trees.

COURSE/LEARNING OUTCOMES

At the end of Advanced Data Structures Lab students will be able to:

- CO1:** Choose appropriate data structures and algorithms. (Remembering)
- CO2:** Explain the necessary mathematical abstraction required to solve problems. (Understanding)
- CO3:** Explain tree representation and traversals; associative containers, red-black trees, and hashing; graph representations, traversals, and basic graph algorithms. (Understanding)
- CO4:** Experiment with the ADT/libraries, to design algorithms for a specific problem. (Applying)

CO5: Analyse the efficiency and proofs of correctness comprehend and select algorithm design approaches in a problem specific manner. (Analysing)

CO5: Design and evaluate programming problem statements. (Evaluating, Creating)

CSML6077: MACHINE LEARNING LAB

(2 credits-30 Hours)(L-T-P:0-0-4)

Objectives:

- *Make use of Data sets in implementing the machine learning algorithms*
 - *Implement the machine learning concepts and algorithms in any suitable language of choice.*
1. Write a program to demonstrate the working of the decision tree algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
 2. Write a program to implement k-Nearest Neighbors algorithm to classify any standard data set. Print both correct and wrong predictions.
 3. Write a program to demonstrate the working of Support Vector Machine. Evaluate the performance based on standard performance measures.
 4. Implement and demonstrate K-means clustering.
 5. Implement and demonstrate Kernel K-means clustering.
 6. Face recognition using PCA.
 7. Write a program to construct a Bayesian network considering medical data.
 8. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
 9. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
 10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

COURSE/LEARNING OUTCOMES

At the end of Machine Learning Lab students will be able to:

CO1: Relate the machine learning algorithm for practical implementation. (Remembering)

CO2: Illustrate the complexity of Machine Learning algorithms and their limitations. (Understanding)

CO3: Apply modern notions in data analysis oriented computing. (Applying)

CO4: Apply common Machine Learning algorithms in practice and analyse the output (Analysing)

CO5: Interpret distributed computations and evaluate experiments in Machine Learning using real-world data (Evaluating)

CO6: Creating machine learning based algorithm (Creating)

CSAA6078: ADVANCED ALGORITHM LAB

(2 credits-45Hours)(L-T-P:0-0-4)

Objectives:

- *The fundamental design, analysis, and implementation of basic data structures.*
- *Basic concepts in the specification and analysis of programs.*
- *Principles for good program design, especially the uses of data abstraction.*
- *Sample Problems on Data structures*

1. Program to find Breadth First Search of a graph.
2. Program to find Depth First Search of a graph.
3. Program to find strongly connected components of a graph.
4. Implement Prim's algorithm to find minimal spanning tree of a graph.
5. Implement Kruskal's algorithm to find minimal spanning tree of a graph.
6. Implement Dijkstra's algorithm to find shortest path in a graph.
7. Implementation of algorithms to compute a maximum weight maximal independent set.
8. Implementation of graph matching algorithms.
9. Implementation of Ford-Fulkerson Method to compute maximum flow.
10. Implementation of Edmond-Karp maximum-flow algorithm.
11. Implement Strassen's Algorithm.
12. Implement Floyd Warshall Algorithm.

COURSE/LEARNING OUTCOMES

At the end of Advanced Algorithm Lab students will be able to:

- CO1:** Recall and explain the fundamentals of design and analysis of basic data structures and experiment with the implementation process. (Remembering, Understanding, Applying)
- CO2:** Examine and evaluate the concepts in the specification and analysis of programs. (Analysing, Evaluating)
- CO3:** Elaborate the principles for good program design, especially the uses of data abstraction. (Creating)

CSDV6079: DATA VISUALISATION LAB

(2 credits-45Hours)(L-T-P:0-0-4)

1. Program to recursively subdivide a tetrahedron to form 3D Sierpinski gasket. The number of recursive steps is to be specified by the user.
2. Program to implement Liang-Barsky line clipping algorithm.
3. Program to draw a color cube and spin it using OpenGL transformation matrices.
4. Program to create a house like figure and rotate it about a given fixed point using OpenGL functions.
5. Program to implement the Cohen-Sutherland line-clipping algorithm. Make provision to specify the input line, window for clipping and view port for displaying the clipped image.
6. Program to create a cylinder and a parallelepiped by extruding a circle and quadrilateral respectively. Allow the user to specify the circle and the quadrilateral.
7. Program, using OpenGL functions, to draw a simple shaded scene consisting of a tea pot on a table. Define suitably the position and properties of the light source along with the properties of the surfaces of the solid object used in the scene.
8. Program to draw a color cube and allow the user to move the camera suitably to experiment with perspective viewing. Use OpenGL functions.
9. Program to fill any given polygon using scan-line area filling algorithm. (Use appropriate data structures.)
10. Program to display a set of values $\{f_{ij}\}$ as a rectangular mesh. Project: 11. Develop a suitable Graphics package to implement the skills learnt in the theory and the exercises indicated in Part A. Use the OpenGL..

11. Program to recursively subdivide a tetrahedron to form 3D Sierpinski gasket. The number of recursive steps is to be specified by the user.
12. Program to implement Liang-Barsky line clipping algorithm.
13. Program to draw a color cube and spin it using OpenGL transformation matrices.
14. Program to create a house like figure and rotate it about a given fixed point using OpenGL functions.
15. Program to implement the Cohen-Sutherland line-clipping algorithm. Make provision to specify the input line, window for clipping and view port for displaying the clipped image.
16. Program to create a cylinder and a parallelepiped by extruding a circle and quadrilateral respectively. Allow the user to specify the circle and the quadrilateral.
17. Program, using OpenGL functions, to draw a simple shaded scene consisting of a tea pot on a table. Define suitably the position and properties of the light source along with the properties of the surfaces of the solid object used in the scene.
18. Program to draw a color cube and allow the user to move the camera suitably to experiment with perspective viewing. Use OpenGL functions.
19. Program to fill any given polygon using scan-line area filling algorithm. (Use appropriate data structures.) Program to display a set of values {fij} as a rectangular mesh.
20. Project: 1. Develop a suitable Graphics package to implement the skills learnt in the theory and the exercises indicated in Part A. Use the OpenGL.

COURSE / LEARNING OUTCOMES

At the end of this course students will be:

- CO1:** Recall the design process to develop visualization methods and visualization systems, and methods for their evaluation. (Remembering)
- CO2:** Prepare and process data and visual mapping and the visualization (Creating).
- CO3:** Illustrate an understanding of large-scale abstract data. (Understanding)
- CO4:** Analyse data in various perspective. (Analysing)
- CO5:** Evaluate the results generated from various applications. (Evaluating)
- CO6:** Create visualization methods for different applications. (Creating)

CSEN6080: DATA ENCRYPTION AND COMPRESSION LAB

(2 credits-45Hours)(L-T-P:0-0-4)

1. Implementation of run length encoding
2. Implementation of Lempel-Ziv coding
3. Implementation of Huffman Encoding of a sequence
4. Implementation of Huffman Decoding of a compressed bit sequence.
5. Implementation of RC4 algorithm.
6. Implementation of S-DES algorithm for data encryption
7. Implementation of RSA Algorithm
8. Implementation of SHA
9. Implementation of MD5
10. Implementation of JPEG algorithm.

COURSE / LEARNING OUTCOMES

At the end of this course students will :

- CO 1:** Recognize the different encryption techniques adopted in both traditional and modern cryptographic mechanisms. (Remembering)
- CO 2:** Implement cryptographic algorithms, and their countermeasures. (Understanding)
- CO 3:** Apply fundamental cryptographic approaches in solving related problems. (Applying)
- CO 4:** Analyse the working of the different encryption and compression algorithms. (Analysing)
- CO 5:** Compare and contrast the working of different data encryption and compression mechanisms. (Evaluating)
- CO 6:** Choose appropriate encryption and compression algorithms to build real-world systems. (Creating)

CSMI6081: MINI PROJECT WITH SEMINAR

(2 credits-45Hours)(L-T-P: 0-0-4)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Our vision:

To cultivate nation builders, with scientific and engineering expertise and moral integrity, committed to the upliftment of society.

Our Mission:

To provide young and enthusiastic minds with sound theoretical and practical knowledge in electronics and communication technologies, so that they grow into competent individuals, capable of

- Converting ideas into reality
- Standing up to challenges to lead from the front and provide progressive solutions
- Contributing towards the growth and development of new technologies
- Creating a positive impact on global society, contributing towards the welfare of mankind

Program Educational Objectives, Department of ECE

1. To create highly professional graduates with sound knowledge in the field of Electronics and Communication engineering through quality education.
2. To cater to global technological needs and to contribute to the industry by delivering the expertise acquired, through problem solving and working on need based projects.
3. To groom young minds with a strong sense of commitment towards the betterment of society and the environment.

BTECH (ELECTRONICS & COMMUNICATION ENGINEERING)

Programme Outcomes (PO):

BTECH programme in Electronics & Communication Engineering has been designed to prepare graduates for attaining the following programme outcomes:

- PO1:** Intellectually Competent- Ability to apply the knowledge of engineering fundamentals, Analyse complex electronics and communication engineering problems, research, identify, lead and deliver engineering specializations for innovative solutions of varied complex engineering problems in the real world.
- PO2:** Morally Upright- Right conscience for the cultural, societal and environmental considerations meeting the real world challenges ethically and responsibly.
- PO3:** Socially Committed- Cognitive thinking to assess societal, environment, security, legal and ethical issues and provide novel electronics and communication engineering solutions for socio-economic development of the society.
- PO4:** Spiritually Inspired- Possess personal and professional standard of ethics with a commitment to integrity and honesty pertaining to professional electronics and communication engineering practice.
- PO5:** Civically Responsible- Be responsible members of various social and professional communities with a spirit of working in a team, communicating effectively on complex electronics and communication engineering solutions to society and engineering communities in multi-disciplinary settings.

Programme Specific Outcomes (PSO):

- PSO1:** To apply knowledge of basic sciences (Mathematics, Physics and Chemistry) for Analysing various engineering principles
- PSO2:** To apply knowledge of social, communication and management skills for leading social projects and decision making
- PSO3:** To apply fundamental knowledge of electronics engineering for solving engineering problems
- PSO4:** To design electrical and electronic circuits for conducting experiments
- PSO5:** To Analyse, interpret and troubleshoot electrical and electronic circuits through application of theoretical and practical knowledge
- PSO6:** To design and make electronic circuits through projects, that can solve industrial problems and/or help uplift human life standards
- PSO7:** To predict future trend in technology related to electronics and communication through software analyses
- PSO8:** To contribute through knowledge acquired taking various courses and designing projects to the ever growing field of electronic communication technology
- PSO9:** To collaborate with different fields of science and technology to making innovative designs that could serve human race in various socio - economic fields

MTECH (ELECTRONICS & COMMUNICATION ENGINEERING)

Programme Outcomes (PO):

MTECH programme in Electronics & Communication Engineering has been designed to prepare graduates for attaining the following programme outcomes:

- PO1:** Intellectually Competent- Ability to apply specialized engineering knowledge to Analyse complex electronics and communication engineering problems, research, identify, lead and deliver engineering specializations for innovative solutions of varied complex engineering problems in the real world.
- PO2:** Morally Upright- Right conscience for the cultural, societal and environmental considerations meeting the real world challenges ethically and responsibly.
- PO3:** Socially Committed- Cognitive thinking to assess societal, environment, security, legal and ethical issues and provide novel electronics and communication engineering solutions for socio-economic development of the society.
- PO4:** Spiritually Inspired- Possess personal and professional standard of ethics with a commitment to integrity and honesty pertaining to professional electronics and communication engineering practice.
- PO5:** Civically Responsible- Be responsible members of various social and professional communities with a spirit of working in a team, communicating effectively on complex electronics and communication engineering solutions to society and engineering communities in multi-disciplinary settings.

Programme Specific Outcomes (PSO):

- PSO1:** To hone their basic knowledge for in-depth understanding of advanced courses in specific fields of electronics and communication engineering like communications, signal processing, microprocessors and embedded systems
- PSO2:** To find out various engineering issues associated in specific engineering fields through application of knowledge in scientific ways of research
- PSO3:** To apply the in depth knowledge of specific fields to design projects looking towards solving various issues related to current state of the art technologies
- PSO4:** To apply knowledge of scientific methods of collecting and Analysing data by setting up of experiments related to innovative research projects for addressing issues or upgrading current technologies in specific fields
- PSO5:** To present results acquired through research projects to the engineering and scientific community in a credible manner through reports, presentations, scientific articles and conference papers
- PSO6:** To collaborate with other fields in science and technology for making innovative research designs that could serve human race in various socio - economic fields
- PSO7:** To apply the experience for further research in relevant fields and contribute to the stock of knowledge and innovation in Electronics and Communication Engineering with a multidisciplinary approach

DETAILED SYLLABUS

THEORY COURSES

ECMM0021: MICROPROCESSORS AND MICROCONTROLLERS

(4 credits – 60 hours)

Objectives: *The course helps the student to develop 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.*

Module I (20 hours)

- a) Microprocessor Architecture: History and evolution, types of microprocessors, introduction to microprocessor and microcomputer architecture, block diagram of 8085, Register organization, ALU, control unit, Timing and control module, Pins and signals, Memory Organization, Memory and I/O Addressing
- b) Instruction set and assembly language programming of 8085: Instruction cycle, machine cycles, Instruction set of 8085, Assembly language programming using 8085 instruction set, use of stack and subroutine.

Module II (13 hours)

Interrupts: Interrupt in 8085, RST Instructions, Issues in implementing interrupt, multiple interrupts and priorities, Daisy Chaining, Interrupt handling in 8085, Enabling, Disabling and masking of interrupts, Programming interrupt controller: 8259

Module III (15 hours)

Data Transfer Techniques: Data transfer techniques, Serial I/O using SID, SOD, Parallel Data transfer using 8155, Asynchronous and synchronous data transfer using 8251A, Programming peripheral interface: 8255, Programming DMA controller: 8257; Microprocessor Interfacing techniques: Interfacing memory and I/O devices, interfacing a LED and seven segment displays, interfacing A/D converter, D/A converter, Interfacing and refreshing dynamic RAMs, Interfacing a keyboard

Module IV (12 hours)

Microcontroller (Architecture and Programming): Introduction to 8051 Microcontrollers (Architecture, Pin description), 8051 addressing modes instruction set of 8051, 8051 Assembly level language programming

COURSE / LEARNING OUTCOMES

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

- CO1:** define various terminologies related to microprocessors and microcontrollers (remembering)
- CO2:** explain internal architecture of 8085 microprocessor and 8051 microcontroller (*Understanding*)
- CO3:** apply the concept of microprocessor and microcontroller to solve real life problems using Assembly Language Programming (*Applying*)
- CO4:** Analyse interfacing of microprocessor with IO devices (*Analysing*)

- CO5:** evaluate various microprocessor based system (Evaluating)
CO6: design and develop microprocessor-based systems in both hardware and software (Creating)

Suggested Readings

1. R.S. Gaonkar, Microprocessor Architecture, Programming and Application with 8085, Pengram
2. Mazidi J Gillispie and Mazidi M Ali, The 8051 Microcontroller and Embedded Systems, Pearson
3. P.K. Ghosh and P.R. Sridhar, 0000 to 8085 - Introduction to Microprocessor for Scientists and Engineers, PHI
4. A.V. Deshmukh, Microcontroller, TMH
5. YU-Cheng Liu and Glenn A Gibson, Microprocessor System, Architecture, Programming and Design
6. Barry B Brey, The Intel Microprocessor, Architecture, Programming and interfacing

ECDP0022: DIGITAL SIGNAL PROCESSING

(3 credits – 45 hours)

Objectives: *The course aims at providing a framework to understand various aspects of digital signal processing and will deal with the design methodology of digital FIR and IIR filters along with various signals, discrete time systems and transforms.*

Module I (12 hours)

- a) Discrete time signals: Elementary examples, classification- periodic and aperiodic Signals energy and power signals, Even and odd signals.
- b) Discrete time system : Block diagram representation of discrete time systems, classification of discrete time systems –static and dynamic, time variant and time- invariant, linear and non-linear, casual and anti-casual, stable and unstable.
- c) Analysis and response (convolution sum) of discrete - time linear LTI system, Recursive and non-recursive discrete time system. Constant coefficient differences equations and their solutions, impulse response of LTI system, Structures of LTI systems, Recursive and non-recursive realization of FIR system, Correlation of discrete time Signal.

Module II (11 hours)

- a) The Z-transform and one-sided Z-transform, Properties of Z-transform, inverse of the Z-transform, Solution of difference equations.
- b) The Discrete Fourier Transform- The DFT and IDFT, relationship, DFT with Z-transform, the DFT as a linear transformation, Relationship of DFT with Z-transform, Properties of DFT: periodicity, linearity, summery and time reversal of a sequence.
- c) Circular convolution, Circular correlation, Circular correction by convolution method, Linear convolution by overlap save methods and by overlap add method, Circular convolution and correlation by DFT method, Overlap add and save filtering by DFT method.

Module III (11 hours)

- a) Fast Fourier Transform: Operation counts by direct copulation of DFT, Radix-2 FFT algorithm- Decimation –in-time (DIT) and Decimation In Frequency (DIF) algorithm, Efficient computation DFT of two real sequences, Efficient computation of DFT of a 2 N- pt real sequences.
- b) Design of Digital Filters: Casually and its implication, Design of linear phase FIR filters using different windows. Design of IIR filters- Impulse Invariance method and bilinear transformation method.

Module IV (11 hours)

- a) Implementation of discrete time system structure of FIR systems – Direct form, cascaded form. Structure IIR Systems - Direct form I and II realizations.
- b) Introduction to Digital Signal Processor – characteristics of digital signal processor.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define and outline the fundamental concepts of Digital Signal Processing (Remembering)
- CO2:** Define the different types of digital signals and digital systems. (*Remembering*)
- CO3:** Define and outline the fundamental concepts related to different transform technique for digital signals and systems. (Remembering)
- CO4:** Describe and classify the different types of Digital signal and systems. (Understanding)
- CO5:** Explain the different types of digitals filters and their mathematical models. (Understanding)
- CO6:** Design various digital systems such as digital filters, etc., and applying the same in fields like Communication, VLSI etc. (Applying)
- CO7:** Classify and Analyse various digital signal transform and filtering techniques. (Analysing)
- CO8:** Evaluate the performance of different transform schemes for digital signals (Evaluating)
- CO9:** Evaluate the various types of filtering techniques and compare their performances for various types of applications (Evaluating)
- CO10:** Simulate different digital signals and LTIC digital systems (Creating)

Suggested Readings

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Pearson.
2. SK Mitra, Digital Signal Processing, Pearson
3. P Ramesh Babu, Digital Signal Processing, SciTech
4. S. Salivahanan, Digital Signal Processing, TMH
5. J. R. Johnson, Introduction of Digital Signal Processing, PHI.
6. Emmanuel C Ifeachor and Barrie W. Jervis, Digital Signal Processing: A Practical Approach, Pearson Education.

ECAC0023: ANALOG COMMUNICATION TECHNIQUES

(4 credits – 60 hours)

Objectives: *This course is intended to make the student understand the basic concepts of analog communication systems covering basic Fourier techniques and the use of these techniques in the analysis and design of communication systems. The subject covers time domain and frequency domain analysis of amplitude modulation (AM), frequency modulation (FM) and concept of noise.*

Module I (7 hours)

- a) Introduction - Communication process, sources of information, communication channels; Modulation- types and need, block diagram of communication system
- b) Energy and power signals Parseval's Theorem: Power spectral density and Energy spectral density, correlation between waveforms: Auto and cross correlation

Module II (25 hours)

- a) Amplitude modulation: Introduction, Double side band suppressed carrier modulation (DSB-SC): Introduction, Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves.
- b) Double side band with carrier modulation (DSB-AM): Introduction Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector; Quadrature Amplitude Modulation (QAM)
- c) Single Side band suppressed carrier modulation (SSB-SC): Introduction, Hilbert transform, properties of Hilbert transform, Convolution, Time-Domain description, Frequency-Domain representation, Generation of SSBSC waves: Phase discrimination method, Frequency discrimination method; Detection of SSB-SC waves: Coherent detection, carrier re-insertion method
- d) Vestigle Side Band modulation (VSB): Introduction, Time-Domain description, Frequency-Domain representation, Generation of VSB waves: Phase discrimination method; Detection of VSB waves: Coherent detection.
- e) AM transmitters: Low level and high level modulation, AM receivers: TRF receivers, Superheterodyne receivers

Module III (15 hours)

- a) Angle modulation: General form of angle modulation, types of angle modulation, Frequency Modulation, Single and multi-tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, Bessel's function, Wide band FM, Transmission bandwidth of FM wave, Generation of FM Waves: Direct and Indirect methods, pre-emphasis and de-emphasis Filters, Demodulation of FM waves using PLL- FM demodulator, Comparison of AM and FM, Frequency Division Multiplexing.
- b) Introduction to Pulse modulation

Module IV (13 hours)

Noise: Internal and External Noise and their different types, noise in cascaded amplifiers, Signal to Noise ratio, Noise figure, Noise figure from equivalent noise resistance, Noise Temperature, Noise figure for cascaded amplifiers, Equivalent circuit of a noisy resistor, Power of a thermal noise voltage, Noise power density in RLC circuit. Noise in AM and FM systems.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the basic concepts & terminologies related to analog modulation schemes. (Remembering)
- CO2:** Label the components of analog communication system (*Remembering*)
- CO3:** Explain the different characteristics of transmitter and receiver (*Understanding*)
- CO4:** Explain the working and operation of the various components of analog communication system (*Understanding*)
- CO5:** Solve problems related to the computation of bandwidth, power requirements and other vital parameters related to analog communication systems. (*Applying*)
- CO6:** Analyse various methods of baseband & band-pass analog transmission and detection related to AM, FM and PM. (*Analysing*)

- CO7:** Analyse different characteristics of transmitter and receiver in analog communication. (*Analysing*)
- CO8:** Analyse energy and power spectral density of the signal. (*Analysing*)
- CO9:** Assess the understanding about designing of analog communication systems (*Evaluating*)
- CO10:** Design different analog communication based systems for AM & FM (*Creating*)

Suggested Readings

1. R.P. Singh and S.D. Sapre, Communication Systems Analog and Digital, Tata McGraw Hill
2. P. Chakrabarti, Analog Communication Systems, Dhanpat Rai and Co.
3. Chandra Sekar, Analog Communication, Oxford.
4. B.P. Lathi, Modern Digital and Analogue Communication Systems, Oxford University Press.
5. Taub and Schilling, Principles of Communication Systems, TMH.
6. Simon Haykin, Communication Systems, John Wiley and Sons.
7. Leon W. Couch, Digital and Analog Communication Systems, Pearson Education Pvt. Ltd.

ECME0024: MICROWAVE ENGINEERING

(3 credits – 45 hours)

Objectives: *The course provides an introduction to microwave theory and techniques, including network theory, transmission lines, passive devices and active devices. The course also describes the microwave sources, propagation and measurement.*

Module I (13 hours)

High Frequency Transmission lines and Wave guides: The Distributed Circuit model for a Transmission line. Wave propagation. The lossless line. Field Analysis of Co-ax Transmission Lines. R, L, C, G parameters of Co-ax and Two wire Transmission Lines. Terminated lossless transmission line. Transmission line as circuit element. The Smith Chart. Solution of Transmission line problems using Smith Chart. Single Stub and Double Stub matching. Lowloss line.

Module II (10 hours)

Wave guides: Rectangular waveguide, Field solution for TE and TM modes, Field patterns power flow through waveguide. Attenuation due to conductor and dielectric losses. Design of Rectangular waveguide to support Dominant TE₁₀ mode Cylindrical waveguide - Dominant Mode. Design of Cylindrical Waveguide to support Dominant TE₁₁ mode. TEM mode in Co-ax line.

Module III (8 hours)

- a) Microwave Resonator: Rectangular Waveguide Cavities. Resonant frequencies and of Cavity Supporting. Dominant mode only. Excitation of waveguide and Resonators.
- b) Waveguide Components: Introduction and basic Properties of Power Dividers (All types of Tee junctions), N-port microwave network, scattering parameters (S – parameters), Directional Couplers, Isolators and Circulators

Module IV (14 hours)

Microwave Sources: Transferred Electron Devices: Introduction and principle of operation of Gunn Diode, Gunn Oscillator Principle and performance Simple Analysis Electron – field interaction. Avalanche Transit Time Devices: Introduction and principle of operation of IMPATT and TRAPATT Diodes. Reflex Klystron oscillator: Velocity Modulation. Electronic Admittance. Power Output

and Frequency vs Reflector Voltage. Square-wave modulation; Multicavity Magnetron: Principle of Operation, Rotating Field. II-mode of Operation, Frequency of Oscillation. The Ordinary type (O-Type) Traveling wave Tube - Constructional features, Principle of Operation as an amplifier; Mixer: Linear Mixer Operation.

COURSE / LEARNING OUTCOMES

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

- CO1:** define the basics of microwave engineering; the different frequency bands, advantages and applications (Remembering)
- CO2:** define the fundamentals of transmission line theory and waveguide theory (Remembering)
- CO3:** explain different measurement parameters and performance of waveguides and resonators (understanding)
- CO4:** apply the knowledge of transmission line and waveguide theory to compute measurement parameters and solve related problems. (Applying)
- CO5:** Analyse different parameters like standing wave, reflection coefficient, and impedance, etc. using Smith chart. (Analysing)
- CO6:** Analyse microwave circuits using scattering matrix. (Analysing)
- CO7:** compare the basic theories in understanding the working of both passive and active microwave components and devices (Evaluating)
- CO8:** Able to test and estimate the performance /parameters/ behavior of a microwave system in Laboratory (Creating)

Suggested Readings

1. D. M. Pozor, Microwave Engineering, John Willy and Sons.
2. Herbert J. Reich, J.G. Skalnik, P.F. Ordnung and H.L. Krauss, Principles of Microwave Engineering, CBS.
3. Samuel Y., Liao, Microwave Device and Circuit, 3rd Edition, Perason
4. R.E. Collin, Foundations for Microwave Engineering, IEEE Press, John Wiley.

ECAP0026: ANTENNA AND WAVE PROPAGATION

(3 credits – 45 hours)

Objectives: This subject is aimed at providing basic knowledge on the theory of radiation of antenna, types of antenna and propagation characteristics and their applications in communication engineering.

Module I (11 hours)

- a) Physical concept of radiation in single wire, two wire, and dipole, Current distribution on a thin wire antenna.
- b) Fundamental Parameters of Antenna: Radiation pattern, Radiation Power Density, Radiation intensity, Directivity, Gain, Antenna efficiency, Beamwidth, Bandwidth, Polarisation, Antenna Input Impedance, Elementary idea about self and mutual impedance, Radiation efficiency, Effective aperture, Antenna Temperature.
- c) Linear Wire Antennas: Retarded potential, Infinitesimal dipole, Current distribution of short dipole and half wave dipole, Far-field, Radiating near-field and reactive near-field region, Monopole and Half wave dipole.

Module II (15 hours)

- a) Antenna Arrays: Array of two point sources, Array factor, n-element linear array with uniform amplitude and spacing, Analysis of Broadside array, Ordinary end-fire array, n- element linear array with non-uniform spacing, Analysis of Binomial and Dolph- Tschebyscheff array, Scanning Array, Superdirective array; Yagi Uda antenna, Loop antenna.
- b) Aperture Antennas: Field Equivalence principle, Rectangular and circular aperture antennas, Slot Antenna, Horn antenna, Paraboloid Reflector antenna – Simple Analysis, Types, Radiation Pattern, Gain and Bandwidth measurement of the given antennas.
- c) Microwave Measurement: Measurement of Admittance. Measurement of Gain of a Horn Antenna

Module III (10 hours)

Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, input impedance of rectangular and circular patch antenna. Microstrip array and feed network; Application of microstrip array antennas. Smart Antennas: Concept and benefits; Fixed weight beamforming basics, Adaptive beamforming. Basics of UWB antennas.

Module IV (9 hours)

Ground wave Propagation: Friis Free space equation, Reflection from earth's surface, Surface and Space wave propagation for vertical and horizontal dipole, Field strength of Space wave, Range of space wave propagation, Effective earth's radius. Ionospheric Propagation: Structure of ionosphere, propagation of radio waves through ionosphere , Critical frequency, Maximum usable frequency, Optimum working frequency, lowest usable high frequency, virtual height, Skip Distance, Effect of earth's magnetic field. Microwave Propagation: Line of sight propagation. Attenuation of Microwaves by Atmospheric gases, Water Vapour and Precipitates.

COURSE / LEARNING OUTCOMES

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

- CO1:** define basic function of an antenna and its parameters (Remembering)
- CO2:** classify different antenna types and arrays (understanding)
- CO3:** explain the physical and mathematical concept of radiation from different antennas and arrays (understanding)
- CO4:** apply the mathematical knowledge to compute and sketch radiation characteristics of different antennas and arrays (Applying)
- CO5:** Analyse behavior of different wire antennas, aperture antennas and linear antenna arrays. (Analysing)
- CO6:** evaluate the behavior of nature on radio wave propagation (Evaluating)
- CO7:** formulate mathematical relations and design linear arrays (Creating)

Suggested Readings

1. C.A. Balanis, Antenna Theory, John Wiley and sons.
2. J.D. Krauss, Antenna Theory, McGraw Hill.
3. K.D.Prasad, Antenna and Wave Propagation, Satya Prakashan.
4. E.C. Jordan, Electromagnetics and radiating systems, PHI.
5. R.E. Collins, Antenna and radio wave propagation, McGraw Hill.
6. M Sachidananda, AR Harish, Antennas and Wave Propagation, Oxford University Press, 2007.

ECVD0027: VLSI DESIGN**(4 Credits – 60 hours)**

Objectives: *The objective of this course is to deal with the study of the technology and building blocks of integrated circuits including salient features of digital circuits, structured systems and design automation in the field of VLSI. The scope of this course includes an introduction to practical considerations and design of integrated circuits.*

Module I (15 hours)

Introduction, Historical perspective, Introduction to IC Fabrication Techniques, VLSI design methodologies, VLSI design flow, Design hierarchy, Design Style. Introduction to CAD technology. The Bipolar Technology, Fabrication of BJT. Fabrication of MOSFETS, NMOS fabrication, CMOS n-well process. MOS Transistor, MOS transistor under external bias, Structure and Operation of MOSFET (Threshold Voltage), MOSFET V-I Characteristics (Gradual Channel Approximation, Channel Length Modulation, Substrate bias effect and Measurement of Parameters), MOSFET scaling and small geometry effects. MOSFET capacitances (Oxide Related Capacitance and Junction Capacitance). Modeling of MOS Transistors- Basic concept the SPICE level-1 models, the level –2 and level –3 model equations.

Module II (15 hours)

MOS Inverters: Static characteristics- voltage transfer characteristics, Noise Immunity and Noise Margins, Power and Area Considerations, Speed of operation, Inverters with resistive load and with n-type MOSFET load, CMOS inverter and characteristics. Switching characteristics and interconnect effects: Delay time definitions and calculation, inverter design with delay constraints, estimation of parasitic switching power dissipation of CMOS inverters.

Module III (15 hours)

- a) Combinational MOS logic circuits, CMOS logic circuits, state style, Complex logic circuits, pass transistor logic, Sequential logic circuit – introduction, SR latch, clocked latch and flip-flop circuits, CMOS D latch and edge triggered flip-flop. Design considerations (Layer Representation), Design Style (Stick Diagrams), Design Rules.
- b) Dynamics logic circuits: Dynamic logic, basic principles, high performance dynamics CMOS circuits, Dynamic RAM, SRAM, flash memory.

Module IV (15 hours)

- a) Systems design method, Design strategies, combinational and Sequential module, ROM implementation, PLDs, PLA, PAL, Sequential System design, State Machines (Mealy Circuit and Moore Circuit) Concept of FPGA, Standard cell based design, Design capture tools, Hardware definition languages such as VHDL and packages. Xilinx (introduction),
- b) Introduction to IRSIM and GOSPL (open source packages), Design verification and testing, Simulation at various levels including timing verification, Faults models. Design strategies for testing chip level and system level test techniques.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define VLSI design Methodologies. (Remembering)
- CO2:** Identify and recognize Fabrication steps of transistors (BJT and MOSFET), Stick Diagram, Static and Switching characteristics of inverters. (Remembering)

- CO3:** Define Digital circuits and building blocks of integrated circuits. (Remembering)
- CO4:** Understand the static and dynamic behavior of MOSFETs and the secondary effects of the MOS transistor model. (Understanding)
- CO5:** Explain the concepts of MOS Technology and its operation in depletion and enhancement modes, basic concepts of combinational MOS logic circuits and Dynamic logic circuits, concepts of programmable logic devices, state machines and Field Programmable Gate Array (FPGA). (Understanding)
- CO6:** Identify CMOS fabrication flow and technology scaling. (Applying)
- CO7:** Construct MOSFET based logic circuit. (Applying)
- CO8:** Analyse and model the MOS transistor circuit, down to physical level. (Analysing)
- CO9:** Analyse various CMOS subsystems at gate level and transistor level. (Analysing)
- CO10:** Evaluate the performance of MOSFET for different designs. (Evaluating)
- CO11:** Compare the design methodologies of various type of PLDs. (Evaluating)
- CO12:** Design MOS inverter for different loads. (Creating)
- CO13:** Implement designs using various programmable devices. (Creating)

Suggested Readings

1. S.M. Kang and Y. Leblebici, CMOS Digital integrated Circuits: Analysis and Design, TMH.
2. Perry, VHDL Programming by Example, TMH.
3. Rabeyet. al, Digital Integrated Circuits: A Design Perspective, Pearson.
4. R.A. Geiger, P.E. Allen et al, VLSI Design Techniques for Analog and Digital Circuits, McGraw Hill.

ECCT0028: DIGITAL COMMUNICATION TECHNIQUES

(4 credits – 60 hours)

Objectives: *This course is aimed at introducing to the student the fundamentals of the theory of Communication, in particular of Digital Communication. The course will provide in-depth knowledge of communication fundamentals, which include probability, random variables, stochastic processes, digital signals and their characteristics, baseband and bandpass digital communications, performance of digital transmission in the presence of noise and optimum detection of digital signals and performance measures.*

Module I (14 hours)

- a) Sampling theorem, Signal reconstruction, Practical difficulties. The treachery of aliasing, The antialiasing filter, Discrete Fourier Transform, Application of sampling theorem: PAM, PWM and PPM signals.
- b) Pulse Code Modulation: Quantization of Signals, Quantization error. Non-uniform quantization. The Compander, The encoder, Transmission bandwidth and output SNR, AT1 carrier system:
- c) Synchronizing and Signaling, Differential PCM, Delta modulation, Adaptive Delta modulation, Output SNR, Comparison with PCM.

Module II (14 hours)

- a) Digital modulation techniques: Generation, Transmission, Reception, Spectrum and Geometrical representation in the signal space of BPSK, DPSK, Differentially-encoded PSK, QPSK, $\pi/4$ QPSK, M-ary PSK, BFSK, M-ary FSK, and Minimum Shifting Keying (MSK).
- b) Introduction to BOC modulation
- c) Noise in PCM and DM: Calculation of quantization noise power, Output signal power, and the thermal noise power.

- d) Output SNR of PCM using different modulation techniques. Output SNR of DM.

Module III (16 hours)

- a) Principles of digital data transmission: A digital communication system. Line coding- Various line codes. Polar signaling ON-OFF. Signaling, Bipolar signaling. Pulse shaping; Scrambling. Regenerative repeater – Preamplifier, Equalizer. Eye diagram. A baseband signal receiver. Peak signal to RMS Noise output voltage ratio, Probability of error. The optimum filter.
- b) White Noise: The matched filter- probability of error of the matched filter coherent reception. Application to phase shift keying Quadrature Phase PSK (QPSK). Use of signal space to calculate P_e . Error probability calculation for BPSK and BFSK.

Module IV (16 hours)

The concept of amount of information, Average information, Entropy- Shannon-Fano algorithm, Shannon's Theorem- channel capacity, Bandwidth - S/ N trade-off, Use of orthogonal signals to attain Shannon's limit, Efficiency of orthogonal signal transmission, Coding- Parity Checkbit coding for error detection, Hamming distance, Upper bounds of probability of error with coding, Block codes - Coding and decoding algebraic codes: Hadamard code, Hamming code, Convolutional coding, Reed Solomon coding , Turbo Coding - Code generation and Decoding. Concept of Low power communication (Green Communication), Spread spectrum modulation, Definition, PN sequence – Generation and Detection, Concept of Low power communication (Green Communication).

COURSE / LEARNING OUTCOMES

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

- CO1:** define various techniques to convert an analog signal into digital signal along with various digital modulation techniques. (Remembering)
- CO2:** define transmitters and receivers of various digital communication techniques. (Remembering)
- CO3:** define optimum filter as well as various source and channel coding techniques used in signal transmission. (Remembering)
- CO4:** explain various techniques to convert an analog signal into digital signal with mathematical justifications. (Understanding)
- CO5:** explain various digital modulation techniques as well as transmitters and receivers of various digital communication systems and their pros and cons. (Understanding)
- CO6:** able to explain optimum filter used in signal transmission. (Understanding)
- CO7:** explain various source and channel coding techniques used in digital communication systems. (Understanding)
- CO8:** develop various techniques to convert an analog signal into digital signal using software tools like MATLAB. (Applying)
- CO9:** develop various digital modulation techniques using software tools like MATLAB. (Applying)
- CO10:** Analyse the difference between various techniques to convert an analog signal into digital signal with mathematical justifications. (Analysing)
- CO11:** Analyse various digital modulation techniques and their pros and cons. (Analysing)
- CO12:** Analyse the optimum filter used in signal transmission. (Analysing)
- CO13:** Analyse the difference between various source and channel coding techniques used in digital communication systems. (Analysing)

- CO14:** select a suitable technique to convert an analog signal into digital signal. (Evaluating)
- CO15:** select on digital modulation technique to be performed for a given situation. (Evaluating)
- CO16:** select a necessary source and channel coding technique for a specific condition. (Evaluating)
- CO17:** discuss various techniques to convert an analog signal into digital signal. (Creating)
- CO18:** discuss various digital modulation techniques. (Creating)
- CO19:** discuss transmitters and receivers of various digital communication techniques. (Creating)
- CO20:** discuss various source and channel coding techniques. (Creating)

Suggested Readings

1. Simon Haykin, Communication Systems, John Wiley and Sons.
2. Taub and Schilling, Principles of Communication Systems, Tata Mc Graw Hill.
3. Leon W. Couch-II, Digital and Analogue Communication System, Pearson.
4. B.P. Lathi, Modern Digital and Analogue Communication Systems, OUP.

ECAM0029: ADVANCED MICROPROCESSORS AND EMBEDDED SYSTEMS

(3 credits – 45 hours)

Objectives: *The objective of the course is to expose the students to the features of advanced microprocessors like 8086, 80386, and Pentium processors and to introduce the architecture, programming, and interfacing of the microcontroller 8051.*

Module I (11 hours)

- a) Some general concept related to higher level processor: pipelining, memory management (physical memory, virtual memory), mode of operation (real and protected), descriptor tables, memory segmentation, paging, super scalar technology
- b) Intel 8086 (16 bit): Introduction: pins and signal description, Architecture, Bus timing, minimum mode 8086, maximum mode 8086. Multiprocessor: parallel processing; Instruction sets of 8086: Instruction formats, Addressing modes, Instruction set: Data transfer Instruction, Arithmetic and logic instruction and program control instructions. Assembly language program, iterative procedure, recursive procedure, parameter passing, 8086-memory interface. Memory management; 8086 Interrupts, 8087 Math coprocessor.

Module II (13 hours)

Intel 80286 Microprocessor: pins and signal description, Architecture, memory management and protection, memory and I/O device Interface; The 80386 and 80486

Microprocessor (32 bits): Introduction to 80386 Microprocessor, 80386 Registers, Memory management, protected mode of operation, paging technique, virtual 8086 mode, Brief introduction to 80387 co processor, Introduction to 80486 Microprocessor.

Module III (11 hours)

The Pentium Microprocessor (64 bit): Introduction to Pentium processor, system architecture, memory system, I/O system, branch prediction logic, Floating-point module, cache structure, super scalar architecture, Introduction to Pentium II processor, Pentium III and Pentium 4.

Module IV (10 hours)

Embedded systems: 8051 interrupt, I/O port programming, interfacing to 8255, 8051 Interfacing with 8255, 8051 Interfacing with External ROM, Interfacing ADC and DAC to 8051, Interfacing a stepper motor with 8051, Introduction to 16-bit microcontroller

COURSE / LEARNING OUTCOMES

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

- CO1:** define the internal organization of some popular microprocessors (8086, 80286, 80386, 80486, 80586) and microcontrollers (8051 and 8096) (Remembering)
- CO2:** explain features and architecture of different microprocessors (8086, 80286, 80386, 80486, 80586) and microcontrollers (8051 and 8096) (Understanding)
- CO3:** apply the knowledge of programming to solve various problems by writing programs of 8086 and 8051 (Applying)
- CO4:** compare the performance of pipe-lining (8086) and non-pipe-lining (8085) architecture microprocessor (Analysing)
- CO5:** conclude the evolution of microprocessors and microcontrollers (Evaluating)
- CO6:** estimate the performance various microprocessors and microcontrollers (Creating)

Suggested Readings

1. Barry B. Brey, The Intel Microprocessor (Architecture, programming and interfacing), Pearson.
2. Douglas V. Hall, Microprocessor and Interfacing, TMH.
3. M. A. Mazidi, J. Mazidi J. G. Mazidi, The 8051 Micro controller and Embedded systems, Pearson.
4. A.K.Roy and K.M. Bhurchandi, Advanced Microprocessor and peripherals (Architecture, programming and interfacing), TMH.

ECFS0031: FIBER OPTIC AND SATELLITE COMMUNICATION**(4 credits – 60 hours)**

Objectives: This course aims at providing a comprehensive introduction to communication systems which include fiber-optic communication technology, satellite communication and multiple access. The course is designed for the students to develop a good understanding of the physical aspect of the technology necessary for them to evaluate and design communication systems.

Module I: Introduction (20 hours)

Block diagram of optical fiber communication system, Advantages of optical fiber communication; Optical fiber waveguides: structure of optical wave guide, light propagation in optical fiber using ray theory, acceptance angle, numerical aperture, skew rays, wave theory for optical propagation, modes in a planar and cylindrical guide, mode volume, single mode fibers, cutoff wavelength, mode field diameter, effective refractive index and group and mode delay factor for single mode fiber. Transmission Characteristics of Optical fiber, Attenuation in optical fibers, intrinsic and extrinsic absorption, linear and nonlinear scattering losses, fiber bend losses; Dispersion and pulse broadening, intramodal and intermodal dispersion for step and graded index fibers, modal noise, over all fiber dispersion for multimode and monomode fiber, dispersion shifted fibers, modal birefringence and polarization maintaining fibers

Module II: Optical Sources (22 hours)

LED, Typical GaAIAs p-n junction double heterostructure, Fabrication of LEDs; Typical Spectral pattern, Modulation of an LED, Laser diodes: Principle of Operation, Typical Constructional features

Radiation Pattern, Modulation Laser diode, Typical Manufactures specifications of LED and LASER, Power Launching and Coupling; Source to fiber power launching, Coupling Power Calculation, Lensing Scheme for improvement of coupling. Fiber-to-fiber Connectors loss. Techniques of Splicing, Splicing loss; Photo Detectors: p-n, PIN and APD Photodetectors, Responsivity and Bandwidth of diodes. Noise in PDs. Equivalent Circuits. SNR. Optical amplifiers; Optical Receiver: Receiver Configuration Sensitivity and Bandwidth of Receiver Bit Error Rate. Optical fiber communication systems: Principal components of an optical fiber communication system, source laminations, optical transmitter circuits, LED and laser drive circuits, optical receiver block diagram, Direct Intercity and sub-carrier intensity modulation using AM, FM and PM.

Module III: Orbital Mechanics (10 hours)

Determination of Orbital Parameters, look angle of a geostationary Satellite from Earth. Launches and Launch Vehicle, Placing Satellite into Geo-stationary Orbit; Satellite Subsystems: A brief Description of AOCS, TTC and M and Power System. Description of Communication System – Transponders; Satellite Antennas: Basic Antennas Types and Relationship; Satellite Link: Basic Transmission Theory, System Noise Temperature and G/T Ratio; G/T Ratio for Earth station.

Module IV: Impactor Satellite: Earth Links (8 hours)

Attenuation, Depolarization, Ionospheric and Tropospheric effects; multiple access: Comprehensive study on FDMA, TDMA and CDMA, Spread Spectrum Transmission and Reception. Introduction to BOC modulation.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the fundamental concepts of light transmission through a dielectric media. (*Remembering*)
- CO2:** List the different types of optical fibers and other components of Fiber Optic Communication such as optical sources, detectors, optical amplifiers and connectors, etc. (*Remembering*)
- CO3:** Define the basic laws, terminologies and orbital parameters related to satellite communication (*Remembering*)
- CO4:** Explain the mechanism and contributing factors of fiber attenuation/dispersion and other transmission characteristics. (*Understanding*)
- CO5:** Describe the photoemission, detection and amplification process (*Understanding*)
- CO6:** Explain the elements of satellite communication, describe the types of satellite, satellite orbits, orbital parameters and the process of launching them in orbits. (*Understanding*)
- CO7:** Illustrate the propagation effects of atmosphere on performance of typical satellite communication. (*Understanding*)
- CO8:** Explain the subsystems of a satellite communication. (*Understanding*)
- CO9:** Describe the various multiple access techniques. (*Understanding*)
- CO10:** Solve problems related to optical fiber and fiber optics link design. (*Application*)
- CO11:** Analyse parameters of satellite link design (*Analysing*)
- CO12:** Classify and Analyse optical fibers in terms of their operating characteristics and material composition. (*Analysing*)

- CO13:** Evaluate the performance of Fiber optic link based on the nature and performance characteristics and assess their importance in design of optical receivers (*Evaluating*)
- CO14:** Compare the various types of multiple access techniques and assess their importance in satellite communication (*Evaluating*)
- CO15:** Design a fiber optic Communication link and Satellite Communication link (*Creating*)

Suggested Readings

1. Djafar K. Mynbaev, Fibre-Optics Communications Technology, Pearson Education.
2. J.M.S. Senior, Optical fiber Communication, PHI.
3. G. Keiser, Optical Fiber Communication, McGraw Hill.
4. R.N. Mutagi, Satellite Communications- Principles and Applications., Oxford University Press
5. T. Pratt, C. Bostian and J. Allnutt, Satellite Communication, John Wiley Co.
6. H. Kolimbins, Digital Communication with Satellite and Fiber optic Application, PHI.
7. W. Tomasi, Advanced Electronic Communication System, Pearson Education.

ECTS0032: TELECOMMUNICATION SWITCHING AND SYSTEMS

(4 credits – 60 hours)

Objectives: *The objective of the course is to provide modern evaluation and implementation procedures in the area of telecommunication services and networks which will help the students to model and design telecommunication/data networks using up-to-date techniques. Various telecommunication and data networking concepts including signaling techniques, public switched data networks, ISDN and DSL are introduced.*

Module I: Telecommunication switching systems (20 hours)

Introduction, Elements of switching systems, switching network configuration, principles of cross bar switching. Electronic space division switching, Time division switching, Combination switching.

Module II: Telephone networks (15 hours)

Subscriber loop systems, switching hierarchy and routing, transmission plan, numbering plan, charging plans. Signaling techniques: In channel signaling, common channel signaling. Network traffic load and parameters, grade of service and blocking probability.

Module III: Data communication networks (15 hours)

Introduction, network architecture, layered network architecture, protocols, data communications hardware, data communication circuits. Public switched data networks, connection oriented and connectionless service, Circuit Switching, packet switching and virtual circuit switching concepts, OSI reference model, LAN, WAN, MAN and Internet. Repeaters, Bridges, Routers and gateways.

Module IV: Integrated services digital network (ISDN) (10 hours)

Introduction, motivation, ISDN architecture, ISDN interfaces, functional grouping, reference points, protocol architecture, signaling, numbering, addressing, BISDN. DSL Technology: ADSL, Cable Modem, Traditional Cable Networks, HFC Networks, Sharing, CM and CMTS and DOCSIS. SONET: Devices, Frame, Frame Transmission, Synchronous Transport Signals, STS I, Virtual Tributaries and Higher rate of service.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define different switching systems and switching network configuration. (Remembering)
- CO2:** Recall and recognize the signaling techniques involved in telephone networks. (Remembering)
- CO3:** List different data network components like repeaters, bridges, routers and gateways. (Remembering)
- CO4:** Explain and compare between telephone, data communication and integrated services digital network. (Understanding)
- CO5:** Illustrate the concepts of circuit and packet switching techniques. (Understanding)
- CO6:** Explain different network topologies. (Understanding)
- CO7:** Choose appropriate elements for telephone and data communication networks. (Applying)
- CO8:** Utilize the signaling, numbering and addressing schemes involved in telephone and ISDN networks. (Applying)
- CO9:** Compare and contrast the data communication network architecture and ISDN architecture. (Analysing)
- CO10:** Evaluate and assess the performance of telephone networks. (Evaluating)
- CO11:** Elaborate and combine the different components involved in telephone, data communication and ISDN networks (Creating)

Suggested Readings

1. T. Viswanath, Tele communication switching system and networks, PHI.
2. W. Tomasi, Advanced electronic communications systems, PHI.
3. J E Flood, Telecommunication switching, Traffic and Networks, Pearson Education.
4. B.A. Forouzan, Data Communication and Networking, TMH.

ECIP0033: DIGITAL IMAGE PROCESSING

(4 credits – 60 hours)

Objectives: This course's objectives are to introduce the students to the fundamentals of digital image processing, Analyse operations on images such as image enhancement, image restoration, Image Segmentation, image compression, colour Image Processing etc. The students would be encouraged to develop the image processing tools from scratch, rather than using any image processing library functions.

Module I (17 hours)

Different stages of Image processing, Components of Image Processing System. Elements of visual perception, 2D Fourier Transform and properties; Image Digitization: A review of Sampling and quantization processes, Image transforms: Unitary and orthogonal transforms, 2D DFT, Discrete cosine transform (DCT) and properties, 2D DCT, Discrete Wavelet Transform, KL transform.

Module II (15 hours)

Some basic relationship between pixels: Neighbour of pixels, Adjacency, Connectivity, Regions, Boundaries, and Distance Measures. Intensity Transforms: Image Negatives, Log Transform, Power Law Transformation, Piecewise linear Transformation function, Histogram Processing,

Fundamentals of Spatial Filtering: Mechanics of spatial Filtering,

2D linear systems, Spatial Correlation and Convolution, Spatial Filter Mask, Smoothing Filtering Mask, Sharpening Filtering Mask. Salt and pepper noise and median filters; Filtering in Frequency domain.

Module III (13 hours)

Image Restoration: A model of image degradation, Estimation of degradation function, Inverse Filtering, Minimum Mean – Square Error Restoration, Image Compression: Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Schematic diagram of Data Compression Procedure, Lossless and Lossy compression, Huffman coding, transform coding; Morphological Image Processing: Dilation, Erosion, Combining Dilation and Erosion, The Hit or Miss Transformation.

Module IV (15 hours)

Image Segmentation: Point Detection, Line Detection, Edge Detection, Thresholding and Region Growing based Segmentation.

Colour Image Processing: Colour Fundamentals, RGB, HSV, CMY colour model, Basic of Colour Image Processing, Intensity Colour Slicing. Intensity to colour Transformation. Multi-resolution Image Processing.

COURSE / LEARNING OUTCOMES

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

- CO1:** define various types of images, various image operations such as image filtering, image segmentation, image enhancement, image restoration, image compression etc. (Remembering)
- CO2:** define various 2D mathematical operations as well as define basic relationship between pixels. (Remembering)
- CO3:** define various operations of morphological image processing as well as various colour image processing techniques. (Remembering)
- CO4:** explain various types of images, various image operations such as image filtering, image segmentation, image enhancement, image restoration, image compression etc. (Understanding)
- CO5:** explain various 2D mathematical operations as well as basic relationship between pixels. (Understanding)
- CO6:** explain various operations of morphological image processing. (Understanding)
- CO7:** explain various colour image processing techniques. (Understanding)
- CO8:** apply various types of images, various image operations such as image filtering, image segmentation, image enhancement, etc. and various 2D mathematical operations using MATLAB. (Applying)
- CO9:** apply basic relationship between pixels and select various operations of morphological image processing using MATLAB. (Applying)
- CO10:** Analyse various types of images, various image operations such as image filtering, image segmentation, image enhancement, image restoration, image compression etc. (Analysing)
- CO11:** Analyse various 2D mathematical operations and basic relationship between pixels. (Analysing)
- CO12:** Analyse various operations of morphological image processing. (Analysing)
- CO13:** Analyse various colour image processing techniques. (Analysing)

- CO14:** select a suitable operation for image filtering, image segmentation, image enhancement, image restoration, image compression etc. (Evaluating)
- CO15:** pick a 2D mathematical operation or select a basic relationship between pixels suitable for specific condition. (Evaluating)
- CO16:** select an operation of morphological image processing for a given situation. (Evaluating)
- CO17:** develop various types of images, various image operations such as image filtering, image segmentation, image enhancement, image restoration, image compression etc. (Creating)
- CO18:** review develop 2D mathematical operations as well as basic relationship between pixels. (Creating)
- CO19:** develop various operations of morphological image processing. (Creating)
- CO20:** develop colour image processing techniques. (Creating)

Suggested Readings

1. R.C.Gonzalez and R.E.Woods, Digital Image Processing, Pearson.
2. K. Jain, Fundamentals of Digital Image Processing, Pearson.
3. B.Chanda and D.Dutt Majumdar, Digital Image Processing and Analysis, PHI.

ECME0034: MICROELECTRONICS

(4 credits – 60 hours)

Objectives: This course introduces basic semiconductor material and semiconductor junction properties. It also introduces basic processes used in fabricating semiconductor devices and integrated circuits. The objective is to develop the background knowledge necessary to understand semiconductor physics and state-of-the-art semiconductor technology related to device fabrication processes. Knowledge on semiconductor devices is a pre-requisite.

Module I: Semiconductor Crystals (7 hours)

Semiconductor material types – crystalline, amorphous and polycrystalline; Crystal structure – lattice and unit cells, Cubic lattices – SCC, BCC, FCC structures, lattice constants, Planes and directions, Miller indices.

Module II: Quantum Theory (8 hours)

The photoelectric effect, Atomic spectra, Probability and uncertainty principle Schrodinger wave equation, potential well problem, quantum effect and quantum tunneling; Pauli exclusion principle.

Module III: Band Theory (15 hours)

Energy bands in solids, electron wave function, wave vector, (E, k) diagram, direct and indirect semiconductors, Effective mass, density of states, Fermi-Dirac distribution, carrier concentration; optical absorption, photoluminescence, cathodoluminescence, electroluminescence; Direct and indirect recombination, trapping, quasi-fermi levels, Diffusion and drift in carriers, diffusion length, contact potential, junction space charge, minority and majority carrier currents, Stored charges and time variation, reverse recovery, Junction capacitance, graded junctions, metal-semiconductor junctions, hetero-junctions.

Module IV: Semiconductor Processing Technology (10 Hours)

An Introduction to Microelectronic Fabrication, Roadmap of semiconductor manufacturing, Semiconductor Materials and Process Chemicals, Crystal Structure, Crystal Growth and Wafer Preparation, Contamination Control; Overview of Wafer Fabrication - Basic Wafer Fabrication Operations, Hot Processing and Ion Implantation, Construction of a Semiconductor Circuit, Chip Terminology, Process Yields.

Module V: Principles of Microelectronics Fabrication (10 Hours)

Oxidation, Rapid Thermal Processing, Photolithography; Photolithographic Processes - Optical Lithography, Photoresists, Non-optical Lithographic Techniques.

Module VI: Processing of Thin Films (10 Hours)

Vacuum Science and Plasmas, Etching, Physical Deposition: Evaporation and Sputtering, Chemical Vapor Deposition, Epitaxial Growth, Device Isolation, Contacts, and Metallization; Overview of Wafer Fabrication - The Business of Wafer Fabrication, Semiconductor Devices and IC Formation, Integrated Circuit Types, Chip Packaging.

COURSE / LEARNING OUTCOMES

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

- CO1:** tell how semiconductors are used for fabrication of integrated circuits (ICs) (Remembering)
- CO2:** infer how semiconductor properties could be related to fabrication of integrated circuits (Understanding)
- CO3:** apply semiconductors properties for use in fabrication of integrated circuits (ICs). (Application)
- CO4:** Analyse basic theories underlying the various processes that are used in fabricating electronic devices and ICs. (Analysing)
- CO5:** deduce process parameters for minimizing defects in fabrication of ICs. (Evaluating)
- CO6:** construct and solve problems related to IC fabrication processes. (Creating)

Suggested Readings

1. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, sixth edition, 2010.
2. Stephen A. Campbell, The Science and Engineering of Microelectronics Fabrication, Oxford University Press, Second Edition, 2001
3. Ben G. Streetman, Solid State Electronic Devices, Prentice Hall, 1980.
4. Stephen A. Campbell, Fabrication Engineering at the Micro and Nanoscale, Oxford University press, 2007
5. R.C. Jaeger, Introduction to Microelectronics Fabrication, 2nd Edition (ISBN:0201444941), 2001
6. PV Zant, Microchip Fabrication: A Practical Guide to Semiconductor Processing, 3rd Edition, Semiconductor Services, 2000 (ISBN: 0071356363)
7. Marc J. Madou, Fundamentals of Microfabrication: The Science of Miniaturization, 2nd Edition (ISBN: 0849308267), 2002

ECES0035: EMBEDDED SYSTEMS AND APPLICATIONS

(4 credits – 60 hours)

Objectives: *The course helps to develop an in-depth understanding of the operation of different types of microcontrollers . It also covers assembly language programming and interfacing techniques using different types of microcontrollers. The students will be able to design and implement microcontroller-based systems in both hardware and software and can apply this knowledge to more advanced structures.*

Module I (15 hours)

Overview and practical aspects of embedded systems, Hardware description of 8051, Programming of 8051, Serial port programming, Interrupt programming, Timer and Counter, RTOS for 8051, Keypad Interfacing, DIP switch interfacing, Design of a traffic light controller system using 8051

Module II (12 hours)

Pin diagram and architecture of 8096, Memory Organization, Addressing mode and interrupts, instruction set of 8096, programming of 8096, design of a numeric machine using 8096

Module III (8 hours)

Introduction to PIC microcontrollers: Architecture, Architecture Differences, Mid-Range instruction Set, Power Input and Decoupling, Reset, Watchdog Timer, System Clock/Oscillators

Module IV (15 hours)

Registers, Parallel Input Output, Interrupts, Prescaler , Mid-Range Built-In EEPROM Flash Access,TMR1 and TMR2 Serial I/O, Analog I/O, Parallel Slave Port (PSP), External Memory Connections ,In-Circuit Serial Programming (ISCP), Assembly Language Programming, Hex File Format, Code-Protect,Features,INTERFACING TO LEDs, LCDs

Module V (10 hours)

ARM Processor Fundamentals: Processor architecture and organization, 3-stage pipeline ARM organization, 5-stage pipeline ARM organization, ARM instruction execution, Instruction set design, The ARM coprocessor interface. The Reduced Instruction Set Computer. The Acorn RISC Machine, Architecture, Instruction set of ARM

COURSE / LEARNING OUTCOMES

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

- CO1:** define various terminologies related to embedded system. (Remembering)
- CO2:** explain the architecture of advanced microcontrollers such as 8096, PIC and ARM. (Understanding)
- CO3:** apply the knowledge of timers, interrupt and serial communication of different microcontrollers. (Application)
- CO4:** Analyse the internal organization and instruction set of 8096, PIC and ARM. (Analysing)
- CO5:** compare advantages, disadvantages and applications of different microcontrollers. (Evaluating)
- CO6:** maximize the performance of microcontroller-based systems. (Creating)

Suggested Readings

1. M. A. Mazidi, J.G. Mazidi, R.D. McKinlay, The 8051 Microcontroller and Embedded systems, Prentice Hall, 2nd Edition.
2. Myke Predko, Programming and Customizing the 8051 Microcontroller, McGraw Hill.
3. Schultz Thomas W.C and 8051
4. David Calcutt Fred Cowan Parchizadeh, 8051 Microcontrollers an Applications-Based Introduction, Elsevier.
5. H.W Huang, Delmar, PIC Microcontroller, CENGAGE Learning, 2007.
6. J B Peatman, Design with PIC Microcontrollers, Prentice Hall.
7. Andrew N. Sloss, Dominic Symes, Chris Wright ARM system developers guide designing and optimizing system software
8. ARM system onchip architecture, Steve Ferber

ECLV0036: LOW POWER VLSI DESIGN**(4 credits – 60 hours)**

Objectives: *The objective of the course is to learn basic ideas, concepts, theory and methods of low power VLSI design and also to gain experience with techniques and tools.*

Module I (17 hours)

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Physics of power dissipation in CMOS devices: MIS structure, long channel MOSFET, Leakage current in deep submicrometer transistors, weak inversion, punchthrough, Device and Technology Impact on Low Power: Dynamic dissipation in CMOS, Load Capacitance, Transistor sizing and gate oxide thickness, Impact of technology Scaling, Technology and Device innovation.

Module II (15 hours)

Power estimation, Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation; Probabilistic power analysis: Random logic signals, probability and frequency, probabilistic power analysis techniques, signal entropy. Low Power Design; Circuit level: Power consumption in circuits. Flip Flops and Latches design, high capacitance nodes, low power digital cells library

Module III (15 hours)

Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic; Low power Architecture and Systems: Power and performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power static RAM architecture, 4T SRAM, 6T SRAM, Banked organization of SRAM.

Module IV (13 hours)

Low power Clock Distribution: Power dissipation in clock distribution, power reduction in clock networks, clock gating reduced clock swing, oscillator circuit for clock generation, Frequency division and multiplication, CMOS floating, low power bus, Variable-threshold-voltage CMOS (VTCMOS) approach, Multi-threshold-voltage CMOS (MTCMOS) approach, Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design, power efficiency of adiabatic logic, pass transistor synthesis.

COURSE / LEARNING OUTCOMES

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

- CO1:** lists the need for low power VLSI chips (Remembering)
- CO2:** explain the sources of power dissipation in CMOS devices (Understanding)
- CO3:** apply low power dissipation techniques in VLSI chips (Applying)
- CO4:** Analyse dynamic and static power dissipation (Analysing)
- CO5:** compare the techniques used to reduce power dissipation in VLSI chips (Evaluating)
- CO6:** discuss different techniques used to reduce the power dissipation (Creating)

Suggested Readings

1. G.K. Yeap and F.N. Najm, Practical Low Power Digital VLSI Design, World Scientific.
2. K. Roy and S. Prasad, Low-Power CMOS VLSI Circuit Design, Wiley.
3. J.M. Rabaey and M. Pedram, Low Power Design Methodologies, Kluwer Academic Publishers.
4. W. Nebel and J. Mermet, Low Power Design in Deep Sub-micron Electronics, Kluwer Academic Publishers.

ECCC0037: COMPUTER COMMUNICATION

(4 credits - 60 hours)

Objectives: *The course is intended at understanding the principles and practice of designing, building, and operating computer networks, particularly the Internet.*

Module I (15 hours)

Overview of Data Communications and Networking: Protocols and Architecture: ISO- OSI, TCP/IP, Data Transmission, Transmission Media: Guided Media, Unguided media (wireless); Data encoding schemes (in brief), Brief idea about spread spectrum technique; Multiplexing-FDM, TDM, ADSL.

Module II (20 hours)

Data Link Layer: Flow Control, Error detection and Error Control HDLC, Point-to- Point Protocol: PPP Multiple Access Techniques: Random Access, Controlled Access, Channelization. Switching Techniques: Circuit switching, Packet Switching, Routing and routing algorithms Message Switching; Wired LAN: IEEE standard, LAN, MAN and WAN Technology, LAN system – Ethernet; ATM, Wireless LANs: IEEE 802.11, Bluetooth virtual circuits, Brief Idea about Switches and Routers.

Module III (15 hours)

Network Layer: Addressing, IPv4, IPv6, Address mapping, ICMP and Routing; Transport Layer: UDP, TCP, Congestion control.

Module IV (10 hours)

Application Layer: Client Server Model, Domain Name System (DNS): Electronic Mail (SMTP) and file transfer (FTP) HTTP and WWW. Network management (SNMP), VOIP and Brief idea about ISDN.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the working of different architectures and protocols involved in data communication. (Remembering)

- CO2:** List and describe the various types of transmission media and network topologies. (Remembering)
- CO3:** Explain the functionalities of different layers of the network architecture. (Understanding)
- CO4:** Illustrate different data access and switching techniques. (Understanding)
- CO5:** Explain switches, routers, ISDN, VOIP etc. (Understanding)
- CO6:** Compare different network topologies, network architecture and transmission media. (Understanding)
- CO7:** Choose appropriate transmission medium, switching and access technique for a given data communication network. (Application)
- CO8:** Examine and compare the performance of different data communication network. (Analysing)
- CO9:** Choose and justify the proper computer network component. (Evaluating)
- CO10:** Elaborate the different components involved in the designing of computer networks. (Creating)

Suggested Readings

1. W. Stallings, Principles of Data Communication and Networking, PHI.
2. B. A. Forouzan, Data Communications and Networking, TMH.
3. L.L. Peterson and B.S.Davis, Computer Networks: A System Approach, Elsevier.
4. A.S. Tannenbaum, Computer Networks, PHI.

ECMC0038: MOBILE COMMUNICATION

(4 Credits - 60 hours)

Objectives: The course introduces the principles of mobile systems and its most important technical aspects and services and emphasizes on both public and professional mobile telephony standards, spread spectrum technology, wireless networks while migrating from wired to wireless applications.

Module I: The Cellular Concept (15 hours)

A brief introduction to Mobile Telephony, Technologies and Choices; Cellular Concept- System Design: Fundamentals- Frequency reuse, Channel Assignment, Handoff Strategies, Interferences and System Capacity, Trunking and Grade of Service; Improving coverage and capacity in Cellular Systems – Cell Splitting, Sectoring, Repeaters and Range Extension, Microcell and Picocell Zone Concept. Antennas for Base Station and hand held Cellular phone.

Module II: Mobile Radio Propagation: Large-Scale path loss (15 hours)

Free space propagation model, Ground Reflection Model, Diffraction, Scattering. Outdoor propagation Model – Okumura Model; Indoor Propagation Model: Partition losses, Long distance Path loss Model; Small Scale Fading and Multipath fading, Doppler Shift. Types of Small Scale Fading and their effect on received signal; Modulation Techniques: FM for Analogue. FM Detection Techniques- PLL and Quadrature Detection. Digital Modulation: $\pi/4$ QPSK and MSK, GMSK.

Module III: Modulation Techniques for Mobile Radio (20 hours)

Spread Spectrum Techniques: DS-SS and FH-SS. Performances of FM, $\pi/4$ QPSK and MSK in Fading and Interference; fundamentals of Equalization, Adaptive Equalizer. Diversity Techniques-Space, frequency Polarization and Time Diversity; Access Techniques: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread; Spectrum Multiple Access-Frequency

Hopped Multiple Access (FHMA), Code Division Multiple Access (CDMA). Frequency and Channel specification for CDMA Digital Cellular Standard (IS-95).

Module IV: Wireless Systems and Standards (10 hours)

Wireless Networking: Various Generations of Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing in Wireless Networks- Circuit Switching, Packet Switching. The X. 25 Protocol; Global System for Mobile (GSM): features, architecture, channel types, Frame Structure in GSM. Signal processing in GSM.

COURSE / LEARNING OUTCOMES

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

- CO1:** define the different components of mobile communication system (Remembering)
- CO2:** explain the concept of cellular communication and frequency reuse (Understanding)
- CO3:** identify the capacity of a cellular system (Application)
- CO4:** analyse GSM mobile communication standard, its architecture, logical channels, advantages and limitations (Analysing)
- CO5:** compare the different techniques used to improve the received signal quality (Evaluating)
- CO6:** compile the different propagation models used to predict the received signal strength (Creating)

Suggested Readings

1. T.S. Rappaport, Wireless Communication, Pearson.
2. W.Y. Lee, Mobile Communication Engineering, McGraw Hill.
3. J.Schiller, Mobile Communication, Pearson.
4. W.Y. Lee, Mobile Cellular Communications, McGraw Hill.

ECOD0039: OPTOELECTRONIC DEVICES

(3 credits - 45 hours)

Objectives: *The course is intended to give the students an exposure to the design criteria for semiconductor optical sources including light emitting diodes and laser diodes, optical detectors, amplifiers and connectors for a variety of applications.*

Module I (15 hours)

Sources: Light Emitting Diodes (LEDs), LED Structures, LED types, Fabrication of LED, Light Source Materials, Internal Quantum Efficiency, Modulation Capacity, Transient Response, Power – Bandwidth Product, Laser Diodes, Laser Diode Modes and Threshold Conditions, Single mode operation, Mode locking, Q-switching, Holography, Resonant Frequencies, Laser Diode Structures and Radiation Patterns, Single Mode Lasers, Modulation of Laser Diodes, Temperature Effects, Light Source Linearity, Modal Partition and Reflection Noise.

Module II (10 hours)

Detectors: PIN Photo-Detector, Avalanche Photodiodes, Photo-Detector Noise, Noise Sources, Signal-to-Noise Ratio, Depletion Layer Photocurrent, Response Time, Avalanche Multiplication Noise, Temperature Effects on Avalanche Gain, Photodiode Materials.

Module III (10 hours)

Amplifiers and Switches: Optical Amplifiers, Semiconductor Laser Amplifiers, Fiber Amplifiers, Rare Erbium Doped Fiber Amplifiers, Raman Fiber Amplifiers, Brillion Fiber Amplifiers, Amplifier Gain, Noise Figure, Bandwidth, Photonic Switching, Integrated Optical Switches.

Module IV (10 hours)

Connectors and Couplers: Cylindrical Ferrule Connector, Bi-Conical Ferrule Connectors, Double Eccentric Connectors, Duplex Fiber Connectors, Expanded Beam Connectors, Beam Splitter, Three Port Couplers, Four Port Couplers, Directional Couplers, Star Couplers, Lenses for Coupling Improvement.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define and show the working of basic optoelectronics devices such as optical sources, detectors, optical amplifiers and connectors, etc. (*Remembering*)
- CO2:** Explain the various types of connectors and couplers employed for fiber optic link design for efficient coupling of light from source to fibre/detector (*Understanding*)
- CO3:** Illustrate the need for semiconductor optical sources & detectors and describe their fundamental principles, structure, types and characteristics (*Understanding*)
- CO4:** Explain the photo-emission and photo-detection process. (*Understanding*)
- CO5:** Explain the nature and performances of various types of optical sources, photodetectors and amplifiers (*Understanding*)
- CO6:** Describe the various types of connectors and couplers employed for fiber optic link design for efficient coupling of light from source to fibre/detector. (*Understanding*)
- CO7:** Compute the efficiencies and other parameters related to optoelectronic sources, detectors and amplifiers. (*Application*)
- CO8:** Classify the different optoelectronic components and Analyse their performances. (*Analysing*)
- CO9:** Evaluate the performance characteristics of optical sources, detectors, optical amplifiers and other optoelectronics components. (*Evaluating*)
- CO10:** Construct a Fiber optic link design and estimate the types of various optoelectronic components used. (*Creating*)

Suggested Readings

1. J. Wilson, J.F.B. Hawkes, Optoelectronics - An Introduction, Prentice Hall of India Private Limited.
2. G. Keiser, Optical Fiber Communications, McGraw Hill.
3. D.K. Mynbaev and L.L.Scheiner, Fiber Optic Communications Technology, Pearson.
4. S.K. Sarkar, Optical Fibers and Fiber Optic communication system, S.Chand and Co.
5. J.C. Palais, Fiber Optic Communications, Pearson.

ECSP0040: SPEECH PROCESSING

(3 credits – 45 hours)

Objectives: The objectives of this course are to introduce the fundamentals of digital speech processing, Analyse the basic subject related to speech processing such as discrete time and continuous time signals, linear time-invariant systems, convolution, Z-transform etc., Models for Speech Production, Complete Model of Auditory Processing, Digital Representation of speech, Cepstrum Analysis of Speech Signal, linear predictive speech coding, Feature Extraction, speaker verification and speaker Identification Systems.

Module I (12 hours)

The Fundamentals of Digital Speech Processing; A Review of Discrete-Time Signal and Systems, the Z-transform, the DFT, Fundamental of Digital Filters, FIR system, IIR Systems, Phonetic Representation of Speech, Models for Speech Production, the human Ear, perception of loudness, critical bands, pitch perception, auditory masking, complete model of auditory processing.

Module II (10 hours)

Time–Domain Methods for Speech Processing; Time-Dependent Processing of speech, short-time energy and Average Magnitude, short time average Zero-crossing rate; Digital Representation of speech Waveform Sampling speech signals, statistical model, instantaneous quantization, instantaneous companding, quantization for optimum SNR, adaptive quantization, feed-forward feedback adaptations.

Module III (7 hours)

Definition of the Cepstrum and Complex Cepstrum, the Short-Time Cepstrum, Computation of the Cepstrum, Short-Time Homomorphic Filtering of Speech, Application to Pitch Detection, Applications to Pattern Recognition, The Role of the Cepstrum.

Module IV (16 hours)

Block diagram of Simplified Model for Speech Production; Basic Principles of Linear Predictive Analysis- the Auto Correlation Method, Cepstral Analysis; The Prediction Error Signal. Digital Speech Processing for Man-Machine Communication by voice. Speaker Recognition Systems- Pre-emphasis, Normalization, Frame blocking, Windowing, Feature Extraction (LPC, PCA, MFCC), Vector quantization, speaker verification and speaker Identification Systems.

COURSE / LEARNING OUTCOMES

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

- CO1:** define and outline the fundamental concepts of digital signal processing related to digital speech processing such as discrete and continuous time signals, Z-transform, DFT, digital filters etc. (Remembering)
- CO2:** explain the mechanism of speech production and reception in the human body. (Understanding)
- CO3:** explain the fundamentals of digital speech processing including models for speech production, feature extraction etc. (Understanding)
- CO4:** design speaker verification and speaker identification systems (Applying)
- CO5:** Analyse the human auditory system, speech signals, models for speech production, feature extraction systems etc. (Analysing)
- CO6:** evaluate a speech signal, speech production system, and speaker verification and speaker identification system. (Evaluating)
- CO7:** design a simple model for speech production. (Creating)

Suggested Readings

1. L.Rabiner and B-H Juang, Fundamentals of Speech Recognition, Pearson.
2. L.R.Rabinu and R.W Schafer, Digital Processing of Speech Signals, Pearson.
3. D. Jurafsky and J H Martin, Speech and Language Processing, Pearson.
4. L.R.Rabinu and R.W Schafer, Theory and Applications of Digital Speech Processing, Pearson.

5. B Gold, N Morgan and D Ellis, Speech and Audio Signal Processing: Processing and Perception of Speech and Music, Wiley.

ECNT0041: INTRODUCTION TO NANOTECHNOLOGY

(3 credits – 45 hours)

Objectives: *This course will introduce the students to Nanotechnology. The course is designed to build up a basic understanding of the nano concepts. It will provide the students the knowledge of synthesis of nanomaterials, their characterization techniques as well as touch upon some applications of nanotechnology.*

Module I (10 hours)

Basics of Nanotechnology: Importance of Nanotechnology, History of Nanotechnology, Properties of Nanomaterials, Difference between Bulk and Nanomaterial, Molecular building blocks for nanostructure systems, Forces between atoms and molecules - Particles and grain boundaries – strong Intermolecular forces – Electrostatic and Vander Waals forces between surfaces.

Module II (12 hours)

Physics of nanomaterials: Atomic scale structure of nanoparticles, nanotubes, nanowires, nanodots etc.; electronic and optical characteristic properties of quantum dots, quantum wires and quantum wells; concept of quantum confinement: 0D, 1D and 2D nanostructures; Size effects – Fraction of Surface Atoms – specific Surface Energy and Surface Stress. Nanofluidics, Nanophotonics, Nanothermodynamics, Plasmonics – plasmons and surface plasmons, SPR, Core-shell quantum dots and quantum-dot- quantum wells.

Module III (12 hours)

Synthesis/fabrication techniques of nanomaterials: Top down approach, Lithography – electron beam and ion beam techniques, Etching – wet and dry etching, Bottom up approach - Solvent based and template based synthesis, other important synthesis methods like CVD, PVD etc.; Doping, Nucleation, Growth and Stability of colloidal nanoparticles, concept of self- assembly. Add some lab component

Module IV (5 hours)

Characterization methods: Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), X-ray diffraction spectroscopy (XRD)

Module V (6 hours)

Applications: Nanosensors and nanoelectronics, Micro and Nano electromechanical systems, Photonic crystals, Nanopiezotronics.

COURSE / LEARNING OUTCOMES

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

- CO1:** define the principles underlying the field of Nanotechnology. (Remembering)
- CO2:** explain the concepts underlying this disruptive field of new technology. (Understanding)
- CO3:** apply this knowledge for fabricating new materials and devices in the nanoscale. (Applying)
- CO4:** Analyse new materials and devices in the nanoscale using various characterization tools (Analysing)

- CO5:** evaluate synthesized materials for their various properties. (Evaluating)
CO6: compile new nano-structured materials for various functions and applications. (Creating)

Suggested Readings

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

ECRM0042: RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHT

(2 credits-30 hours)

Objective: This course is designed to help students to identify research problems in various fields. It aims at giving potential researchers the knowledge of effectively analysing and interpreting results and presenting the findings to the scientific and technological community of the world. This course also aims at motivating students to bring about their creative ideas for innovation and establishing research impact in the global fora through intellectual ownership.

Module I: Research problem formulation and solution (12 Hours)

Meaning, sources, scope and objective of a research problem; Good research problem criteria and characteristics, errors in selecting a research problem; Research problem solutions– approaches for investigation; Approaches to effective literature studies; Data collection, analysis, interpretation and instrumentation; Plagiarism and ethical practices.

Module II: Technical writing (10 Hours)

Effective writing; Research proposal development and its format; Different report types.

Module III: Intellectual Property Rights (8 Hours)

- a) **Nature of intellectual property:** Patent, design, trade and copyright; Patenting and development process; Patent grant under PCT and procedure; Geographical indications.
- b) **Patent rights:** Administration of patent systems, scope, information and databases, technology licensing.
- c) **New developments and case studies.**

COURSE / LEARNING OUTCOMES

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

- CO1:** To be able to identify research problems in various fields
CO2: To be able to approach investigations scientifically in order to find solutions for research problems of interest
CO3: To know how to undertake literature review for knowing the state of the art in the areas of interest
CO4: To know how to put forward the research problems, findings, analyses and interpretations effectively
CO5: To know how to take ownership of new findings through intellectual property right laws

Suggested Readings

1. Goddard Wayne, Melville Stuart, Research Methodology: An Introduction For Science And Technology Students, Juta & Co. Ltd.
2. Kumar Ranjit, Research Methodology A Step By Step Guide For Beginners, SAGE publications Inc.
3. Halbert J. Debora, Resisting Intellectual Property, CRC press.
4. Menell S. Peter, Lemley A. Mark, Merges P. Robert, Intellectual Property In New Technological Age, Clause 8 Publishing.
5. C.R. Kothari, Research Methodology Methods and Techniques, New Age International

ECED0043: ELECTRONIC DEVICES**(3 credits-45 hours) (L-T-P:3-0-0)**

Objective: This course introduces basic semiconductor material, semiconductor junction properties, electronic devices *and electronic circuit design*. The course will also help in understanding the operation of simple devices such as *p-n junctions and optoelectronic devices*. More complex devices such as *Bipolar Junction Transistors (BJT) and Field Effect Transistors (FETs)*, will also be introduced. It also introduces basic processes used in fabricating semiconductor devices and integrated circuits. The objective is to develop the background knowledge necessary to understand semiconductor physics and state-of-the-art semiconductor technology related to device fabrication processes.

Module I (3 Hours)

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon

Module II (12 Hours)

P-N Junction: P-N junction characteristics, I-V characteristics, Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors; Generation and recombination of carriers; Poisson and continuity equation; small signal switching models; Avalanche breakdown, Zener diode, Schottky diode LED, photodiode and solar cell; **Diode circuits**.

Module III (15 Hours)

Bipolar Junction Transistor: *BJT types; BJT configurations; I-V characteristics, Ebers-Moll Model, BJT biasing; bias stability, small signal analysis, low frequency transistor models and analysis, estimation of voltage gain, input resistance, output resistance etc.*

Module IV (9 Hours)

MOSFET: *Introduction to MOSFET, MOSFET types; I-V characteristics, CMOS. Biasing and Stabilization of Q-point, small signal models of MOS transistor, MOS capacitor, C-V characteristics.*

Module V (6 Hours)

Integrated circuit fabrication process: Oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define the basic principles associated with how electrons behave and various processes that are used in fabricating electronic devices and ICs. (Remembering)
- CO2:** Understand the basic principles of electronic devices and how they operate. (Understanding)

- CO3:** Apply knowledge and understanding of electronic devices and their operation principles to making electronic circuits. (Applying)
- CO4:** Analyse electronic circuits. (Analysing)
- CO5:** Explain operation and working of basic electronic circuits and deduce their outputs. (Evaluating)
- CO6:** Create electronic circuits using different devices and components to perform certain operations. (Creating)

Suggested Readings

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson, 2014.
2. D. Neamen, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.
4. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

ECSS0044: SIGNALS AND SYSTEMS

(3 credits-45 hours) (L-T-P:2-1-0)

Objective: *The objective of this course on Signals and Systems is to acquaint the student with the various types of signals which form the basis electronic communication and to provide the theoretical background necessary to understand the working of any electronic communication system.*

Module I (6 hours)

Signals and systems as seen in everyday life, and in various branches of engineering and science. Definition and Classification of signals: continuous and discrete time signals. Types of signals: Analog and Digital signals, Deterministic and random signals, periodic and aperiodic signals, power and energy signals, even and odd signals. Standard signals: Impulse, Step, Ramp, Exponential, Gate, Signum, Rectangular and Sinc. Analysis of different signal types. Operation on signals, System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

Module II (7 hours)

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of LSI systems. System representation through differential equations and difference equations.

Module III (12 hours)

Fourier series representation. The Continuous-time Fourier Transform (CTFT) and its properties. The Discrete-Time Fourier Transform (DTFT) and its properties. The Discrete Fourier Transform (DFT). The notion of a frequency response and its relation to the impulse response. Convolution/multiplication and their effect in the frequency domain, magnitude and phase response. Parseval's Theorem. Energy Spectral Density (ESD) and Power Spectral Density (PSD). Auto-correlation and Cross-correlation functions. The idea of signal space and orthogonal bases.

Module IV (11 hours)

The Laplace Transform: definition and properties, inverse Laplace transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence (ROC), poles and zeros of system. Initial value and final value theorem. Laplace domain analysis. Solution to differential equations and system behavior. The z-Transform for discrete time signals and systems: definition and properties, inverse Z-transform, eigen functions, region of convergence (ROC), z-domain analysis.

Module V (9 hours)

State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. Sampling: Definition, mathematical model and types. The Sampling Theorem and its implications: Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing, its effects and methods to eliminate aliasing. Relation between continuous and discrete time systems.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define different types of signals and systems. (Remembering)
- CO2:** Define the fundamentals of LTI system and its properties. (Remembering)
- CO3:** Illustrate different transforms like Fourier transform, Laplace transform and Z-transform. (Understanding)
- CO4:** Apply the knowledge of different transforms to study the properties of different signals and systems. (Applying)
- CO5:** Analyse properties of continuous-time systems in the frequency domain and Laplace domain using Fourier and Laplace transforms. (Analysing)
- CO6:** Analyse properties of discrete-time systems in the frequency domain and Z- domain using Fourier and Z transform. (Analysing)
- CO7:** Explain and evaluate the concept of sampling, ESD, PSD, auto-correlation and cross-correlation to different signals. (Evaluating)
- CO8:** Formulate and predict the characteristics of different systems to implement in communication systems (Creating)

Suggested Readings

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. P Ramesh Babu, R Ananda Natarajan, Signals and Systems, SciTech Publications, 2006.
4. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
5. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.
6. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International, 1999.

ECNT0045: NETWORK THEORY**(3 credits-45 hours) (L-T-P:2-1-0)**

Objective: *The objective of this course is to introduce the laws that govern the response of electrical circuits and networks. This course will help in understanding various network theorems, two port networks, resonance circuits, electrical filter circuits and analysis of steady and transient state of electrical circuits*

Module I (20 hours)

Voltage division rule, current division rule. Star-Delta conversion, Kirchhoff's current law (KCL, Kirchhoff's voltage law (KVL), Node and Mesh analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power transfer, compensation and Tellegen's theorem as applied to AC. circuits.

Module II (10 hours)

Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

Module III (15 hours)

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define various network theorems. (Remembering)
- CO2:** Show the need for transient analysis of various circuits (Remembering)
- CO3:** Define different types of resonance circuits (Remembering)
- CO4:** Explain various resistive and reactive circuits. (Understanding)
- CO5:** Explain various filter circuits. (Understanding)
- CO6:** Explain the Two four port network. (Understanding)
- CO7:** Explain various types of resonance circuits. (Understanding)
- CO8:** Explain the steady state and transient response of circuits. (Understanding)
- CO9:** Apply network theorems to solve complex circuits. (Applying)
- CO10:** Apply the knowledge of resonance circuits to design application based circuits. (Applying)
- CO11:** Analyse resistive and reactive circuits. (Analysing)
- CO12:** Analyse resonance circuits. (Analysing)
- CO13:** Evaluate performance of various resistive circuits. (Evaluating)
- CO14:** Evaluate performance of various reactive circuits. (Evaluating)
- CO15:** Design various resistive circuits. (Creating)
- CO16:** Design various reactive circuits. (Creating)

Suggested Readings

1. Van, Valkenburg.; "Network analysis"; Prentice hall of India, 2000
2. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994
3. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education

ECDS0046: DIGITAL SYSTEM DESIGN

(3 credits-45 hours)(L-T-P:3-0-0)

Objective: *The objectives of this course are to introduce the concept of digital and binary systems and give students the concept of digital electronics. The course also provides fundamental concepts used in the design of digital systems, the basic tools for the design and implementation of digital circuits, modules and subsystems.*

Module I (8 hours)

Logic Simplification and Combinational Logic Design :Review of Boolean algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

Module II (9 hours)

MSI devices: Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

Module III (12 hours)

Sequential Logic: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

Module IV (8 hours)

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

Module V (8 hours)

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modelling styles in VHDL, Data types and objects, Dataflow, Behavioural and Structural Modelling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** List and recognize the various logic gate ICs and other components and instruments used in DLD lab. (Remembering)
- CO2:** Demonstrate the working and operation of hardware involved in designing and building of digital circuits. (Understanding)
- CO3:** Apply Boolean laws for solving and minimizing logic functions practically. (Applying)
- CO4:** Analyse practically different combinational and sequential circuits. (Analysing)
- CO5:** Evaluate practically and determine the behaviour of different digital circuits. (Evaluating)
- CO6:** Design and build various combinational circuits and sequential circuits. (Creating)

Suggested Readings

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

ECAC0047: ANALOG CIRCUITS

(3 Credits – 45 hours)(L-T-P:3-0-0)

Objective: *To understand the basic concepts in the design of electronic circuits using Linear Integrated Circuits and their application in the processing of analog signals. The course also helps in learning the linear and non-linear applications of operational amplifiers (OpAmps), the theory and applications of analog multipliers, ADC and DAC and a few special function integrated circuits.*

Module I (10 hours)

High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Module II (15 hours)

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (output resistance and minimum sustainable voltage (VON), maximum usable load. Differential Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.

Module III (15 hours)

OPAMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation. Open loop and closed loop concept, virtual ground, equivalent circuit, ideal characteristics, ideal transfer curve, OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, difference amplifier, precision rectifier, comparator, zero crossing detector, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Module IV (5 hours)

Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define the linear and non-linear applications of BJT and op-amp. (Remembering)
- CO2:** Classify and comprehend the working principle of different circuits based on BJT and op-amp. (Understanding)
- CO3:** Apply the methods learned in the class to design and implement practical projects. (Applying)
- CO4:** Analysis of modern analog circuits using integrated circuits. (Analysing)
- CO5:** Demonstrate the use of analog circuit analysis techniques to Analyse the operation and behaviour of various analog circuits. (Evaluating)
- CO6:** Design, layout, and testing of Analog circuits. (Creating)

Suggested Readings

1. R. S. Sedha, A textbook of Applied Electronics, S. Chand & Company Ltd.
2. T.R. Ganesh Babu and B. Suseela, Linear Integrated Circuits, Scitech Publications (India) Pvt. Ltd.
3. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
4. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
5. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
6. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11
7. Publishing, Edition IV 6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

ECEL0048: ELECTRONIC MEASUREMENTS**(3 credits- 45 hours) (L-T-P:3-0-0)**

Objective: The course is aimed at introducing the concept of measurement and the related instrumentation requirement as a vital ingredient of electronics and communication engineering to learn basic concepts of electronic measurements, importance of signal generators and signal Analysers in measurements and relevance of digital instruments in measurements.

Module I (10 hours)

- a) Performance characteristics of instruments, Static characteristics, Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Errors in Measurement, Dynamic Characteristics-speed of response, Fidelity, Lag and Dynamic error. DC Voltmeters - Multirange, Range extension/Solid state and differential voltmeters, AC voltmeters - multi range, range extension, shunt. Thermocouple type RF ammeter, Ohmmeters series type, and shunt type, Multimeter for Voltage, Current and resistance measurements.
- b) AC Bridges- Measurement of inductance- Maxwell's bridge, Anderson bridge. Measurement of capacitance - Schering Bridge. Wheatstone bridge. Wien Bridge, Errors and precautions in using bridges. Q-meter

Module II (15 hours)

- a) Oscilloscopes CRT features, vertical amplifiers, horizontal deflection system, sweep, trigger pulse, delay line, sync selector circuits, simple CRO, triggered sweep CRO, Dual beam CRO, Measurement of amplitude and frequency, Lissajous method of frequency measurement, standard specifications of CRO.
- c) Dual trace oscilloscope, sampling oscilloscope, storage oscilloscope, digital readout oscilloscope, digital storage oscilloscope. Probes for CRO- Active and Passive, attenuator type, Frequency counter, Time and Period measurement
- d) Wave Analysers, Harmonic Distortion Analysers, Spectrum Analysers, Digital Fourier Analysers.
- e) Signal Generator - fixed and variable, AF oscillators, Standard and AF sine and square wave signal generators, Function Generators, Square pulse, Random noise, sweep, Arbitrary waveform.

Module III (10 hours)

- a) Transducers- active and passive transducers : Resistance, Capacitance, inductance; Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors. Introduction to various sensors- Optical, Bio-medical etc.
- b) Measurement of physical parameters force, pressure, velocity, humidity, moisture, speed, proximity and displacement. Data acquisition systems.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define and outline the fundamental characteristics of electronic measuring Instruments. (Remembering)
- CO2:** Classify and explain the different types of electronic measuring instruments. (Understanding)
- CO3:** Experiment with different bridge circuit models. (Applying)
- CO4:** Analyse various range extension techniques of measuring instruments. (Analysing)
- CO5:** Measure the various parameters related to Electronics measuring instruments. (Evaluating)
- CO6:** Elaborate the performance of different measuring instruments based on the nature and performance characteristics and assess their importance in measurement. (Creating)

Suggested Readings:

1. A.K. Sawhney, Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai, 2009
2. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, 1st Ed., PHI
3. H. S. Kalsi, Electronic Instrumentation, TMH India
4. D. Patranabis, Sensors and Transducers, 2nd Ed., PHI.
5. David A. Bell, Electronic Instrumentation and Measurements, 2nd Ed., PHI

ECDP0049: DIGITAL SIGNAL PROCESSING

(3 credits – 45 hours) (L-T-P:2-1-0)

Objective: *The course aims at providing a framework to understand various aspects of digital signal processing and will deal with the design methodology of digital FIR & IIR filters along with various signals, discrete time systems and transforms.*

Module I (10 hours)

- a) Discrete time signals: Sequences; Representation of signals on orthogonal basis; Sampling and reconstruction of signals; Elementary examples; Classifications of discrete time signals; Operations on discrete time signals.
- b) Discrete time system: Discrete systems attributes; Properties of discrete time system; Classification of discrete time systems.

Module II (15 hours)

- a) Analysis of LTI systems: Analysis and response (convolution sum) of discrete - time linear LTI system; Z-Transform; Constant coefficient differences equations and their solutions.
- b) Frequency Analysis LTI systems: Discrete Fourier Transform (DFT); Circular convolution; Overlap save methods and overlap add method; Fast Fourier Transform (FFT); FFT Algorithms.
- c) Implementation of Discrete Time Systems: Recursive and non-recursive discrete time system; Realization of FIR & IIR system;

Module III (10 hours)

- a) Design of FIR Digital filters: Window method; Park-McClellan's method.
- b) Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters; Impulse Invariance method, Matched Z-transform method, Backward difference method and bilinear transformation method.

Module IV (10 hours)

- a) Effect of finite register length in IIR & FIR filter design; Parametric and non-parametric spectral estimation.
- b) Introduction to multirate signal processing.
- c) Applications of DSP.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define and outline the fundamental concepts of signals and system. (Remembering)
- CO2:** List and recognize the different mathematical tools like Z-transform, DFT, etc., used in digital signal processing. (Remembering)
- CO3:** Define various classifications of digital filters. (Remembering)
- CO4:** Define multirate signal processing. (Remembering)
- CO5:** Recall different effects related to quantization and representation of numbers in terms digital system. (Remembering)
- CO6:** Classify the different types of signals and discrete time system, digital filters and different methods of designing digital filters. (Undersatnding)
- CO7:** Interpret the various effects of finite word length in digital systems. (Undersatnding)
- CO8:** Give illustration on spectral estimation. (Undersatnding)
- CO9:** Explain the different methods of multirate signal processing. (Undersatnding)
- CO10:** Compute the time domain and frequency domain responses of various discrete time systems. (Applying)
- CO11:** Design and Analyse digital filters for different specifications. (Applying)
- CO12:** Use the digital signal processing concepts to practical DSP system. (Applying)
- CO13:** Implement fast algorithms in DSP processors. (Applying)
- CO14:** Classify and Analyse various methods of IIR and FIR filter design. (Analysing)
- CO15:** determine the appropriate design procedure for digital filter. (Analysing)
- CO16:** Evaluate the method of different filter design technique and different types of filters. (Evaluating)
- CO17:** Compare the various types of digital filters. (Evaluating)
- CO18:** Design different IIR and FIR systems. (Creating)
- CO19:** Recognize the different effects related finite word length in digital system. (Creating)

Suggested Readings:

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Pearson.
2. SK Mitra, Digital Signal Processing, Pearson
3. P Ramesh Babu, Digital Signal Processing, SciTech
4. S. Salivahanan, Digital Signal Processing, TMH
5. J. R. Johnson, Introduction of Digital Signal Processing, PHI.
6. Emmanuel C Ifeachor and Barrie W. Jervis, Digital Signal Processing: A Practical Approach, Pearson Education.

ECEEC0050: ANALOG ELECTRONIC CIRCUITS

(3 Credit-45 hours) (L-T-P:3-0-0)

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, analysis and operation of electronics devices and circuits and problem solving skills of electronic circuits.*

Module I (7 hours)

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, LED, photodiode, clamping and clipping circuits

Module II (10 Hours)

PNP and NPN transistors, Structure and I-V characteristics of a BJT, BJT as a switch, BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers, phototransistor, Small signal equivalent circuits (h-parameter model) and analysis CE configuration.

Module III (10 Hours)

JFET and MOSFET structure and I-V characteristics, JFET and MOSFET as a switch, as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, CMOS inverter

Module IV (4 Hours)

Internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product, output voltage swing)

Module V (7 Hours)

Op-amp as Inverting and non-inverting amplifier. Op-Amp applications in constant gain multiplier, Voltage summing, Integrator, Differentiator and controlled sources. Differential amplifier, instrumentation amplifier, active filters, voltage regulator, Zero Crossing Detector, Square-wave and triangular-wave generators

Module VI (7 Hours)

555 Timer: Block diagram, Monostable operation, Astable operation Regulated Power Supply: Voltage feedback regulation, Current limiting characteristics, Power supply characteristics, Current boosters, Switching regulators

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define PN junction diode and their properties and uses. (Remembering)
- CO2:** Explain the working of basic electronic circuits such as transistors, diodes and amplifiers. (Understanding)
- CO3:** Build different circuits using diodes, transistors and OPAMPs. (Applying)
- CO4:** Analyse various amplifier and filter circuits. (Analysing)
- CO5:** Evaluate the performance of 555 timer as monostable and astable vibrator. (Evaluating)
- CO6:** Design amplifiers, integrators, oscillators and filter circuits using OPAMPs. (Creating)

Suggested Readings

1. A. S. Sedra and K. C. Smith, Microelectronic Circuits, Oxford University Press, New York
2. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education
3. S Salivahanan, N Suresh Kumar and A Vallavaraj, Electronic Devices and Circuits, Tata McGraw-Hill
4. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, New Delhi
5. David A. Bell, **Electronic Devices and Circuits**, 4th Edition, Prentice Hall of India, New Delhi
6. Ramakant A Gayakwad Op-Amps and Linear Integrated Circuits, 4th Edition, PHI Learning Publishers

ECBE0051: BASIC ELECTRONICS**(1 Credit-15 hours) (L-T-P:1-0-0)**

Objective: *This course will provide a broad overview of basic electronic components, devices and circuits. The students will develop the ability to apply the basic knowledge in design, analysis and operation of these devices and circuits.*

Module I (4 hours)

Diodes and Applications: Semiconductor Diode – Construction, Operation, V-I Characteristics, Static & Dynamic Resistance, Ideal versus Practical, , Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications.

Module II (4 hours)

Transistors: Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action; BJT Configurations – Common Base, Common Emitter and Common Collector, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of JFET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits.

Module III (4 hours)

Amplifiers & Oscillators: Classification of transistor amplifiers and oscillators; Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Basic Features, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators.

Module IV (3 hours)

Operational Amplifiers and Applications: Introduction to Op-Amp, Op-Amp as Differential Amplifier, Parameters of Op-Amp – CMRR, PSRR, Slew Rate; Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground, Inverting & Non-inverting amplifier.

Number System & Digital Electronics: Introduction to decimal and binary number system; Logic gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR, universal gates.

COURSE / LEARNING OUTCOMES

On successful completion of the course the students will be able to:

- CO1:** Define the various terminologies related to semiconducting materials, basic electronic devices, and simple electronic circuits and systems. (Remembering)

- CO2:** Explain and illustrate the basic working principle and operation of various active components like diodes and transistors. (Understanding)
- CO3:** Apply the knowledge of transistors to design amplifiers and oscillators. (Applying)
- CO4:** Analyse the characteristics/working principle/operation of semiconductors / transistors /op-amps/amplifiers/oscillators. (Analysing)
- CO5:** Evaluate the performance & characteristics of different types of electronic circuits. (Evaluating)
- CO6:** Design and develop different types of electronic circuits (Creating)

Suggested Readings

1. David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India
2. SantiramKal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India
3. Thomas L. Floyd and R. P. Jain (2009), Digital Fundamentals by Pearson Education
4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), Basic Electronics – A Text-Lab. Manual, TMH
5. R. T. Paynter (2009), Introductory Electronic Devices & Circuits, Conventional Flow Version, Pearson

ECEE0052: BASIC ELECTRONICS ENGINEERING

(4 Credits-60 hours) (L-T-P:3-1-0)

Objective: *This course is intended to give a preliminary understanding of the world of Electronics - Semiconducting materials and basic devices, simple circuits and communication systems. It will also serve to create a better appreciation of going digital and to generate continued interest in the course.*

Module I (18 hours)

Semiconductor Devices and Applications: Introduction to types of semiconductors – Intrinsic & Extrinsic, N-type and P-types, Energy Band Diagram; Introduction to P-N junction Diode – Construction, Operation, and V-I characteristics, Static & Dynamic Resistance, Ideal versus Practical, Half wave and Full-wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener diode and its characteristics, Zener diode as voltage regulator; Regulated power supply IC based on 78XX and 79XX series, Introduction to Bipolar Junction Transistor (BJT) – Construction, Operation; BJT Configurations – Common Base, Common Emitter and Common Collector, input-output and transfer characteristics, Operating Point; BJT as a single stage CE amplifier, frequency response and bandwidth.

Module II (16 hours)

Operational Amplifier and its Applications: Introduction to Operational Amplifiers – Equivalent circuit, Transfer Characteristics, Op-Amp input modes and parameters, Ideal Characteristics; Op-Amp in Open Loop Configuration, Op-Amp with Negative Feedback, Concept of Virtual Ground, Practical Op-Amp IC 741, Inverting and Non-inverting Amplifier; Applications of Op-Amp – Summing and Difference Amplifier, Unity Gain Buffer, Comparator, Integrator and Differentiator, Log Amplifier, Instrumentation Amplifier.

Timing Circuits and Oscillators: Oscillators – Basic Features, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator; RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators

Module III (14 hours)

Digital Electronics Fundamentals: Number System and Boolean Algebra, Basic and Universal Gates –Symbols, Truth tables, logic expressions; Logic simplification using K- map, Logic ICs, Half and Full Adder/Subtractor, Multiplexers, Demultiplexers, Flip-Flops, Shift Registers and Counters; Block diagram of Microprocessor/Microcontroller and their applications.

Module IV (12 hours)

Electronic Communication Systems: The Elements of Communication System, IEEE Frequency Spectrum, Signals and its Classification, Types of Signals; Transmission Media – Wired and Wireless, Baseband and Passband transmission; Modulation – Types of Modulation, Need for modulation, AM and FM Modulation schemes; Mobile communication systems – Cellular Concept and Block Diagram of GSM System.

COURSE / LEARNING OUTCOMES

On completion of the course the students will:

- CO1:** Define the various terminologies related to semiconducting materials, basic electronic devices, simple electronic circuits and systems, digital logic circuits and communication systems. (Remembering)
- CO2:** Explain and illustrate the basic working principle and operation of various electronic components and circuits. (Understanding)
- CO3:** Explain different digital components like adders/subtractors, MUX/DEMUX, flip-flops, registers and counters. (Understanding)
- CO4:** Explain & compare the fundamentals of basic communication types. (Understanding)
- CO5:** Apply the knowledge of transistors to build amplifiers and oscillators. (Applying)
- CO6:** Apply the laws and axioms of Boolean algebra to solve/simplify basic digital logic circuits/expressions. (Applying)
- CO7:** Analyse the characteristics/working principle/operation of various analog and digital electronic circuits. (Analysing)
- CO8:** Evaluate the performance & characteristics of different types of electronic circuits (Evaluating)
- CO9:** Design and develop different types of electronic circuits. (Creating)

Suggested Readings

1. Bell, “Electronic Devices & Circuits” Oxford, 5th edition, 2015.
2. Floyd, “Electronic Devices” Pearson Education, 9th edition, 2012.
3. R.P. Jain, “Modern Digital Electronics”, Tata McGraw Hill, 3rd Edition, 2007.
4. Frenzel, “Communication Electronics: Principles and Applications”, Tata McGraw Hill, 3rd Edition, 2001.

ECAP0053: ADVANCED DIGITAL SIGNAL PROCESSING

(3 Credit-45 hours)(L-T-P: 3-0-0)

Objective: *This course is intended to make the students learn the essential advanced topics in digital signal processing that are necessary for successful post graduate-level research. The course includes a review of the linear constant-coefficient system properties covered in an undergraduate DSP course, and then examines a variety of filter structures, time-varying and adaptive systems, fast algorithms, and other topics relevant to the research areas of the students.*

Module I (10 Hours)

Overview of DSP: Discrete time signals and Systems. Characterization in time and frequency, LTI System, the Z-transform, DFT, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design & structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR, FIR differentiators.

Module II (7 Hours)

Multi rate DSP: Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub-band coding.

Module III (8 Hours)

Linear prediction & optimum linear filters: Stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Module IV (8 Hours)

Introduction to adaptive signal processing: Adaptive Filters, FIR adaptive filters: steepest descent adaptive filter, LMS algorithm, Gradient Adaptive Lattice, Minimum mean square criterion, Recursive Least Square algorithm, Applications: noise cancellation, channel equalization, adaptive recursive filters, recursive least squares, Kalman Filter.

Module V (7 Hours)

Estimation of Spectra from Finite-Duration Observations of Signals: Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum Variance Spectral Estimation, Eigen analysis, Algorithms for Spectrum Estimation.

Module VI (5 Hours)

Application of DSP & Multi rate DSP: Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall and illustrate theory of different filters and algorithms. (Remembering, Understanding)
- CO2:** Choose best algorithm for adaptive filter design. (Applying)
- CO3:** Understand theory of multirate DSP, solve numerical problems and write algorithms. (Understanding, Applying)
- CO4:** Analyse theory of prediction and solution of normal equations. (Analysing)
- CO5:** Examine applications of DSP at block level. (Analysing)
- CO6:** Interpret the utilization of advanced algorithms like LMS, MMSE etc., for designing of adaptive filters. (Evaluating)
- CO7:** Design the various types of digital filters. (Creating)

Suggested Readings

1. J. G. Proakis and D. G. Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems-Filter Banks- Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.

3. Bruce W. Suter, "Multirate and Wavelet Signal Processing", 1st Edition, Academic Press, 1997.
4. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
5. S. Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
6. D. G. Manolakis, V.K. Inglean and S. M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

ECDV0054: DIGITAL IMAGE AND VIDEO PROCESSING

(3 credits- 45 hours) (L-T-P: 3-0-0)

Objective: *This course is intended to give the students an overview of important topics of image and video processing. The course starts with an introduction to the basics of image and video processing such as sampling, aliasing etc. and image transforms like DFT, DCT etc. and then moves on to advanced topics such as image and video restoration, segmentation, compression etc. It also introduces the students to concepts of colour image processing.*

Module I (10 Hours)

Digital Image and Video Fundamentals: Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations, ImageTransforms. Need for image transforms, DFT, DCT, Walsh, Hadamard transform, Haar transform, Wavelet transform.

Module II (8 Hours)

Image and Video Enhancement and Restoration: Histogram, Point processing, filtering, image restoration, algorithms for 2-D motion estimation, change detection, motion-compensated filtering, frame rate conversion, deinterlacing, video resolution enhancement, Image and Video restoration (recovery).

Module III (10 Hours)

Image and Video Segmentation: Discontinuity based segmentation- Line detection, edge detection, thresholding, Region based segmentation, Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation, Morphological imageprocessing.

Module IV (7 Hours)

Colour image Processing: Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, Fullcolour processing.

Module V (5 Hours)

Image and Video Compression: Lossless image compression including entropy coding, lossy image compression, video compression techniques, and international standards for image and video compression (JPEG, JPEG 2000, MPEG-2/4, H.264, SVC), Video Quality Assessment.

Module VI (5 Hours)

Object recognition: Image Feature representation and description-boundary representation, boundary descriptors, regional descriptors, feature selection techniques, introduction to classification, supervised and unsupervised learning, Template matching, Bayes classifier.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the fundamental concepts of digital image processing and video processing. (Remembering)

- CO2:** Recall image transforms such as DFT, DCT etc. (Remembering)
- CO3:** Explain concepts such as image and video restoration, segmentation, compression etc. (Understanding)
- CO4:** Outline concepts of colour image processing. (Understanding)
- CO5:** Experiment with different models used for image and video segmentation, compression etc. (Applying)
- CO6:** Analyse the difference between grey scale images and colour images and their respective processing methods. (Analysing)
- CO7:** Assess image and video quality. (Evaluating)
- CO8:** Discuss the concepts of object recognition. (Creating)

Suggested Readings

1. Ed. Al Bovik, "Handbook of Image and Video Processing", 2nd Edition, Academic Press, 2000.
2. J. W. Woods, "Multidimensional Signal, Image and Video Processing and Coding", 2nd Edition, Academic Press, 2011.
3. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
4. A. M. Tekalp, "Digital Video Processing", 2nd Edition, Prentice Hall, 2015.
5. S. Shridhar, "Digital Image Processing", 2nd Edition, Oxford University Press, 2016.

ECAU0055: AUDIO PROCESSING

(3 credits – 45 hours)(L-T-P: 3-0-0)

Objective: *This course is intended to introduce the students to the fundamentals of audio processing and then move on to more advanced topics such as LPC, speech coding etc. The course also delves into applications of audio processing such as speech recognition and speaker recognition.*

Module I (8 Hours)

Principle Characteristics of Speech: Linguistic information, Speech and Hearing, Speech production mechanism, Acoustic characteristic of speech Statistical Characteristics of speech. Speech production models, Linear Separable equivalent circuit model, Vocal Tract and Vocal Cord Model.

Module II (10 Hours)

Speech Analysis and Synthesis Systems: Digitization, Sampling, Quantization and coding, Spectral Analysis, Spectral structure of speech, Autocorrelation and Short Time Fourier transform, Window function, Sound Spectrogram, Mel frequency Cepstral Coefficients, Filter bank and Zero Crossing Analysis, Analysis –by-Synthesis, Pitch Extraction.

Module III (7 Hours)

Linear Predictive Coding Analysis: Principle of LPC analysis, Maximum likelihood spectral estimation, Source parameter estimation from residual signals, LPC Encoder and Decoder, PARCOR analysis and Synthesis, Line Spectral Pairs, LSP analysis and Synthesis.

Module IV (10 Hours)

Speech Coding: Reversible coding, Irreversible coding and Information rate distortion theory, coding in time domain: PCM, ADPCM, Adaptive Predictive coding, coding in Frequency domain: Sub band coding, Adaptive transform coding, Vector Quantization, Code Excited Linear Predictive Coding (CELP).

Module V (5 Hours)

Speech Recognition: Principles of speech recognition, Speech period detection, Spectral distance measure, Structure of word recognition system, Dynamic Time Warping (DTW), Theory and implementation of Hidden Markov Model (HMM).

Module VI (5 Hours)

Speaker recognition: Human and Computer speaker recognition Principles Text dependent and Text Independent speaker recognition systems. Applications of speech Processing.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the fundamental characteristics of speech such as the linguistic information, acoustic characteristics etc. (Remembering)
- CO2:** Explain the mechanism of speech production and reception in the human body. (Understanding)
- CO3:** Explain the fundamentals of audio processing including models for speech production, feature extraction etc. (Understanding)
- CO4:** Examine LPC, PARCOR analysis etc. (Analysing)
- CO5:** Evaluate speech coding techniques. (Evaluating)
- CO6:** Design speech recognition and speaker recognition systems. (Creating)

Suggested Readings

1. Sadaoki Furui, "Digital Speech Processing, Synthesis and Recognition" 2nd Edition, Taylor & Francis, 2000.
2. Rabiner and Schafer, "Digital Processing of Speech Signals", Pearson Education, 1979.

ECCV0056: COMPUTER VISION

(3 credits- 45 hours) (L-T-P: 3-0-0)

Objective: *The course is intended to make an insight into different aspects of Computer Vision and Machine learning, working principles, systems associated and applications.*

Module I (10 Hours)

Image Formation Models: Colour- Generation, Human Perception, Representation, Model for an Image Colour; Camera: Pinhole and Lens Types, geometric Camera model and Camera calibration; Monocular imaging system, Orthographic & Perspective Projection, Binocular imaging systems, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Radiometry, Projections, Transforms- Fourier, Hough and Radon; Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

Module II (8 Hours)

Feature Extraction: Image representations (continuous and discrete), Scene Segmentation and Labeling; Counting Objects; Edge detection, Edge linking, corner detection, texture, binary shape analysis, boundary pattern analysis, circle and ellipse detection, Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges;

Module III (10 Hours)

Shape Representation and Segmentation: Statistical Decision Theory; Pattern Recognition Principles; Clustering Approach- K- Means Clustering; Parametric Approach- Bayes' Classifier; Relaxation Approach; Shape Similarity Based Recognition; Expert System; Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, B-Splines, Least Squares and Eigen Vector Line Fitting, Medial representations, Multi-resolution analysis, Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation

Module IV (5 Hours)

Motion Detection and Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Background Subtraction and Modeling, Optical Flow, KLT, Spatio Temporal Analysis, Dynamic Stereo; Motion parameter estimation, Structure from motion, Motion Tracking in Video.

Module V (7 Hours)

Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition, Geometric templates from spatial relations, Probabilistic and inferential methods- neural networks, support vector machines; Recognition by relations between templates.

Module VI (5 Hours)

Applications of Computer Vision: Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle Vision Systems, CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the working of camera and explain behavior of various sources, surfaces, shadows, human visual systems etc. (Remembering, Understanding)
- CO2:** Illustrate the image formation models and feature extraction for computer vision. (Understanding)
- CO3:** Perform various image analysis operations on the images and videos such as segmentation, counting objects, shape determination, feature extraction etc. (Applying)
- CO4:** Write algorithms for high level vision analysis such as object detection and classifications using input features and classifiers. (Applying)
- CO5:** Perform mid-level vision analysis of images and videos such as segmentation using clustering, graph based etc., using advanced algorithms. (Analysing)
- CO6:** Evaluate the segmentation and motion detection and estimation techniques. (Evaluating)
- CO7:** Develop small applications and detect the objects in various applications. (Creating)

Suggested Readings

1. D. Forsyth and J. Ponce, "Computer Vision - A modern approach", 2nd Edition, Pearson Prentice Hall, 2012
2. Szeliski, Richard, "Computer Vision: Algorithms and Applications", 1st Edition, Springer Verlag London Limited, 2011.

3. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.
4. K. Fukunaga, "Introduction to Statistical Pattern Recognition", 2nd Edition, Morgan Kaufmann, 1990.
5. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
6. B. K. P. Horn, "Robot Vision", 1st Edition, McGraw-Hill, 1986.
7. E. R. Davies "Computer and Machine Vision: Theory, Algorithms, Practicalities", 4th Edition, Elsevier Inc, 2012.

ECAA0057: ADVANCED COMPUTER ARCHITECTURE

(3 credits- 45 hours)(L-T-P: 3-0-0)

Objective: *The main objective of this course is to introduce the students with the concept of parallelism and pipelining, the design aspects and challenges. After this course students will be able to evaluate the issues in vector and array processors. They will also learn about high performance scalable multithreaded and multiprocessor systems.*

Module I (5 Hours)

Parallel Processing and Pipelining Processing- Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture

Module II (10 Hours)

Pipeline Architecture-Principles and implementation of Pipelining, Classification of pipelining processors, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Advanced pipelining techniques, Software pipelining, VLIW (Very Long Instruction Word) processor.

Module III (8 Hours)

Vector and Array Processor- Issues in Vector Processing, Vector performance modeling, SIMD Computer Organization, Static Vs Dynamic network, Parallel Algorithms for Array Processors: Matrix Multiplication.

Module IV (7 Hours)

Multiprocessor Architecture - Loosely and Tightly coupled multiprocessors, Inter Processor communication network, Time shared bus, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP).

Module V (5 Hours)

Multithreaded Architecture- Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions, Parallel Programming Techniques: Message passing program development.

Module VI (10 Hours)

Parallel algorithms for multiprocessors- Classification and performance of parallel algorithms, operating systems for multiprocessors systems, Message passing libraries for parallel programming interface, PVM (in distributed memory system), Message Passing Interfaces (MPI).

COURSE / LEARNING OUTCOMES

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

- CO1:** define various types of computer architecture and architecture related concepts. (Remembering)
- CO2:** explain parallelism and pipelining concepts, the design aspects and challenges. (Understanding)
- CO3:** apply various algorithms for processors. (Applying)
- CO4:** Analyse high performance scalable multithreaded and multiprocessor systems. (Analysing)
- CO5:** assess the issues in vector and array processors. (Evaluating)
- CO6:** discuss parallel algorithms for multiprocessors. (Creating)

Suggested Readings

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing" McGraw Hill Education, 2012.
2. Kai Hwang, "Advanced Computer Architecture", McGraw Hill Education, 1993.
3. William Stallings, "Computer Organization and Architecture, Designing for Performance" Prentice Hall, 6th edition, 2006.
4. Kai Hwang, "Scalable Parallel Computing", McGraw Hill Education, 1998.
5. Harold S. Stone "High-Performance Computer Architecture", Addison-Wesley, 1993.

ECSI0058: STATISTICAL INFORMATION PROCESSING

(3 credits- 45 hours)(L-T-P: 3-0-0)

Objective: *This course is intended to introduce the students to the concepts of information processing. The course starts with the fundamental concepts of random variables and then moves on to random processes, random signal modelling, spectral analysis etc. It also covers concepts of information theory and source coding.*

Module I (10 Hours)

Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete & Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Module II (5 Hours)

Random signal modeling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications, Linear System with random input, Forward and Backward Predictions, Levinson Durbin Algorithm.

Module III (10 Hours)

Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing. Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute

Value of Error Estimate Maximum A Posteriori Estimate , Multiple Parameter Estimation Best Linear Unbiased Estimator, Least-Square Estimation Recursive Least-Square Estimator.

Module IV (5 Hours)

Spectral analysis: Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonicsignals.

Module V (8 Hours)

Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon-Fano, Arithmetic, Adaptive coding, RLE, LZW Data compaction, LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

Module VI (7 Hours)

Application of Information Theory: Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements, Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes, & Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the fundamental concepts of random variables and random process. (Remembering)
- CO2:** Explain concepts of statistical decision theory, parameter estimation theory, information theory etc. (Understanding)
- CO3:** Make use of random signal modelling such as HMM etc. and source coding such as Huffman coding etc. (Applying)
- CO4:** Inspect concepts of spectral analysis such as autocorrelation function, periodogram etc. (Analysing)
- CO5:** Evaluate random processes, random signal modelling techniques etc. (Evaluating)
- CO6:** Discuss application of information theory such as BCH codes, Reed-Solomon codes etc. (Creating)

Suggested Readings

1. Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes",4th Edition, McGraw-Hill,2002.
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill,2000.
3. MouradBarkat , "Signal Detection and Estimation", Artech House, 2nd Edition,2005.
4. R G. Gallager, "Information theoryand reliable communication", Wiley, 1stedition, 1968.
5. F. J. MacWilliams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", New York, North-Holland,1977.
6. Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition,2010.

ECVD0059: VOICE AND DATA NETWORKS

(3 credits- 45 hours) (L-T-P: 3-0-0)

Objective: *This course is intended to give the students an exposure to the design criteria of voice and data networks. The course starts with network design and performance issues in general, moves on to introducing the students to issues in design of voice and data networks and then gives an extensive idea on voice networks and data networks.*

Module I(8 Hours)

Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

Module II (7 Hours)

Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

Module III (8 Hours)

Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

Module IV (7 Hours)

Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local areanetworks,

Module V (10 Hours)

Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup, Routing in Internet. End to End Protocols, TCP and UDP, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.

Module VI (5 Hours)

Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the fundamental concepts of network design and network performance issues, network terminology etc. (Remembering)
- CO2:** Explain concepts of voice and data networks. (Understanding)
- CO3:** Apply designs of voice and data networks such as link layer design etc. (Applying)
- CO4:** Inspect concepts of inter-networking, IP protocol and addressing CIDR, TCP, UDP etc. (Analysing)
- CO5:** Evaluate Queuing models, traffic models, Markov systems etc. (Evaluating)
- CO6:** Discuss congestion avoidance, quality of service in packet networks etc. (Creating)

Suggested Readings

1. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufman, 2011.

3. Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1st Edition, Morgan Kaufman, 2004.
4. Walrand, "Communications Network: A First Course", 2nd Edition, McGraw Hill, 2002.
5. Leonard Kleinrock, "Queueing Systems, Volume I: Theory", 1st Edition, John Wiley and Sons, 1975.
6. Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, 1993.
7. Vijay Ahuja, "Design and Analysis of Computer Communication Networks", McGraw Hill, 1987

ECVC0060: AUDIO, VIDEO CODING AND COMPRESSION

(3 credits- 45 hours)(L-T-P: 3-0-0)

Objective: *This course is designed to give the students an idea about multimedia systems and processing. The course starts with basic coding techniques such as Huffman coding etc. and transforms such as DCT etc. and then gives an extensive idea on video and audio coding along with their compression systems.*

Module I (5 Hours)

Introduction to Multimedia Systems and Processing, Lossless Image Compression Systems, Huffman Coding, Arithmetic and Lempel-Ziv Coding, Other Coding Techniques.

Module II (10 Hours)

Lossy Image Compression Systems, Theory of Quantization, Delta Modulation and DPCM, Transform Coding & K-L Transforms, Discrete Cosine Transforms, Multi-Resolution Analysis, Theory of Wavelets, Discrete Wavelet Transforms, Still Image Compression Standards: JBIG and JPEG.

Module III (8 Hours)

Video Coding and Motion Estimation: Basic Building Blocks & Temporal Redundancy, Block based motion estimation algorithms, other fast search motion estimation algorithms.

Module IV (5 Hours)

Video Coding Standards: MPEG-1 standards, MPEG-2 Standard, MPEG-4 Standard, H.261, H.263 Standards, H.264 standard.

Module V (7 Hours)

Audio Coding: Basic of Audio Coding, Audio Coding, Transform and Filter banks, Polyphase filter implementation, Format and encoding, Psychoacoustic Models.

Module VI (10 Hours)

Multimedia Synchronization: Basic definitions and requirements, References Model and Specification, Time stamping and pack architecture, Packet architectures and audio-video interleaving, Multimedia Synchronization, Playback continuity. Video Indexing and Retrieval: Basics of content based image retrieval, Video Content Representation, Video Sequence Query Processing.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the fundamental concepts of multimedia systems and processing. (Remembering)
- CO2:** Outline concepts of lossy and lossless image compression systems, still image compression standards etc. (Understanding)
- CO3:** Make use of standards of audio and video coding. (Applying)
- CO4:** Analyse motion estimation algorithms. (Analysing)

- CO5:** Evaluate multimedia synchronization, audio-video interleaving video indexing and retrieval etc. (Evaluating)
- CO6:** Discuss applications of audio coding, video coding and various compression systems. (Creating)

Suggested Readings

1. Iain E.G. Richardson, "H.264 and MPEG-4 Video Compression", Wiley, 2003.
2. Khalid Sayood, "Introduction to Data Compression", 4th Edition, Morgan Kaufmann, 2012
3. Mohammed Ghanbari, "Standard Codecs: Image Compression to Advanced Video Coding", 3rd Edition, The Institution of Engineering and Technology, 2011.
4. Julius O. Smith III, "Spectral Audio Signal Processing", W3K Publishing, 2011.
5. Nicolas Moreau, "Tools for Signal Compression: Applications to Speech and Audio Coding", Wiley, 2011.

ECWM0061: WIRELESS AND MOBILE COMMUNICATION

(3 credits- 45 hours)

Objective: *This course is intended to make the students learn the essential advanced topics in wireless communication. The course starts with an introduction to basics of wireless communication such as cellular concepts and then moves on to important advanced topics related to multiple access techniques, equalizers, fading etc. It also introduces the students to 4G and 5G standards that are relevant topics for today's times.*

Module I (10 Hours)

Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM. 2.5G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE.

Module II (8 Hours)

Spectral efficiency analysis based on multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas, Wireless network planning (Link budget and power spectrum calculations).

Module III (10 Hours)

Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Module IV (5 Hours)

Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Module V (7 Hours)

Code Division Multiple Accesses: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Module VI (5 Hours)

Higher Generation Cellular Standards: 3G Standards, evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the fundamental concepts of cellular communication, multiple access techniques etc. (Remembering)
- CO2:** Outline concepts of GSM, GPRS etc. (Understanding)
- CO3:** Utilize GSM, CDMA etc. (Applying)
- CO4:** Analyse spectral efficiency based on multiple access techniques, equalizers in communication receivers etc. (Analysing)
- CO5:** Evaluate path loss, fading, diversity etc. (Evaluating)
- CO6:** Discuss 3G, 4G and 5G standards. (Creating)

Suggested Readings

1. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5thedition,2008.
2. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition,2009.
3. T.S.Rappaport, "Wireless Communications Principles and Practice", 2ndedition,PHI, 2002.
4. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH,1995.
5. AshaMehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London, 1997.

ECSC0062: SATELLITE COMMUNICATION

(3 Credits- 45 hours) (L-T-P: 3-0-0)

Objective: *This course is intended to give the students an exposure to the important concepts of satellite communication. The course starts with fundamental principles of satellite communication and architecture of satellites. It then introduces the students to more advanced topics such as orbital analysis, satellite sub-systems, link budget etc.*

Module I (8 Hours)

Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.

Module II (10 Hours)

Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.

Module III (10 Hours)

Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.

Module IV (7 Hours)

Typical Phenomena in Satellite Communication: Effect of Solar Eclipse on satellite, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Module V (5 Hours)

Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.

Module VI (5 Hours)

Modulation and Multiple Access Schemes used in satellite communication, Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO, GPS.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the brief history of satellite systems and fundamental concepts of satellite communication. (Remembering)
- CO2:** Outline concepts of satellite sub-systems, modulation and multiple access schemes used in satellite communication etc. (Understanding)
- CO3:** Make use of orbital analysis, satellite link budget etc. (Applying)
- CO4:** Analyse phenomena in satellite communication such as effect of solar eclipse on satellite, Doppler shift etc. (Analysing)
- CO5:** Evaluate subsystems such as AOCS, communication subsystem etc. (Evaluating)
- CO6:** Discuss VSAT, DBS-TV etc. (Creating)

Suggested Readings

1. Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition, 2010.
2. S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India, 2011.
3. Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
4. Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.

ECWN0063: WIRELESS SENSOR NETWORKS

(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 WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology, medium access control protocols and address physical layer issues, sensor management, sensor network middleware, operating systems. Also to learn key routing protocols for sensor networks and main design issues, transport layer protocols for sensor networks, and design requirements*

Module I (5 Hours)

Introduction: Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Module II (8 Hours)

Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Module III (7 Hours)

Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Module IV (10 Hours)

Overview of sensor network protocols: Sensor network protocols (details of at least 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Module V (5 Hours)

Data dissemination and processing: Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Module VI (10 Hours)

Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall and illustrate the Concepts, Network Architecture and Applications of Ad-hoc and Wireless Sensor Networks. (Remembering, Understanding)
- CO2:** Illustrate the Concepts, Architecture of ad-hoc and sensor networks and MAC layer protocols. (Understanding)
- CO3:** Identify the design of routing protocols for ad-hoc and wireless networks. (Applying)
- CO4:** Analyse the protocol design issues of Ad-hoc Networks. (Analysing)
- CO5:** Elaborate and Evaluate the QOS related performance measurements of ad-hoc and sensor networks. (Evaluating, Creating)

Suggested Readings

1. H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.
3. F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
4. YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

ECON0064: OPTICAL NETWORKS

(3 Credits- 45 hours)(L-T-P: 3-0-0)

Objective: *This course is intended to give the students an exposure to the design criteria of optical networks. The course starts with fundamentals such as SONET etc. and then deals with practical optical network design issues such as network performance, fault management, optical layer protection schemes etc.*

Module I (5 Hours)

SONET/SDH: Optical transport network, IP, routing and forwarding, multiprotocol label switching.

Module II (8 Hours)

WDM network elements: Optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

Module III (7 Hours)

Control and management: Network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

Module IV (5 Hours)

Network Survivability: Protection in SONET/SDH & client layer, optical layer protection schemes

Module V (10 Hours)

WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

Module VI (10 Hours)

Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the fundamental concepts of optical networks. (Remembering)
- CO2:** Outline concepts of SONET, SDH etc. (Understanding)
- CO3:** Utilize WDM network elements, OADM architectures etc. (Applying)
- CO4:** Analyse network survivability, WDM network design etc. (Analysing)
- CO5:** Evaluate network management functions, optical layer services, interfacing etc. (Evaluating)
- CO6:** Discuss concepts of OTDM, PON, AON etc. (Creating)

Suggested Readings

1. Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3rd edition, 2010.
2. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.

ECCR0065: COGNITIVE RADIO**(3 Credits- 45 hours) (L-T-P: 3-0-0)**

Objective: *This course will help the students to understand the spectrum scarcity problem and how cognitive radio deals with this problem. It will also deals with the contribution of cognitive radio systems in wireless networks and its architectures that enable the development of the cognitive radio network (both centralized and distributed). After this course students will be able to learn the technologies to allow an efficient use of TVWS for radio communications. It also discusses about various cognitive radio standards along with various research challenges for deployment of cognitive radio network.*

Module I (10 Hours)

Introduction: Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

Module II (10 Hours)

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

Module III (8 Hours)

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

Module IV (7 Hours)

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

Module V (5 Hours)

Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).

Module VI (5 Hours)

Research Challenges in Cognitive Radio: Network layer and transport layer issues, crosslayer design for cognitive radio networks.

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall and illustrate the fundamental concepts of cognitive radio networks. (Remembering, Understanding)
- CO2:** Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it. (Applying)
- CO3:** Examine technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies. (Analysing)
- CO4:** Elaborate and evaluate the fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimization techniques for better spectrum exploitation. (Evaluating, Creating)

Suggested Readings

1. Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
2. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
3. Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
4. HuseyinArslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
5. Francisco Rodrigo Porto Cavalcanti, SorenAndersson, "Optimizing Wireless Communication Systems" Springer, 2009.
6. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

ECRC0066: RF AND MICROWAVE CIRCUIT DESIGN

(3 Credits- 45 hours) (L-T-P: 3-0-0)

Objective: *The objectives of this course are to provide students with RF circuit fundamentals for designing various circuit building blocks in a typical RF transceiver. At the completion of the course, students should appreciate the workings of RF transceivers. They are expected to be able to design key building blocks of RF transceivers, including low-noise amplifiers, standard matching circuits, RF amplifiers, mixers, power amplifiers and RF oscillators.*

Module I (8 Hours)

Transmission Line Theory: Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.

Module II (7 Hours)

Microwave Network Analysis: Impedance and equivalent voltage and current, Impedance and admittance matrix, the scattering matrix, transmission matrix, Signal flow graph.

Module III (10 Hours)

Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.

Module IV (5 Hours)

Nonlinearity And Time Variance in Microwave Circuits: Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.

Module V (10 Hours)

Microwave Semiconductor Devices And Modeling: PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.

Module VI (5 Hours)

Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators, Mixers design.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain the behavior of RF passive components and model active components. (Understanding)

- CO2:** Perform transmission line analysis. (Applying, Analysing)
CO3: Demonstrate use of Smith Chart for high frequency circuit design. (Understanding)
CO4: Justify the choice/selection of components from the design aspects. (Evaluating)
CO5: Contribute in the areas of RF circuit design. (Creating)

Suggested Readings

1. Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", AuthorHouse, 2009.
2. D.M.Pozar, " Microwave engineering" ,Wiley, 4th edition, 2011.
3. R.Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc, 2009.
4. G.D. Vendelin, A.M. Pavo, U. L. Rohde, "Microwave Circuit Design Using Linear And Non Linear Techniques", John Wiley 1990.
5. S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987.

ECMA0067: MICROCONTROLLERS AND APPLICATIONS

(3 credits- 45 hours)

Objective: *The course helps to develop an in-depth understanding of the operation of microcontrollers, assembly language programming and microcontroller interfacing techniques. The students will be able to design and implement microcontroller based systems in both hardware and software and can apply this knowledge to more advanced structures.*

Module I (7 hours)

Introduction: History of Microcontrollers and Microprocessors. Differences between Microcontrollers and Microprocessors, Introduction to MPU of different categories- such as Microcontroller-8051, AVR, PIC, etc., their specific features, advantages.

Module II (10 hours)

Microcontroller 8051: Introduction; MCS-51 Architecture; Registers, I/O Ports, Memory organization.

Module III (12 hours)

Assembly Language Microcontroller 8051: Instructions, Addressing modes, Arithmetical, Logical, Jumps, Loops and Call etc., Interrupts Timers/ Counters and Serial Communications.

Module IV (8 hours)

Application of MCS-51: Interfacing 7-segment display, LCD, Key board, ADC etc. Development of instrumentation system such as temperature, pressure, flow, frequency, pulse width, voltage, rpm, pH etc. monitoring. Generation of PWM wave, Data- logger, alarm enunciators, PID controller, programmable controller and interlock control.

Module V (8 hours)

Introduction to PIC microcontrollers: Architecture, Mid-Range instruction Set, Power Input and Decoupling, Reset, Watchdog Timer, System Clock/Oscillators.

COURSE/LEARNING OUTCOMES

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

- CO1:** define various terminologies related to microprocessor and microcontrollers. (Remembering)

- CO2:** differentiate between microprocessor and microcontroller and to explain the internal organization of 8051 microcontroller and PIC16C61 microcontroller. (Understanding)
- CO3:** apply 8051 microcontroller to solve real life problems. (Applying)
- CO4:** Analyse the performance of 8051 microcontroller. (Analysing)
- CO5:** evaluate 8051 microcontroller based system. (Evaluating)
- CO6:** summarize the application of 8051 microcontroller and propose solution for real life applications. (Creating)

Suggested Readings

1. M. A. Mazidi and J. G. Mazidi, the 8051 Microcontroller and Embedded Systems
2. A V Deshmukh, Microcontrollers: Theory and Applications
3. SubrataGhosal, 8051 Microcontroller-Internals, Instructions, Programming and Interfacing, Pearson
4. Md Ali Mazidi, Rolin D. Mc-Kindly and Janice Gillistie, the 8051 Microcontroller and Embedded System Using Assembly and C
5. Lyla B. Das, Embedded Systems-An Integrated Approach, Pearson
6. Relevant Data Sheets

ECPP0068: PARALLEL PROCESSING

(3 Credits- 45 hours)(L-T-P: 3-0-0)

Objective: *The objective of this course is to expose the students to the concept of parallel processing and pipelining. In this course students are introduced to the limitations of different architectures of computer. After this course students will be able to Analyse the performance parameters for different architectures.*

Module I (5 hours)

Overview of Parallel Processing and Pipelining, Performance analysis, Scalability

Module II (10 hours)

Principles and implementation of Pipelining, Classification of pipelining processors, Advanced pipelining techniques, Software pipelining

Module III (10 hours)

VLIW processors, Case study: Superscalar Architecture- Pentium, Intel Itanium Processor, Ultra SPARC, MIPS on FPGA, Vector and Array Processor, FFT Multiprocessor Architecture

Module IV (5 hours)

Multithreaded Architecture, Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions

Module V (10 hours)

Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Shared Memory Programming, Data Parallel Programming, Parallel Software Issues

Module VI (5 hours)

Operating systems for multiprocessors systems, Customizing applications on parallel processing platforms

COURSE/LEARNING OUTCOMES**Suggested Readings:**

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing", MGH
2. International Edition
3. Kai Hwang, "Advanced Computer Architecture", TMH
4. V. Rajaraman, L. Sivaram Murthy, "Parallel Computers", PHI.
5. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition

ECPM0069: PATTERN RECOGNITION AND MACHINE LEARNING**(3 credits- 45 hours)(L-T-P: 3-0-0)**

Objective: *The course is intended to make an insight into different statistical models for pattern recognition problems. This course includes different statistical models, linear regression models, different machine learning tools like Neural Network, Fuzzy Logic and different clustering techniques.*

Module I (10 Hours)

Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

Module II (5 Hours)

Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for classification

Module III (10 Hours)

Neural Network: Perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving backpropagation, additional networks and training methods, Adaboost, Deep Learning

Module IV (8 Hours)

Linear discriminant functions: Decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Module V (7 Hours)

Algorithm independent machine learning: Lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers.

Module VI (5 Hours)

Unsupervised learning and clustering: k-means clustering, fuzzy k-means clustering, hierarchical clustering.

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall, Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques. (Remembering, Understanding)
- CO2:** Summarize, Analyse, and relate research in the pattern recognition area verbally and in writing. (Understanding, Analysing)
- CO3:** Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature. (Applying)
- CO3:** Apply and examine pattern recognition techniques to real-world problems such as document analysis and recognition. (Applying, Analysing)
- CO4:** Implement and evaluate simple pattern classifiers, classifier combinations, and structural pattern recognizers. (Evaluating, Creating)

Suggested Readings

1. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.
3. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

ECDE0070: DETECTION AND ESTIMATION THEORY

(3 Credits- 45 Hours)(L-T-P:3-0-0)

Objective: The objective of the course is to familiarize the students with mathematical understanding of signal detection and estimation. This course also intends to use various approaches to formulate and solve problems for signal detection and parameter estimation from noisy signals.

Module I (5 Hours)

Review of Vector Spaces: Vectors and matrices: notation and properties, orthogonality and linear independence, bases, distance properties, matrix operations, Eigen values and eigenvectors.

Module II (7 Hours)

Properties of Symmetric Matrices: Diagonalization of symmetric matrices, symmetric positive definite and semi definite matrices, principal component analysis (PCA), singular value decomposition.

Module III (10 Hours)

Stochastic Processes: Time average and moments, ergodicity, power spectral density, covariance matrices, response of LTI system to random process, cyclostationary process, and spectral factorization.

Module IV (10 Hours)

Detection Theory: Detection in white Gaussian noise, correlator and matched filter interpretation, Bayes' criterion of signal detection, MAP, LMS, entropy detectors, detection in colored Gaussian noise, Karhunen-Loeve expansions and whitening filters.

Module V (5 Hours)

Estimation Theory: Minimum variance estimators, Cramer-Rao lower bound, examples of linear models, system identification, Markov classification, clustering algorithms.

Module VI (8 Hours)

Topics in Kalman and Weiner Filtering: Discrete time Wiener-Hopf equation, error variance computation, causal discrete time Wiener filter, discrete Kalman filter, extended Kalman filter. Specialized Topics in Estimation: Spectral estimation methods like MUSIC, ESPRIT, DOA Estimation.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define vector spaces, properties of random process and algorithms associated with detection and estimation theory. (Remembering)
- CO2:** Illustrate the mathematical background of signal detection and estimation. (Understanding)
- CO3:** Derive and apply filtering methods for parameter estimation. (Applying)
- CO4:** Examine the importance of properties of matrices in signal detection and estimation. (Analysing)
- CO5:** Compare the performances of various detection and estimation algorithms. (Evaluating)
- CO6:** Use classical and Bayesian approaches to formulate and solve problems for signal detection and parameter estimation from noisy signals. (Creating)

Suggested Readings

1. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory", Prentice Hall, 1993
2. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume II: Detection Theory", 1st Edition, Prentice Hall, 1998
3. Thomas Kailath, Babak Hassibi, Ali H. Sayed, "Linear Estimation", Prentice Hall, 2000.
4. H. Vincent Poor, "An Introduction to Signal Detection and Estimation", 2nd Edition, Springer, 1998.

ECIA0071: IOT AND APPLICATIONS

(3 credits- 45 hours)(L-T-P: 3-0-0)

Objective: The main objective of this course is to introduce the students with the concept of IOT and M2M. In this course they will study IOT architecture and applications in various fields along with the security and privacy issues in IOT.

Module I (10 Hours)

IoT & Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Module II (8 Hours)

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global

information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module III (7 Hours)

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module IV (10 Hours)

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Module V (5 Hours)

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues

Module VI (5 Hours)

Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

COURSE/LEARNING OUTCOMES

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

- CO1:** choose recent technologies related to IOT and Web technologies. (Remembering)
- CO2:** illustrate the concept of IOT and M2M. (Understanding)
- CO3:** apply the concept of IOT architecture and Web technologies. (Applying)
- CO4:** Analyse IOT architecture and applications in various fields. (Analysing)
- CO5:** assess the security and privacy issues in IOT. (Evaluating)
- CO6:** elaborate IOT-Data-Platforms and Data Aggregation used in various purposes. (Creating)

Suggested Readings

1. Vijay Madiseti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013
3. CunoPfister, “Getting Started with the Internet of Things”, OReilly Media, 2011

ECDD0072: DIGITAL DESIGN AND VERIFICATION

(3 credits- 45 hours)(L-T-P:3-0-0)

Objective: The objective of the course is to familiarize the students with Front end design and verification techniques and create reusable test environments. This course also intends to perform verification of increasingly complex designs more efficiently and effectively.

Module I (10 Hours)

Revision of basic Digital systems: Combinational Circuits, Sequential Circuits, Logic families. Synchronous FSM and asynchronous design, Metastability, Clock distribution and issues, basic building blocks like PWM module, pre-fetch unit, programmable counter, FIFO, Booth's multiplier, ALU, Barrel shifter etc.

Module II (8 Hours)

Verilog/VHDL Comparisons and Guidelines, Verilog: HDL fundamentals, simulation, and testbench design, Examples of Verilog codes for combinational and sequential logic, Verilog AMS

Module III (7 Hours)

System Verilog and Verification: Verification guidelines, Data types, procedural statements and routines, connecting the test bench and design, Assertions, Basic OOP concepts, Randomization, Introduction to basic scripting language: Perl, Tcl/Tk

Module IV (8 Hours)

Current challenges in physical design: Roots of challenges, Delays: Wire load models Generic PD flow, Challenges in PD flow at different steps, SI Challenge - Noise & Crosstalk, IR Drop, Process effects: Process Antenna Effect & Electromigration.

Module V (7 Hours)

Programmable Logic Devices: Introduction, Evolution: PROM, PLA, PAL, Architecture of PAL's, Applications, Programming PLD's, FPGA with technology: Antifuse, SRAM, EPROM, MUX, FPGA structures, and ASIC Design Flows, Programmable Interconnections, Coarse grained reconfigurable devices.

Module VI (5 Hours)

IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, and Use of external hard IP during prototyping, Case studies, and Speed issues. Testing of logic circuits: Fault models, BIST, JTAG interface.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define combinational, sequential logic design and PLDs. (Remembering)
- CO2:** Explain the design methodology of HDL (VHDL/Verilog). (Understanding)
- CO3:** Explain the architecture of PLDs. (Understanding)
- CO4:** Apply HDL coding techniques for various combinational and sequential circuit design. (Applying)
- CO5:** Compare different circuit designs for speed, power and noise optimization. (Analysing)
- CO6:** Verify increasingly complex designs more efficiently and effectively. (Evaluating)
- CO7:** Use EDA tools like Xilinx, Cadence, Mentor Graphics for various electronic design. (Creating)

Suggested Readings

1. Douglas Smith, "HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog", Doone publications, 1998.
2. Samir Palnitkar, "Verilog HDL: A guide to Digital Design and Synthesis", Prentice Hall, 2nd Edition, 2003.

3. Doug Amos, Austin Lesea, Rene Richter, "FPGA based Prototyping Methodology Manual", Synopsys Press, 2011.
4. Christophe Bobda, "Introduction to Reconfigurable Computing, Architectures, Algorithms and Applications", Springer, 2007.
5. Janick Bergeron, "Writing Testbenches: Functional Verification of HDL Models", Second Edition, Springer, 2003.

ECBS0073: BIOMEDICAL SIGNAL PROCESSING

(3 credits- 45 hours)(L-T-P: 3-0-0)

Objective: The course will help to develop an in-depth understanding of different types of biomedical signals. The students will be able to identify and Analyse different biomedical signals.

Module I (5 hours)

Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters

Module II (5 hours)

Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's DAC's) Processing, Digital filtering

Module III (7 hours)

Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time-frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant)

Module IV (9 hours)

Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications.

Module V (8 hours)

Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio-Signals analysis Multiresolution analysis (MRA) and wavelets, Principal component analysis(PCA), Independent component analysis(ICA)

Module VI (6 hours)

Pattern classification—supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of biomedical signal classification examples

COURES/LEARNING OUTCOMES

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

- CO1:** define various types of biomedical signals. (Remembering)
- CO2:** illustrate the concept of various types of biomedical signals and their acquisition techniques. (Understanding)
- CO3:** apply signal processing concepts for the conditioning of biomedical signals. (Applying)
- CO4:** Analyse biomedical signals based on different parameters. (Analysing)
- CO5:** assess the signal analysis techniques for biomedical signals. (Evaluating)

CO6: choose and propose soft computing techniques for the processing of biomedical signals. (Creating)

Suggested Readings

1. W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall, 1993.
2. Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley &
3. Son's publication, 2001.
4. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I", McGraw Hill, 2009.
5. D C Reddy, "Biomedical Signal Processing", McGraw Hill, 2005.
6. Katarzyn J. Blinowska, Jaroslaw Zygierevicz, "Practical Biomedical Signal Analysis Using MATLAB", 1st Edition, CRC Press, 2011.

ECDS0074: DSP ARCHITECTURE

(3 credits- 45 hours) (L-T-P: 3-0-0)

Objective: The objective of the course is to familiarize the students with architecture of various DSP hardware. It aims to equip the students with ability to design, programming (assembly and C), and testing code using Code Composer Studio environment and other tools at an intermediate to advanced level that will serve them well towards tackling various problems in this discipline.

Module I (10 Hours)

Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core Algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

Module II (15 Hours)

Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family, TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

Module III (10 Hours)

VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC Module by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

Module IV (5 Hours)

Application of DSPs for signal processing, communication and multimedia. Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware.

Module V (5 Hours)

FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define fixed and floating point processors. (Remembering)
- CO2:** Understanding of major areas and challenges in DSP based embedded systems. (Understanding)
- CO3:** Identify and formalize architectural level characterization of P-DSP hardware. (Applying)
- CO4:** Analyse the architecture and working principles of Digital signal processors (Fixed and Floating). (Analysing)
- CO5:** Evaluate and measure the performance of Fixed and floating point processors. (Evaluating)
- CO6:** Design digital circuits, program (assembly and C), and test code using Code Composer Studio environment. (Creating)

Suggested Readings

1. M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1st Edition, PHI, 2006.
2. Fayez Gebali, "Algorithms and Parallel Computing", 1st Edition, John Wiley & Sons, 2011
3. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff
4. McDonald, "Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman, 2000.
5. Ann Melnichuk, Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press, 2010.
6. Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
7. E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands, 2007.

ECRS0075: ANTENNAS AND RADIATING SYSTEMS

(3 Credits- 45 hours)(L-T-P:3-0-0)

Objective: The objective of this course is to introduce students with the concept of antennas, their principle of operation, analysis and their applications. It will also cover the theory of wave propagation over ground, through troposphere and ionosphere; diversity principles; propagation effects in microwave systems, satellite, space, and radar links.

Module I (10 Hours)

Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Module II (8 Hours)

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non-uniform current.

Module III (7 Hours)

Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

Module IV (8 Hours)

Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. **Horn Antennas:** E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

Module V (7 Hours)

Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.

Module VI (5 Hours)

Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

COURSE/LEARNING OUTCOMES

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

- CO1:** Compute the far field distance, radiation pattern and gain of an antenna for given current distribution. (Applying)
- CO2:** Compute the array factor for an array of identical antennas. (Applying)
- CO3:** Estimate the input impedance, efficiency and ease of match for antennas. (Evaluating)
- CO4:** Design antennas and antenna arrays for various desired radiation pattern characteristics. (Creating)

Suggested Readings

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
3. R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
4. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

ECCN0076: ADVANCED COMMUNICATION NETWORK**(3 Credits- 45 hours)(L-T-P:3-0-0)**

Objective: The main objective of the course is to familiarize the students with concepts in communication networking. This course is intended to teach the students about various protocols in communication networking. 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 this discipline.

Module I (8 Hours)

Overview of Internet-Concepts, challenges and history. Overview of -ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

Module II (10 Hours)

Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP; Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket algorithm and its properties.

Module III (10 Hours)

Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms.High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.; Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

Module IV (7 Hours)

IP address lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producing and controlled prefix expansion algorithms.

Module V (5 Hours)

Admission control in Internet.Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ).DiffServ architecture and framework.

Module VI (5 Hours)

IPV4, IPV6, IP tunnelling, IPswitching and MPLS, Overview of IP over ATM and its evolution to IP switching.MPLS architecture and framework.MPLS Protocols. Traffic engineering issues in MPLS.

COURSE/LEARNING OUTCOMES

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

- CO1:** Definition of basic taxonomy and terminology of the computer networking area. (Remembering)
- CO2:** Understand advanced concepts in Communication Networking. (Understanding)
- CO3:** Understand the mechanisms in Quality of Service in networking. (Understanding)
- CO4:** Apply the basic concepts to build efficient networks. (Applying)
- CO5:** Analyse the network from layers of OSI and TCP/IP model perspective. (Analysing)
- CO6:** Evaluate and measure the performance issues in different networks. (Evaluating)
- CO7:** Design and develop protocols for Communication Networks. (Creating)

Suggested Readings

1. Jean Wairand and PravinVaraiya, "High Performance Communications Networks", 2nd edition, 2000.
2. Jean Le Boudec and Patrick Thiran, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Veriag, 2001.
3. Zhang Wang, "Internet QoS", Morgan Kaufman, 2001.
4. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers, 2004.
5. George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers, 2005.

ECMS0077: MIMO SYSTEM

(3 Credits- 45 hours)(L-T-P:3-0-0)

Objective: This course covers the fundamentals of Multiple input multiple output (MIMO) antenna based wireless communication systems. This course covers important concepts of MIMO communication such as capacity computation, error probability analysis, transmitter and receiver design, multi-user communication, etc. After completion of the course the participants will be able to apply the methods for performance analysis and design of advanced wireless communication systems.

Module I (5 Hours)

Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems.

Module II (10 Hours)

Diversity, Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation

Module III (10 Hours)

The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.

Module IV (8 Hours)

Codebooks for MIMO, Beamforming, Beamforming principles, increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer

Module V (7 Hours)

Case study: MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models

Module VI (5 Hours)

Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers, MIMO for multi-carrier systems (e.g. MIMO-OFDM), multi-user communications, multi-user MIMO. (Understanding)
- CO2:** Illustrate, Analyse and interpret the cooperative and coordinated multi-cell MIMO and MIMO in 4G (LTE, LTE-Advanced, WiMAX). (Understanding, Analysing, Evaluating)
- CO3:** Perform Mathematical modeling and analysis of MIMO systems. (Creating)

Suggested Readings

1. Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design", Academic Press, 1st edition, 2010.
2. Mohinder Janakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.

ECSA0078: EMBEDDED SYSTEMS AND APPLICATIONS

(3 Credits- 45 hours)(L-T-P: 3-0-0)

Objective: The objective of this course is to expose the students to the features of advanced microcontrollers such as PIC and AVR. In this course students are introduced to the architecture, programming and interfacing of all these microcontrollers. Industrial applications of these microcontrollers are also introduced in this course.

Module I (10 Hours)

PIC Microcontroller: Overview of PIC Microcontrollers, PIC16CXX Series: Architecture, Memory Organization, Registers, Oscillator Connections, Reset Actions, I/O ports, Interrupt, Timers, ADC, Watch Dog timer, Instruction Set

Module II (10 Hours)v

PIC16F8XX Series:

- a) Architecture, Memory Organization, Registers, Oscillator Connections, I/O ports, Interrupt, Timers, ADC, Instruction Set, Capture/Compare/PWM Module, MSSP Module, USART, Watch Dog Timer.
- b) Assembly Language Programming using PIC16CXX and PIC16F8XX

Module III (10 Hours)

PIC24FXX Family Microcontroller: Architecture, Memory Organization, Registers, Oscillator Connections, I/O ports, Interrupt, Timers, Watch Dog timer, ADC, PWM, Serial Communications, Programming using Embedded C.

Module IV (15 Hours)

AVR Microcontroller:

- a) Introduction, History, Importance of AVR, Naming Convention of AVR, Mega AVR Series.
- b) ATmega8 Microcontroller: Architecture, Pin Diagram, Memory Organization, Registers, Oscillator Connections, I/O ports, Interrupt, Timers, ADC, Watch Dog timer.
- c) ATmega16 Microcontroller: Architecture, Pin Diagram, Memory Organization, Registers, Oscillator Connections, I/O ports, Interrupt, Timers, ADC, Watch Dog timer.
- d) Programming using ATmega8 and ATmega16.

COURSE /LEARNING OUTCOMES

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

- CO1:** define various terminologies related to embedded system. (Remembering)
- CO2:** explain the internal organization of PIC and AVR microcontroller. (Understanding)
- CO3:** apply PIC and AVR microcontrollers to solve real life problems. (Applying)
- CO4:** Analyse the performance of PIC and AVR microcontrollers. (Analysing)
- CO5:** evaluate various embedded systems used for industry applications. (Evaluating)
- CO6:** summarize the application of PIC and AVR microcontrollers. (Creating)

Suggested Readings

1. V. Deshmukh, Microcontroller: Theory and Applications, TMG, 1st Edition
2. Md. Ali Mazidi, Rolin D. Mckinlay, Danny Causey, PIC Microcontroller and Embedded Systems: Using Assembly and C, Pearson, 1st Edition

3. Md. Ali Mazidi, SarmadNaimi, SepehrNaimi, The AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson, 1st Edition
4. Relevant Data Sheets

ECMT0079: MEMORY TECHNOLOGIES

(3 Credits- 45 hours)(L-T-P: 3-0-0)

Objective: The course helps to develop an in-depth understanding of the various memory types. The students will be able to learn. After this course students will be able to design semiconductor memory circuits and subsystems. They can also identify various fault models, modes and mechanisms in semiconductor memories and their testing procedures.

Module I (10 hours)

Random Access Memory Technologies, Static Random Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOS SRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures, Application Specific SRAMs.

Module II (5 hours)

DRAMs, MOS DRAM Cell, BiCMOS DRAM, Error Failures in DRAM, Advanced DRAM Design and Architecture, Application Specific DRAMs. SRAM and DRAM Memory controllers.

Module III (5 hours)

Non-Volatile Memories, Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs, Floating Gate EPROM Cell, OTP EPROM, EEPROMs, Non-volatile SRAM, Flash Memories

Module IV (10 hours)

Semiconductor Memory Reliability and Radiation Effects, General Reliability Issues, RAM Failure Modes and Mechanism, Non-volatile Memory, Radiation Effects, SEP, Radiation Hardening Techniques. Process and Design Issues, Radiation Hardened Memory Characteristics, Radiation Hardness Assurance and Testing

Module V (10 hours)

Advanced Memory Technologies and High-density Memory Packing Technologies, Ferroelectric Random Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, Analog Memories, Magneto Resistive Random Access Memories (MRAMs), Experimental Memory Devices

Module VI (5 hours)

Memory Hybrids (2D & 3D), Memory Stacks, Memory Testing and Reliability Issues, Memory Cards, High Density Memory Packaging

COURSE/LEARNING OUTCOMES

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

- CO1:** Able to define various memory architecture
- CO2:** Able to explain memory circuits and subsystems
- CO3:** Able to apply various fault models, modes and mechanisms in semiconductor memories and their testing procedures
- CO4:** Able to Analyse advanced memory technologies

CO5: Able to assess various high density memory packing technologies

CO6: Able to discuss memory testing and reliability issues and start of the art memory chip design

Suggested Readings

1. Ashok K Sharma, "Advanced Semiconductor Memories: Architectures, Designs and Applications", Wiley Interscience
2. Kiyooltoh, "VLSI memory chip design", Springer International Edition
4. Ashok K Sharma," Semiconductor Memories: Technology, Testing and Reliability, PHI

ECBS0080: COMMUNICATION BUSES AND INTERFACES

(3 Credits- 45 hours)(L-T-P:3-0-0)

Objective: This main objective of this course is to introduce the students with the concept of various communication buses. After this course students will be able to develop APIs for configuration, reading and writing data onto serial bus and can also design and develop peripherals that can be interfaced to desired serial bus

Module I (8 hours)

Serial Busses, Physical interface, Data and Control signals, features

Module II (8 hours)

Limitations and applications of RS232, RS485, I2C, SPI

Module III (8 hours)

CAN - Architecture, Data transmission, Layers, Frame formats, applications

Module IV (8 hours)

PCI - Revisions, Configuration space, Hardware protocols, applications

Module V (8 hours)

USB - Transfer types, enumeration, Descriptor types and contents, Device driver

Module VI (5 hours)

Data Streaming Serial Communication Protocol, Serial Front Panel Data Port (SFPDP) using fiber optic and copper cable

COURSE/LEARNING OUTCOMES

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

CO1: Able to define various terms related to serial buses

CO2: Able to explain features of serial buses

CO3: Able to apply serial buses for a particular application

CO4: Able to Analyse APIs for configuration, reading and writing data onto serial bus

CO5: Able to assess various peripherals that can be interfaced to desired serial bus

CO6: Able to discuss data streaming serial communication protocol, serial front panel data port using fiber optic and copper cable

Suggested Readings

1. Jan Axelson, "Serial Port Complete - COM Ports, USB Virtual Com Ports, and Ports for Embedded Systems", Lakeview Research, 2nd Edition

3. Jan Axelson, "USB Complete", Penram Publications
4. Mike Jackson, Ravi Budruk, "PCI Express Technology", Mindshare Press
5. Wilfried Voss, "A Comprehensive Guide to Controller Area Network", Copperhill Media Corporation, 2nd Edition, 2005.
6. Serial Front Panel Draft Standard VITA 17.1 – 200x
7. Technical references on www.can-cia.org, www.pcisig.com, www.usb.org

ECRS6008: RESEARCH SEMINAR II - MTECH

(4 credits)

Tasks to be performed by the students during this research Seminar include

1. Preparation of the Project Proposal that will be developed during semesters 3 and 4 and/or extensive literature survey leading to the project proposal
2. Presentation on the proposed proposal comprising the following three components:
 - a. Presentation
 - b. Report
 - c. Viva Voce Examination
3. Extra credits will be given for any publication during this phase.

COURSE / LEARNING OUTCOMES

At the end of the Research Seminar students will be able to:

- CO1:** List sources of primary and secondary data for review of a topic of interest. (*Knowledge*)
- CO2:** Locate various sources of primary and secondary data for review of a topic of interest. (*Comprehension*)
- CO3:** Prepare a review report on topic of interest from the various listed sources of information. (*Application*)
- CO4:** Illustrate scientific concepts for a topic of interest with simple words, diagrams, explanations, conclusions etc. (*Analysis*)
- CO5:** Arrange the related information gathered and present it. (*Synthesis*)
- CO6:** Summarize research findings on a specific topic in the form of a review article. (*Evaluation*)

ECMP6009: PROJECT PHASE I - MTECH

(12 credits)

Objectives: During this phase the student will start a research 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

COURSE / LEARNING OUTCOMES

At the end of Project Phase I students will be able to:

- CO1:** Select a project of interest. (*Knowledge*)

- CO2:** Defend the topic of interest for continuing work, by doing initial studies on it. (*Comprehension*)
- CO3:** Prepare a working methodology for the project for its successful completion. (*Application*)
- CO4:** Design and experiment on the selected project. (*Analysis*)
- CO5:** Devise tools and methods for experimenting and troubleshooting for getting expected outcomes. (*Synthesis*)
- CO6:** Explain, justify and defend the project work by presenting the work and writing a report. (*Evaluation*)

ECMP6013: PROJECT PHASE II - MTECH

(16 credits)

Objective: During this phase the student will carry forward and complete the work that they have started in Phase I. It is expected that the student will publish at least one research paper in a well-known journal to augment their work during this phase. Published papers will carry extra weightage during evaluation. The mode and components of evaluation and the weightages attached to them shall be published by the Department at the beginning of the semester.

E-resource for learning:

LaTeX, www.spokentutorial.org

COURSE / LEARNING OUTCOMES

At the end of Mini Project II students will be able to:

- CO1:** Select a project of interest. (*Knowledge*)
- CO2:** Defend the topic of interest for continuing work, by doing initial studies on it. (*Comprehension*)
- CO3:** Prepare a working methodology for the project for its successful completion. (*Application*)
- CO4:** Design and experiment on the selected project. (*Analysis*)
- CO5:** Devise tools and methods for experimenting and troubleshooting for getting expected outcomes. (*Synthesis*)
- CO6:** Explain, justify and defend the project work by presenting the work and writing a report. (*Evaluation*)

ECMM6020: MICROPROCESSORS AND MICROCONTROLLERS LAB

(2 credits)

1. Introduction to 8085 kit and simulator.
2. Addition and Subtraction of two 8 –bit numbers without using H-L pair and with H-L pair.
3. Decimal Addition of two 8-bit numbers using DAA and without DAA Operation
4. Multiplication of two 8-bit numbers.
5. Perform AND, OR, NOT, rotate and shift operation on an 8 bit number.
6. Find the Largest number and smallest number in an Array.
7. Arrange an array in ascending order.
8. Addition of 10 bytes data.

9. Search a byte from an array
10. Binary to Gray and Gray to Binary Conversion.
11. Find one's complement and two's complement of an 8 bit no.
12. To generate Fibonacci Series up to 10th term.
13. To count the number of 1's and 0's in a Register.
14. Interfacing with Traffic Light controller and Stepper motor Controller.
15. Interfacing with 8 channels 8-bit ADC Card and Dual channel 8-bit DAC Card.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall and Identify the basic components of the 8085 kit. (Remembering)
- CO2:** define and develop an in-depth understanding of microprocessor interfacing techniques. (Understanding)
- CO3:** develop an in-depth understanding of Assembly Language Programming and apply it in the designing of microprocessor based system. (Applying)
- CO4:** Analyse various Assembly Language Programs and interfacing circuits practically (Analysing)
- CO5:** evaluate the various microprocessor based systems. (Evaluating)
- CO6:** design and develop microprocessor-based systems (Creating)

ECAC6021: ANALOG COMMUNICATION TECHNIQUES LAB

(2 credits)

1. Realization of "Colpitt Oscillator" using BJT (Bipolar junction Transistor).
2. Realization of "Hartley Oscillator" using BJT (Bipolar junction Transistor).
3. Realization of "Amplitude Modulation Circuit".
4. Realization of "Envelope Detector Circuit" which is used to envelope an AM signal.
5. Realization of "Band pass and Band reject filter".
6. To Study the Characteristic of Single Sideband AM Modulation.
7. To Study Armstrong Frequency Modulator.(using both discrete circuit and kit)
8. To Study the Frequency Division Multiplexing/De-multiplexing with Sinusoidal Wave.
9. To Study Pulse Width Modulation using IC-555 Timer.
10. To Study the Measurement of Noise Figure.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Define the components practically used in analog communication laboratory. (Remembering)
- CO2:** Compare the theoretical knowledge through practical (*Understanding*)
- CO3:** Apply basic knowledge of signals and systems. (*Applying*)
- CO4:** Analyse the nature of signals during the transmission & reception. (*Analysing*)
- CO5:** Assess analog modulated waveform in time /frequency domain and also find modulation index. (Evaluating)
- CO6:** Design different circuits related to generation and detection of AM based application, carrier generation, filtering applications, multiplexing etc. (*Creating*)

ECDP6022: DIGITAL SIGNAL PROCESSING LAB

(2 credits)

At least eight experiments are to be performed from the following.

1. Different types of Signal generation using MATLAB. (Both continuous and discrete.)
2. Linear Convolution of sequences. (Without using the inbuilt function (conv) available in MATLAB.)
3. Circular Convolution of two Sequences. Comparison of result with the result obtained from Linear convolution.
4. i) Finding Auto correlation of a sequence
ii) Finding cross correlation of 2 sequences
iii) Finding power spectral density of a sequence.
5. Finding linear convolution of periodic sequences using DFT and IDFT.
6. Implementation of FFT (Fast Fourier Transform) algorithm i) Decimation in Time (DIT)
ii) Decimation in Frequency (DIF)
7. Design of FIR filter (lowpass, highpass, bandpass). Using windowing technique (hanning window, hamming window, rectangular window, Kaiser window)
8. Design of IIR filter. (Design of Butterworth Filter Design of Chebyshev filter).
9. Convolution of long duration sequences using overlap add, overlap save method.
10. Working with a DSP processor. (fixed point -TMS320C-5X / Floating point) series.
11. Implement convolution (Linear and circular convolution)
12. FIR and IIR implementation.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall and outline the basics of MATLAB software (*Remembering*)
- CO2:** Identify the built in functions and coding techniques of MATLAB (*Remembering*)
- CO3:** Classify and explain the different data types in MATLAB software. (*Understanding*)
- CO4:** Demonstrate the applications of Matlab in signal and system manipulations. (*Understanding*)
- CO5:** Design and simulate digital systems such as digital filters using MATLAB and applying the same in fields like Communication, VLSI etc. (*Applying*)
- CO6:** Classify and Analyse various digital signals, transform techniques and filtering techniques using MATLAB simulation (*Analysing*)
- CO7:** Evaluate the performance of different MATLAB coding methods, algorithm for simulation and digital signals processing schemes. (*Evaluating*)
- CO8:** Simulate different digital signals and LTIC digital systems using MATLAB simulation. (*Creating*)

ECMI6023: MINI PROJECT II

(2 credits)

Mini projects are assigned to students individually or in groups by the Department under the supervision of the designated faculty member. The objective of the mini project is to train the

students to design, simulate or study mini electronic or communication systems which will give them hands on experience in re-creating the principles they have studied in their engineering classes. Mini projects executed during the fifth semester must display a greater maturity of knowledge than those in the fourth semester.

COURSE / LEARNING OUTCOMES

At the end of Mini Project II students will be able to:

- CO1:** Choose different electronic components and instruments required for the project. (Remembering)
- CO2:** Explain different problems encountered in designing a system (Understanding)
- CO3:** Apply the domain knowledge to find out the solution for real life problems. (Applying)
- CO4:** Analyse the performance of the various electronic components used in the system. (Analysing)
- CO5:** Evaluate the results obtained from the designing of electronic systems. (Evaluating)
- CO6:** Discuss, improve and maximize the performance of the developed project. Also compile a technical report of the project. (Creating)

ECVD6024: VLSI DESIGN LAB

(2 credits)

1. Code the behavior of AND, OR, NOT, NAND, NOR, Ex-OR and Ex-NOR. Repeat the experiment using FPGA board.
2. Behavioral, Structural and Dataflow modeling of Half-Adder. Repeat the experiment using FPGA board.
3. Code the behavioral modeling of Half-Adder in VHDL and use this behavioral model to implement structural modeling of Full-Adder. Repeat the experiment using FPGA board.
4. Code the behavioral modeling of Full-Adder in VHDL and use this behavioral model to implement structural modeling of 4-bit parallel adder. Repeat the experiment using FPGA board.
5. Code the behavioral modeling of 4-bit carry look ahead adder in VHDL. Repeat the experiment using FPGA board.
6. Code the behavioral modeling of 4:1 multiplexer in VHDL and use this model to implement 8:1 multiplexer. Repeat the experiment using FPGA board.
7. Code the behavioral modeling of RS Flip-Flop and modify it to J-K, D and Master Slave J-K Flip-Flop. Repeat the experiment using FPGA board.
8. Code the behavioral modeling of 4-bit binary up-down counter in VHDL. Repeat the experiment using FPGA board.
9. Code the behavioral modeling of 4-bit shift register in VHDL. Repeat the experiment using FPGA board.
10. Code the structural modeling of 4-bit synchronous counter. Repeat the experiment using FPGA board.
11. Code the generic modeling of all the gates. Repeat the experiment using FPGA board.
12. Design a state machine for a 4-bit pattern identifier. Pattern to be identified is 0110. Overlap pattern is permitted. Output will be 1 for every pattern to be matched.
13. Overlap pattern is permitted. Output will be 1 for every pattern to be matched.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Define Hardware Descriptive Language (VHDL and VERILOG). (Remembering)

- CO2:** Define Combinational and Sequential digital circuits. (Remembering)
- CO3:** Define Field Programmable Gate Array (FPGA). (Remembering)
- CO4:** Explain the working principles of various combinational and sequential circuits. (Understanding)
- CO5:** Explain dataflow, behavioral and structural modelling of hardware descriptive language. (Understanding)
- CO6:** Explain the basic steps in running a program written in VHDL/VERILOG in Xilinx. (Understanding)
- CO7:** Explain the fundamental blocks present in FPGA and the basic steps for interfacing, downloading and executing a HDL program in FPGA. (Understanding)
- CO8:** Build combinational and sequential digital circuits using Xilinx-VHDL/VERILOG Language. (Applying)
- CO9:** Analyse the working principle of list of combinational and sequential digital circuits. (Analysing)
- CO10:** Analyse the test bench waveform of the simulated circuits using Xilinx ISE. (Analysing)
- CO11:** Evaluate the performance of combinational and sequential circuits in Xilinx. (Evaluating)
- CO12:** Evaluate the Output of combinational and sequential circuits in FPGA. (Evaluating)
- CO13:** Synthesize the list of combinational and sequential circuits using Xilinx tool. (Creating)
- CO14:** Implement the simulated circuits in FPGA. (Creating)

ECCT6025: DIGITAL COMMUNICATION LAB

(2 credits)

1. To study and implement PPM using IC555 Timer.
2. Study of PCM using Time Division Multiplexing (Trainer based and Simulation).
3. Design and study of a sampling and reconstruction circuit using discrete components.
4. Study of Delta Modulation and Adaptive Delta Modulation using hardware kit.
5. Generation and detection of ASK Modulation and Demodulation using a) Hardware kit
b) Discrete components
6. Generation and detection of FSK Modulation and Demodulation using a) Hardware kit
b) Simulation
7. Generation and detection of PSK and DPSK Signals using a) Hardware kit
b) Simulation
8. Study of QPSK Modulation and Demodulation. a) Hardware kit b) Simulation
9. Design of a Block Code Encoder. (6, 3)/ (7, 4) Block Code.
10. Design of a PN Sequence Generator.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** define pulse modulation techniques and to recognize the necessary hardware to design them. (Remembering)
- CO2:** define a technique to convert an analog signal into digital signal using sample and hold circuit. (Remembering)

- CO3:** define various digital modulation techniques and to recognize the necessary hardware to design them. (Remembering)
- CO4:** explain the necessary hardware for pulse modulation. (Understanding)
- CO5:** explain the hardware required in a sample and hold circuit. (Understanding)
- CO6:** explain the hardware required for various digital modulation techniques. (Understanding)
- CO7:** explain the necessary hardware for PN sequence generator. (Understanding)
- CO8:** develop hardware for pulse modulation techniques. As well as a converter that converts an analog signal into digital signal. (Applying)
- CO9:** develop hardware for various digital modulation techniques along with a hardware for PN sequence generator. (Applying)
- CO10:** Analyse the importance of the components used in the hardware for pulse modulation techniques. (Analysing)
- CO11:** Analyse the importance of the components used in the hardware for a converter that converts an analog signal into digital signal. (Analysing)
- CO12:** Analyse the importance of the components used in the hardware for various digital modulation techniques. (Analysing)
- CO13:** Analyse the importance of the components used in the hardware for PN sequence generator. (Analysing)
- CO14:** select necessary component to design hardware to convert an analog signal into digital signal. (Evaluating)
- CO15:** select necessary component to design hardware for pulse modulation techniques as well as various digital modulation techniques. (Evaluating)
- CO16:** select necessary component to design hardware for PN sequence generator. (Evaluating)
- CO17:** develop hardware to convert an analog signal into digital signal. (Creating)
- CO18:** develop hardware for pulse modulation techniques. (Creating)
- CO19:** develop hardware for various digital modulation techniques. (Creating)
- CO20:** develop hardware for PN sequence generator. (Creating)

ECME6026: MICROWAVE AND ANTENNA ENGINEERING LAB

(2 credits)

1. V-I characteristics of Gunn Diode.
2. Study the characteristics of Square Wave Modulation of Reflex- Klystron tube for NV-9000 .
3. Determine the frequency and wavelength in a rectangular wave guide working on TE₁₀ mode.
4. Determine the SWR and Reflection Co-efficient.
5. Study the function of the Multi-hole Directional Coupler.
6. Study of Scattering parameters of Circulator.
7. Study of Scattering parameters of E-plane Tee and H-plane Tee.
8. Study of Scattering parameters of Magic Tee
9. Study of the Reciprocity theorem for antennas, the variation in the radiation strength at a given distance from the antenna and to perform Polarisation test.

10. Study the Radiation Pattern for Yagi-UDA folded dipole antenna and the Simple dipole $\lambda/2$ antenna.
(Following experiments are to be simulated in Matlab)
11. Create a default open ended rectangular waveguide. Vary its properties and display it.
Plot the E and H field distribution of this waveguide at 2.1GHz.
12. Create a dipole antenna of length 3m and width 0.5m and then plot its radiation pattern in both polar and rectangular co-ordinate system. Visualize 2D slices from 3D data. Also calculate the HPBW and FNBW from the plot.
13. Create and view a default horn antenna. Vary its properties and plot its radiation pattern. Also calculate the HPBW and FNBW from the plot.
14. Create a default linear antenna array using dipole antenna as individual element. Visualize the geometry of the array, the radiation pattern, directivity and current distribution.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** define different passive/active components and how to connect them to perform experiments. (Remembering)
- CO2:** compare the characteristics and performances of different microwave components, devices and circuits using standard test bench. (Understanding)
- CO3:** apply the theoretical knowledge for measuring different parameters experimentally (Applying)
- CO4:** Analyse and test the characteristics and performances of different microwave components, devices and circuits using standard test bench. (Analysing)
- CO5:** Analyse and test the characteristics of dipole and Yagi antenna through radiation pattern plots and polarization matching. (Analysing)
- CO6:** compare the experimental results with theoretical values and provide a suitable conclusion. (Evaluating)
- CO7:** design and determine the performance characteristics of different antennas and antenna arrays in MATLAB. (Creating)

ECAM6027: EMBEDDED SYSTEMS LAB

(2 credits)

1. Introduction to 8051 micro controller boards and AVR Micro controller boards.
2. Introduction to 8086 and 8051 microcontroller simulator.
3. ALP to display a message without array and using array.
4. ALP to transfer one byte and two byte nos. from one set of memory location to another using 8086.
5. ALP to add, subtracts, multiply and divide of one byte and two byte nos. using 8086.
6. ALP to rotate, AND, OR, NOT of one byte and two byte nos. using 8086.
7. ALP to find some mathematical expression using 8086.
8. ALP to transfer one byte and two byte nos. from one set of memory location to another using 8051.

9. ALP to add, subtracts, multiply and divide of one byte and two byte nos. using 8051.
10. ALP to rotate, AND, OR, NOT of one byte and two byte nos. using 8051.
11. ALP to find some mathematical expression using 8051.
12. ALP using Recursive and iterative procedure, timers using 8086.
13. ALP to interface LEDs, 7 Segment display and LCD using 8051.
14. ALP to On/off DIP switches using 8051.
15. ALP to interface ADC and DAC using 8051.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall the basic concepts required to write programs using 8086 microprocessor and 8051 microcontroller. (Remembering)
- CO2:** Explain the concept of assemblers and development board. (Understanding)
- CO3:** Apply knowledge of programming for interfacing. (Applying)
- CO4:** Compare 8086 microprocessor with 8051 microcontroller. (Analysing)
- CO5:** Assess various input output devices with 8051 microcontroller. (Evaluating)
- CO6:** Elaborate the performance of 8086 microprocessor and 8051 microcontroller. (Creating)

ECSP6028: SIGNAL PROCESSING LAB

(2 Credits)

At least eight experiments are to be performed from the following.

1. Different types of Signal generation using MATLAB. (both continuous and discrete.)
2. Linear Convolution of sequences. (Without using the inbuilt function (conv) available in MATLAB.)
3. Circular Convolution of two Sequences Compression of result with the result obtained from Linear convolution.
4. Socket Programming (java or c).
 - i) Finding Auto correlation of a sequence ii) Finding cross correlation of 2 sequences
 - iii) Finding power spectral density of a sequence.
5. Finding the convolution of periodic sequence using DFT and IDFT.
6. Implementation of FFT (Fast Fourier Transform) algorithm i) Decimation in Time (DIT)
 - ii) Decimation in Frequency (DIF)
7. Design of FIR filter (lowpass, highpass, bandpass). Using windowing technique (hanning window, hamming, window rectangular window, Kaiser window).
8. Design of IIR filter. (Design of Butterworth Filter Design of Chebyshev filter).
9. Convolution of long duration sequences using overlap add, overlapsave meter.
10. Working with a DSP processor. (fixed point -TMS320C-5X / Floating point) series. i) Implement convolution (Linear and circular convolution)
 - ii) FIR and IIR implementation.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** define various signals and systems and various operations used in digital systems, various algorithms for fast Fourier transform as well as various digital filters. (Remembering)
- CO2:** Explain various signals and systems using MATLAB, explain various algorithms for fast Fourier transform using MATLAB, various operations used in digital systems and digital filters using MATLAB. (Understanding)
- CO3:** Experiment with various signals and calculate the output of various operations used in signal and systems using software tools like MATLAB. (Applying)
- CO4:** Compute fast Fourier transform of a signal as well as design various digital filters using MATLAB. (Applying)
- CO5:** Analyse various signals and systems using MATLAB, various algorithms for fast Fourier transform using MATLAB. (Analysing)
- CO6:** Analyse various operations used in digital systems and digital filters using MATLAB. (Analysing)
- CO7:** Evaluate a LTI system for processing a signal in a given situation using MATLAB. (Evaluating)
- CO8:** Evaluate an algorithm for fast Fourier transform for a specific condition using MATLAB. (Evaluating)
- CO9:** develop various signals and systems, LTI systems using MATLAB. (Creating)
- CO10:** develop various algorithms for fast Fourier transform using MATLAB. (Creating)
- CO11:** develop various operations used in digital systems using MATLAB. (Creating)
- CO21:** Pick an operation to be used in digital systems using MATLAB. (*Evaluation*)

ECMI6029: MINI PROJECT III

(2 credits)

Mini projects are assigned to students individually or in groups by the Department under the supervision of the designated faculty member. The objective of the mini project is to train the students to design, simulate or study mini electronic or communication systems which will give them hands on experience in re-creating the principles they have studied in their engineering classes. The mini projects taken up in the sixth semester are expected to be more advanced than the mini projects taken up in previous semesters.

COURSE / LEARNING OUTCOMES

At the end of Mini Project II students will be able to:

- CO1:** Choose different electronic components and instruments required for the project. (Remembering)
- CO2:** Explain different problems encountered in designing a system (Understanding)
- CO3:** Apply the domain knowledge to find out the solution for real life problems. (Applying)
- CO4:** Analyse the performance of the various electronic components used in the system. (Analysing)
- CO5:** Evaluate the results obtained from the designing of electronic systems. (Evaluating)
- CO6:** Discuss, improve and maximize the performance of the developed project. Also compile a technical report of the project. (Creating)

ECOP6030: FIBER OPTIC COMMUNICATION LAB**(2 credits)**

1. Setting up a fiber optic analog link using 650nm wavelength LED
2. Setting up a fiber optic analog Link using 950 nm wavelength LED
3. Setting up the frequency modulation technique.
4. Study of bending loss over optical fiber.
5. Study of numerical aperture of an optical fiber.
6. Setting up an analog time division multiplexed and de-multiplexed through optical fiber communication link.
7. Study of the characteristics of laser diodes.
8. Optical Power (P_o) of laser diode vs. laser diode forward current (IF).
9. Monitor photo diode current (IM) vs. laser optical power output (P_o).
10. Study of radiation pattern of LED.
11. Study of Pulse Wide Modulation technique through optical fiber link
12. Setting up of fibre-optic link in optical bench
13. Measuring the refractive index of glass using Brewster's Angle

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** List and define the various instruments/devices and experimental kit used in the fiber optics lab (*Remembering*)
- CO2:** List and define the different types of optical fibers and other components of Fiber Optic Communication lab such as optical sources, detectors, optical amplifiers and connectors, etc. (*Remembering*)
- CO3:** Explain the phenomena of light transmission through an optical fiber link (*Understanding*)
- CO4:** Compare the important components/parameters/ characteristics of a fiber optic link (*Understanding*)
- CO5:** Solve and compute basic fiber parameters experimentally. (*Applying*)
- CO6:** Analyse the important components/parameters/ characteristics of a fiber optic link (*Analysing*)
- CO7:** Assess the various modulation techniques employed in FOCS (IM, FM, PWM, TDM) (*Evaluating*)
- CO8:** Design a Fiber Optic analog and digital Link (kit and optical bench) (*Creating*)

ECTS6031: TRAINING SEMINAR**(2 credits)**

Objective: During the semester break at the end of the third year, students are required to undergo an Industrial Training. The purpose of the Industrial Training is to expose students to real-life industry situations, so that they may be able to apply the engineering knowledge and skills that they have gained through class-room teaching and lab activities, in an on-the-job situation. After the period of training, students are to present their experience in the form of reports and

seminar presentations. Students will be evaluated on the basis of seminar, viva voce examination and written reports.

COURSE / LEARNING OUTCOMES

At the end of Training Seminar students will be able to:

- CO1:** Relate theory and practical with real life examples. (*Remembering*)
- CO2:** Illustrate various issues of electronics based on their field experience (*Understanding*)
- CO3:** Apply the acquired knowledge to solve real life problems. (*Applying*)
- CO4:** Analyse application of the theory into the practical field. (*Analysing*)
- CO5:** Evaluate the application of different electronic components in industry. (*Evaluating*)
- CO6:** Discuss the different technologies used in industries. (*Creating*)
- CO7:** To examine and evaluate the use of different communication techniques/electronic devices/instruments/concepts learned, in actual industrial scenario (*Evaluation*)

ECMP6032: MAJOR PROJECT (PHASE I)

(4 credits)

During the last year of their study, B. Tech. students are required to take up a major project. This may be an individual project or a group project. The Major Project is an integral learning experience that encourages students to break away from the compartmentalization of the different courses they have studied during the three years of their study and aims to provide opportunities to explore the inter-relationships and inter-connectedness of the various courses and gather them together into a single learning experience.

The major project focuses upon the following:

- **Interdisciplinary:** The major project provides a platform for students to apply the knowledge and skills acquired from different courses.
- **Collaboration:** It encourages students to work in groups over an extended period of time. They clarify the task, plan their work, share the responsibilities and work towards the successful completion of the project.
- **Process and Product:** Project work focuses on both process and product. The process would include collaboration, gathering and processing of information. The product may take the form of a working model, a complete software package, etc.
- **Written and Oral presentation:** Project work provides students with opportunities to present their findings as a written thesis in a prescribed format and orally with an intended audience and purpose in mind.

During the first phase in the seventh semester, students are expected to choose the project, prepare a synopsis under the guidance of a project supervisor appointed by the department, present the synopsis to the committee set up for the purpose, get approval for the synopsis and start the project work. Students are expected to submit weekly activity reports and present a progress seminar during this phase. They will also undergo a viva voce examination, in which they will be examined on all the basic areas of the discipline in which they have chosen their project

E-resource for learning

LaTeX, www.spoken-tutorial.org

COURSE / LEARNING OUTCOMES

At the end of Major Project I students will be able to:

- CO1:** Define the problem statement for the project work. (Remembering)
- CO2:** Recall the various theories/phenomenon through the background study. (Remembering)
- CO3:** Choose the hypothesis for the project work through literature survey. (Remembering)
- CO4:** Find the particular methodology to be adopted for the project work. (Remembering)
- CO5:** List out the various hardware and software requirements. (Remembering)
- CO6:** Classify the whole project work in various modules. (Understanding)
- CO7:** Explain the various component/module of the project. Understanding
- CO8:** Demonstrate the working model of the proposed work. Understanding
- CO9:** Contrast the results obtained properly. Understanding
- CO10:** Extend the work for Major project Phase II. (Understanding)
- CO11:** Apply mathematical skills and how these skills are important in engineering. (Applying)
- CO12:** construct software implementation skills and design skills especially from a systems perspective. (Applying)
- CO13:** Develop technical writing and communication skills. (Applying)
- CO14:** Analyse the advance electronic or communication systems. (Analysing)
- CO15:** Simplify different problems encountered in designing a system. (Analysing)
- CO16:** Defend a part of the whole project. (Evaluating)
- CO17:** Recommend a model for the second phase of the project. (Evaluating)
- CO18:** Elaborate the performance of the work done. (Creating)
- CO19:** Test for the results with proper mathematical modeling. (Creating)
- CO20:** Estimate the limitations of the work done. (Creating)
- CO21:** Compile a technical report on the part of the project. (Creating)

ECMP6033: MAJOR PROJECT (PHASE II) AND VIVA VOCE

(8 credits)

During the second phase students are expected to focus on process and completion of the projects and prepare project reports under the guidance of the Supervisors. The internal assessments shall be evaluated by the DPEC and the external assessment shall be done by the external examiner(s) assisted by the DPEC and the supervisor. The modality and components of the internal assessment and their weightages shall be notified at the beginning of each semester. The External assessment shall have the following components:

- Project Implementation: 40 marks
- Seminar presentation: 20 marks
- Viva voce examination: 20 marks
- Project documentation: 20 marks

COURSE / LEARNING OUTCOMES

At the end of Major Project II students will be able to:

- CO1:** Define the problem encountered in Phase-I. (Remembering)

- CO2:** Relate the various theories/phenomenon. (Remembering)
- CO3:** Find the particular methodology to be adopted for the project work. (Remembering)
- CO4:** List out the various hardware and software requirements. (Remembering)
- CO5:** Classify the whole project work in various modules. (Understanding)
- CO6:** Demonstrate the various component/module of the project. (Understanding)
- CO7:** Explain the working model of the proposed work. (Understanding)
- CO8:** Interpret the results obtained properly. (Understanding)
- CO9:** Extend the model for future working model. (Understanding)
- CO10:** Apply mathematical skills and how these skills are important in engineering. (Applying)
- CO11:** construct software implementation skills and design skills especially from a systems perspective. (Applying)
- CO12:** Develop technical writing and communication skills. (Applying)
- CO13:** Analyse the advance electronic or communication systems. (Analysing)
- CO14:** Contrast different problems encountered in designing a system.
- CO15:** Evaluate the complete system. (Evaluating)
- CO16:** Interpret knowhow on the topic selected for the project. (Evaluating)
- CO17:** Perceive future scope of the work carried out. (Evaluating)
- CO18:** Appraise teamwork skills. (Evaluating)
- CO19:** Elaborate the performance of the work done. (Creating)
- CO20:** Contrast on limitations of the system designed. (Creating)
- CO21:** Compile a technical report on the project (Creating)

ECED6034: ELECTRONIC DEVICES LAB

(1 Credit-2 hours) (L-T-P:0-0-2)

List of Experiments:

1. Study the Characteristics of PN junction Diodes.
2. Study the Characteristics of Zener Diodes.
3. Design half wave and full wave rectifiers using diodes and study various parameters.
4. Design various multiplier circuits using diodes and capacitors.
5. Design wave forming circuits or clippers using diodes.
6. Study Static Characteristics of a Bipolar Junction Transistor (CE Mode)
7. Study the Characteristics of JFET.
8. Series voltage Regulator.
9. Study of BJT as a switch.
10. Design of CE amplifiers using voltage divider biasing and plot and understand its response curve.

COURSE / LEARNING OUTCOMES

On successful completion of the Electronic Devices Lab the students will be able to:

- CO1:** Label electronic devices and tools used in the lab. (Remembering)
- CO2:** Understand the working of electronic devices and tools used in the lab. (Understanding)

- CO3:** Apply knowledge and understanding of electronic devices and their operation principles to making electronic circuits. (Applying)
- CO4:** Analyse various electronic circuits. (Analysing)
- CO5:** Compare performances of different electronic circuits for various applications. (Evaluating)
- CO6:** Construct electronic circuits using different devices and components to perform certain operations. (Creating)

ECDS6035: DIGITAL SYSTEM DESIGN LAB

(1 credit- 2 hours)(L-T-P:0-0-2)

List of Experiments:

1. To study and verify the truth table of logic gates.
2. To realize half/full adder and half/full subtractor.
3. To convert given binary number to gray code and given gray code to its equivalent binary number.
4. To verify the truth table of MUX and DEMUX.
5. To verify the truth table of one bit and four bit comparator using logic gates.
6. To study shift register in all its modes i.e. SIPO/SISO, PISO/PIPO.
7. Realization of 3-bit asynchronous counter and Mod-N counter design.
8. Realization of 3-bit synchronous counter design.
9. Truth table verification of flip-flops: (i) RS-Type, (ii) D-Type, (iii) T-Type, (iv) JK-Type.
10. Realization of 2:4 decoder and 4:2 encoder design.
11. Design and testing of Ring counter/ Johnson counter.

COURSE / LEARNING OUTCOMES

On successful completion of Digital System Design Lab the students will be able to:

- CO1:** List and recognize the various logic gate ICs and other components and instruments used in DLD lab. (Remembering)
- CO2:** Demonstrate the working and operation of hardware involved in designing and building of digital circuits. (Understanding)
- CO3:** Apply Boolean laws for solving and minimizing logic functions practically. (Applying)
- CO4:** Analyse practically different combinational and sequential circuits. (Analysing)
- CO5:** Evaluate practically and determine the behaviour of different digital circuits. (Evaluating)
- CO6:** Design and build various combinational circuits and sequential circuits. (Creating)

ECAC6036: ANALOG CIRCUITS LAB

(1 credit- 2 hours)(L-T-P:0-0-2)

List of Experiments:

Any ten or more experiments from the following are to be performed depending on the no of laboratory classes.

1. Inverting, Non Inverting amplifier using op-amp
2. Adder – Subtractor using op-amp

3. Integrator – Differentiator using op-amp
4. Comparator – Zero crossing detector using op-amp
5. Schmitt trigger using op-amp
6. Triangular wave generator using op-amp
7. Monostable or Astable multivibrator using op-amp
8. Active Filters – LPF 1st and 2nd order using op-amp
9. Active Filters – HPF 1st and 2nd order using op-amp
10. Digital to analog converter using op-amp
11. Analog to Digital converter using op-amp.
12. 555 Timer application as monostable or astable multivibrator
13. Instrumentation amplifier
14. RC phase shift oscillator using op-amp
15. Wein Bridge oscillator using op-amp

COURSE / LEARNING OUTCOMES

On successful completion of Analog Circuits Lab the students will be able to:

- CO1:** Define the various terminologies and parameters related to operational amplifier (741) and IC555. (Remembering)
- CO2:** Extend the theoretical knowledge to practical one. (Understanding)
- CO3:** Experiment with different types of circuits based on operational amplifiers and some specialized ICs. (Applying)
- CO4:** Analysis of various analog circuits by understanding the output based on design. (Analysing)
- CO5:** Demonstrate knowledge by designing analog circuits based on requirement using operational amplifiers. (Evaluating)
- CO6:** Design circuits using operational amplifiers for various applications. (Creating)

ECEL6037: ELECTRONIC MEASUREMENTS LAB

(1 credit- 2 hours)(L-T-P:0-0-2)

List of Experiments:

1. Extension of range of Ammeter.
2. Extension of range of Voltmeter.
3. Measurement of frequency using Lissajous Pattern.
4. Measurement of phase-angle using Lissajous Pattern.
5. Measurement of resistance by Wheatstone bridge method.
6. Study of Maxwell bridge circuit.
7. Measurement of frequency by Wien Bridge using Oscilloscope.
8. Measurement of Inductance by Anderson Bridge.
9. Study of Schering bridge circuit.
10. Study of Spectrum Analyser
11. Study of transducers (RTD/Thermistor/Thermocouple).

COURSE / LEARNING OUTCOMES

On successful completion of Electronic Measurements Lab the students will be able to:

- CO1:** List various measuring instruments used for measurement of electrical quantities. (Remembering)
- CO2:** Explain the correct procedure of using a C.R.O. (Understanding)
- CO3:** Apply different electronic measuring instruments for different measurement Applications. (Applying)
- CO4:** Compare performances of different type of measuring instruments to be applied for measurement of electrical quantities. (Analysing)
- CO5:** Choose and justify the proper measurement devices. (Evaluating)
- CO6:** Elaborate the different components involved in measurement. (Creating)

ECDP6038: DIGITAL SIGNAL PROCESSING LAB

(1 credit- 2 hours)(L-T-P:0-0-2)

List of Experiments:

1. MATLAB code to generate different unitary discrete time signals.
2. MATLAB code for verification of sampling theorem, Demonstrate the effects of aliasing arising from improper sampling
3. MATLAB code to demonstrate the folding, time scaling and shifting with any k samples towards the right or left of any signal $x[n]$.
4. MATLAB code to determine the Linear Convolution of any input signal $x[n]$ with the impulse response $h[n]$ i.e, $y[n]=x[n]*h[n]$.
5. MATLAB code to determine the N-point DFT $X(k)$ for any signal $x[n]$ for $N=L$, $N<L$, and $N>L$, where L is the length of the signal also demonstrate the effect of the three different cases.
6. MATLAB code to determine the IDFT of complex DFT $X(k)$.
7. MATLAB code to determine the Circular Convolution of any two signals $x_1[n]$ and $x_2[n]$ using matrix method and also using DFT and IDFT.
8. MATLAB program to determine the linear convolution using circular convolution of any two signals.
9. MATLAB program to demonstrate a simple FIR (Butterworth LPF, HPF, BPF and BSF) filter using different windows.
10. MATLAB program to demonstrate a simple FIR low-pass and high-pass filter using frequency sampling method.
11. MATLAB program to demonstrate a simple IIR (Butterworth LPF, HPF, BPF and BSF) filter.
12. MATLAB program to determine the autocorrelation of $x[n]$ then the power spectral density (PSD) using DFT.
13. MATLAB program to determine the time response (unit impulse and unit step response) and frequency response of any recursive system.
14. Introduction to DSP (TMS3207613) board

COURSE / LEARNING OUTCOMES

At the end of the Digital Signal Processing Lab experiments students will be able to:

- CO1:** Identify the different MATLAB functions useful for DSP. (Remembering)

- CO2:** Recall the various theories/phenomenon to do the simulation in MATLAB. (Remembering)
- CO3:** List out the various software tools requirements for DSP. (Remembering)
- CO4:** Classify a system design problem in various parts to be solved/ simulated in MATLAB. (Understanding)
- CO5:** Describe the various component/module of the MATLAB program of a particular problem. (Understanding)
- CO6:** Explain the algorithm behind any program. (Understanding)
- CO7:** Enhanced comprehension and appreciation of how concepts are related from one course to another to form a unified knowledge base. (Understanding)
- CO8:** Apply mathematical skills and how these skills are important in writing MATLAB programs for DSP. (Applying)
- CO9:** Construct software implementation skills and design skills especially from a systems perspective. (Applying)
- CO10:** Troubleshoot different errors encountered in developing a MATLAB program. (Analysing)
- CO11:** Analyse different digital filters in FDA tool of MATLAB. (Analysing)
- CO12:** Compile a technical report on the different experiments. (Creating)
- CO13:** Develop a knowhow on DSP using MATLAB. (Creating)
- CO14:** Improve skill to simulate, design and analysis of different discrete time signals and signal processing techniques. (Creating)
- CO15:** Evaluate the simulated results. (Evaluating)
- CO16:** Justify the results with proper mathematical relationship. (Evaluating)
- CO17:** Contrast on limitations of the program developed. (Evaluating)

ECEEC6039: ANALOG ELECTRONIC CIRCUITS LAB

(1 credit- 2 hours)(L-T-P:0-0-2)

List of Experiments:

1. To Study the Characteristics of Zener Diodes.
2. Study of the Half-wave and Full-wave rectifier circuits with and without capacitor filter
3. To Study the characteristics of a Bipolar Junction Transistor (CE Mode)
4. To design of CE amplifier and analyse the frequency response of the amplifier
5. To Study the Characteristics of JFET
6. Inverting and non-inverting op-amp amplifiers
7. Op-amp linear applications: adders, sub-tractors
8. Op-amp based active filters: Low Pass and High Pass
9. Instrumentation Amplifier
10. 555 timer applications: Monostable and Astable

COURSE / LEARNING OUTCOMES

At the end of the Analog Electronic Circuits Lab experiments students will be able to:

- CO1:** Define PN junction diode and their properties and uses. (Remembering)
- CO2:** Explain the working of basic electronic circuits such as transistors, diodes and amplifiers. (Understanding)

- CO3:** Build different circuits using diodes, transistors and OPAMPs. (Applying)
- CO4:** Analyse various amplifier and filter circuits. (Analysing)
- CO5:** Evaluate the performance of 555 timer as monostable and astable vibrator. (Evaluating)
- CO6:** Design amplifiers, integrators, oscillators and filter circuits using OPAMPs. (Creating)

ECBE6040: BASIC ELECTRONICS LAB

List of Experiments:

1. Identification, Specifications, Testing of R, L, C Components; Bread Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, LEDs; Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS)
2. Study of Cathode Ray Oscilloscopes – Displaying and Determining Amplitude, Phase and Frequency of Sinusoidal Signals in CRO
3. To study the characteristics of a P-N Junction diode
4. To design a full wave bridge rectifier circuit with and without filter
5. To study the static characteristics of a BJT in CE mode
6. To study the static characteristics of a BJT in CB mode
7. To design an Inverting and Non Inverting amplifier using op-amp
8. To design a monostable and an astable multivibrator using 555 timer IC
9. To verify different logic gates
10. Realisation of simple logical expression using logic gates

COURSE / LEARNING OUTCOMES

At the end of Experiments students will be able to:

- CO1:** Define the hardware involved in designing and building of electronic circuits. (Remembering)
- CO2:** Classify and compare different passive and active electronic components and devices. (Understanding)
- CO3:** Apply the theoretical knowledge in developing different electronic circuits. (Applying)
- CO4:** Analyse the characteristics of different components like diodes, transistors, amplifiers and oscillators. (Analysing)
- CO5:** Evaluate and estimate the behavior of logic gates. (Evaluating)
- CO6:** Create and test electronic circuits using the components and devices studied in the course. (Creating)

ECAP6041: ADVANCED DIGITAL SIGNAL PROCESSING LAB

(2 credits)(L-T-P: 0-0-4)

List of Experiments:

1. Basic Signal Representation
2. Different operations on discrete time signals
3. Linear and Circular convolution
4. Correlation Auto And Cross

5. Stability Using Hurwitz Routh Criteria
6. Sampling FFT Of Input Sequence
7. Butterworth Low pass And High pass Filter Design
8. Chebychev Type I,II Filter
9. State Space Matrix from Differential Equation
10. Normal Equation Using Levinson Durbin
11. Decimation And Interpolation Using Rationale Factors
12. Maximally Decimated Analysis DFT Filter
13. Cascade Digital IIR Filter Realization
14. Convolution And M Fold Decimation & PSD Estimator
15. Estimation Of PSD
16. Inverse Z Transform
17. Group Delay Calculation
18. Separation Of T/F
19. Parallel Realization of IIR filter

COURSE / LEARNING OUTCOMES

At the end of this Advanced Digital Signal Processing Lab, students will be able to

- CO1:** Find the particular methodology to be adopted for writing the various programs in MATLAB. (Remembering)
- CO2:** Demonstrate the various component/module of the MATLAB program of a particular problem. (Understanding)
- CO3:** Extend the MATLAB programs in system design perspective. (Understanding)
- CO4:** Apply mathematical skills and how these skills are important in writing MATLAB programs for DSP. (Applying)
- CO5:** Contrast the advance topics like Multirate signal processing in MATLAB. (Analysing)
- CO6:** Assess a know-how on DSP using MATLAB. (Evaluating)
- CO7:** Improve skill to simulate, design and analysis of different discrete time signals and signal processing techniques. (Creating)
- CO8:** Elaborate on limitations of the program developed. (Creating)

ECDV6042: DIGITAL IMAGE AND VIDEO PROCESSING LAB

(2 credits)(L-T-P: -0-0-4)

List of Experiments:

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration

9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

COURSE / LEARNING OUTCOMES

At the end of the Digital Image and Video Processing Lab, students will be able to:

- CO1:** Define basic operations on images like addition, subtraction etc. (Remembering)
- CO2:** Illustrate histogram of an image. (Understanding)
- CO3:** Experiment with image and video segmentation, video enhancement, image compression and restoration. (Applying)
- CO4:** Analyse colour models. (Analysing)
- CO5:** Determine boundary and regional features of an image. (Evaluating)
- CO6:** Estimate an object in an image or video. (Creating)

ECWM6043: WIRELESS AND MOBILE COMMUNICATION LAB

(2 credits)(L-T-P: 0-0-2)

List of Experiments:

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.
2. Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.
3. Study of GSM handset for various signaling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
4. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.
5. To study various GSM AT Commands their use and developing new application using it. Understanding of 3G Communication System with features like; transmission of voice and video calls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.
6. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.
7. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and De- Interleaver.
8. To study and Analyse different modulation techniques in time and frequency domain using SDR kit.

COURSE/LEARNING OUTCOMES

At the end of Wireless and Mobile Communication Lab, students will be able to:

- CO1:** Define the fundamental concepts of cellular communication like frequency reuse, cell splitting etc. (Remembering)
- CO2:** Outline concepts of GSM and CDMA architecture, network concepts etc. (Understanding)
- CO3:** Utilize GSM handset for various signalling techniques. (Applying)

- CO4:** Analyse transmitter and receiver sections in mobile handset, different modulation techniques etc. (Analysing)
- CO5:** Evaluate AT commands in 3G network. (Evaluating)
- CO6:** Discuss features of 3G communication systems such as transmission of voice and video calls, SMS etc. (Creating)
- CO7:** Discuss concepts of software radio in real time environment. (Creating)

ECMA6044: MICROCONTROLLER AND APPLICATIONS LAB

(2 credits)(L-T-P: 0-0-2)

List of Experiments:

1. Introduction to various simulators used for 8051 microcontroller
2. Assembly language programming of 8051 microcontroller for arithmetic operations
3. Assembly language programming of 8051 microcontroller for logical operations
4. Introduction to development board of 8051 microcontroller
5. Interfacing of LED with 8051 microcontroller
6. Interfacing of Seven segment display with 8051 microcontroller
7. Interfacing of LCD interfacing with 8051 microcontroller
8. Interfacing of Keyboard with 8051 microcontroller
9. Interfacing of ADC with 8051 microcontroller
10. Assignment based on above mentioned experiments.

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall and write assembly language and C program using 8051 microcontroller. (Remembering)
- CO2:** explain the instruction set of 8051 microcontroller. (Understanding)
- CO3:** perform various experiments using 8051 microcontroller. (Applying)
- CO4:** Analyse how to relate different peripheral devices with 8051 microcontroller. (Analysing)
- CO5:** Evaluate the performance of 8051 based embedded systems. (Evaluating)
- CO6:** assemble various I/O devices with 8051 microcontroller. (Creating)

ECPM6045: PATTERN RECOGNITION & MACHINE LEARNING LAB

(2 credits)(L-T-P: 0-0-2)

List of Experiments:

1. Implement maximum likelihood algorithm
2. Implement Bayes classifier
3. Implement linear regression
4. Design a classifier using perceptron rule
5. Design a classifier using feed-forward back-propagation and delta rule algorithms
6. Implement deep learning algorithm
7. Implement linear discriminant algorithm

8. Design a two class classifier using SVM
9. Design a multiclass classifier using SVM
10. Perform unsupervised learning

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall the methods for machine learning. (Remembering)
- CO2:** illustrate necessary knowledge in methods for machine learning. (Understanding)
- CO3:** Describe computational data analysis problems in terms of computational mathematics. (Understanding)
- CO4:** Illustrate the fundamental concepts and methods of machine learning, statistical pattern recognition and its applications. (Understanding)
- CO5:** Identify algorithmic aspects in Pattern recognition and machine learning task, evaluate correctness and efficiency of the used methods, and their applicability in each current situation. (Applying)
- CO6:** Analyse and evaluate simple algorithms for pattern classification. (Analysing)
- CO7:** Design simple algorithms for pattern classification, code them with programming language and test them with benchmark data sets. (Evaluating, Creating)
- CO8:** Improve and develop methods and algorithms as applicable to machine learning. (Creating)

ECDE6046: DETECTION AND ESTIMATION THEORY LAB

(2 credits)(L-T-P:2-0-0)

List of Experiments:

1. Simulate signal and noise models models.
2. Simulate spatially separated target Signal in the presence of Additive Correlated White Noise
3. Simulate spatially separated target Signal in the presence of Additive Uncorrelated White Noise
4. Simulate spatially separated target Signal in the presence of Additive Correlated Colored Noise
5. Detect Constant amplitude Signal in AWGN
6. Detect Time varying Known Signals in AWGN
7. Detect Unknown Signals in AWGN
8. Compare performance comparison of the Estimation techniques - MLE, MMSE, Bayes Estimator, MAP Estimator, Expectation Maximization (EM) algorithm
9. Performance comparison of conventional Energy Detectors and Coherent Matched Filter Techniques

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall mathematical properties of stochastic processes. (Remembering)
- CO2:** Understand the mathematical background of signal detection and estimation. (Understanding)
- CO3:** Apply methods of detection and estimation of signals in white and non-white Gaussian noise. (Applying)
- CO4:** Analyse signals and noise models. (Analysing)

- CO5:** Compare the performances of various estimation techniques. (Evaluating)
- CO6:** Design optimal and suboptimal detection and estimation algorithms under realistic conditions. (Creating)

ECRS6047: ANTENNAS AND RADIATING SYSTEMS LAB

(2 credits)(L-T-P:0-0-2)

List of Experiments:

1. Simulation of half wave dipole antenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance of antenna.
3. Simulation of quarter wave, full wave antenna and comparison of their parameters.
4. Simulation of monopole antenna with and without ground plane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.
6. Simulation of a half wave dipole antenna array.
7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.
8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.
9. Case study.

COURSE/LEARNING OUTCOMES

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

- CO1:** Definition of basic taxonomy and terminology of the computer networking area. (Remembering)
- CO2:** Understand and build the skills of sub-netting and routing mechanisms. (Understanding)
- CO3:** Understand basic protocols of computer networks, and how they can be used to assist in network design and implementation. (Understanding)
- CO4:** Apply mathematical foundations to solve computational problems in computer networking. (Applying)
- CO5:** Analyse performance of various communication protocols. (Analysing)
- CO6:** Compare routing algorithms. (Evaluating)
- CO7:** Design and develop protocols for Communication Networks and practice packet/file transmission between nodes. (Creating)

ECCN6048: ADVANCED COMMUNICATION NETWORKS LAB

(2 credits)(L-T-P: 0-0-2)

List of Experiments:

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
3. Configuring NIC's IP Address.

4. Determining IP Address and MAC Address using if-config command.
5. Changing IP Address using if-config.
6. Static IP Address and Configuration by Editing.
7. Determining IP Address using DHCP.
8. Configuring Hostname in /etc/hosts file.
9. Design TCP iterative Client and Server application to reverse the given input sentence.
10. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call “select”.
11. Design UDP Client Server to transfer a file.
12. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
13. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.
14. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
15. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb. Use a TFTP client and repeat the experiment.
16. Signaling and QoS of labeled paths using RSVP in MPLS.
17. Find shortest paths through provider network for RSVP and BGP.
18. Understand configuration, forwarding tables, and debugging of MPLS.

COURSE/LEARNING OUTCOMES

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

- CO1:** Definition of basic taxonomy and terminology of the computer networking area. (Remembering)
- CO2:** Understand and build the skills of sub-netting and routing mechanisms. (Understanding)
- CO3:** Understand basic protocols of computer networks, and how they can be used to assist in network design and implementation. (Understanding)
- CO4:** Apply mathematical foundations to solve computational problems in computer networking. (Applying)
- CO5:** Analyse performance of various communication protocols. (Analysing)
- CO6:** Compare routing algorithms. (Evaluating)
- CO7:** Design and develop protocols for Communication Networks and practice packet/file transmission between nodes. (Creating)

ECDS6049: DSP ARCHITECTURE LAB

(2 credits)(L-T-P:0-0-2)

List of Experiments:

1. Introduction to Code Composer Studio-I
2. Introduction to Code Composer Studio-II
3. Introduction to the Addressing Modes
4. FFT and Bit Reversal Operation
5. FFT and its Applications
6. Audio Codec and its Applications
7. Real Time Data Exchange
8. FIR filtering by interfacing Matlab with Code Composer Studio
9. Introduction to Interrupts
10. Digital communication using Binary Phase Shift Keying

COURSE/LEARNING OUTCOMES

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

- CO1:** Define various algorithms and mathematical concepts associated with Digital signal processor. (Remembering)
- CO2:** Understanding various algorithms and mathematical concepts associated with Digital signal processor. (Understanding)
- CO3:** Apply various operations like FFT, bit reversal in DSP applications. (Applying)
- CO4:** Analyse different DSP related algorithms and digital filters. (Analysing)
- CO5:** Evaluate and measure the performance DSP related algorithms and digital filters using MATLAB and Code Composer Studio. (Evaluating)
- CO6:** Design digital circuits, program (assembly and C), and test code using Code Composer Studio environment and MATLAB. (Creating)

ECSA6050: EMBEDDED SYSTEMS AND APPLICATIONS Lab

List of Experiments

1. Introduction to MPLAB and Embedded C.
2. LED interfacing with PIC Microcontroller
3. 7 Segment display interfacing with PIC Microcontroller
4. LCD interfacing with PIC Microcontroller
5. Keyboard interfacing with PIC Microcontroller
6. ADC and DAC interfacing with PIC Microcontroller
7. Serial Communication using PIC Microcontroller
8. Timer using PIC Microcontroller
9. Interrupt using PIC Microcontroller
10. Basic programming using AVR Microcontroller
11. Data Acquisition using LabView
12. Interfacing of Microcontroller with LabVIEW

COURSE/LEARNING OUTCOMES

At the end of Embedded Systems and Applications Lab, students will be able to:

- CO1:** Recall and write assembly language and C program using PIC and AVR Microcontroller. (Remembering)
- CO2:** Explain the instruction set of PIC and AVR microcontroller. (Understanding)
- CO3:** perform various experiments using PIC and AVR microcontroller. (Applying)
- CO4:** Relate different peripheral devices with PIC and AVR microcontroller. (Analysing)
- CO5:** Assemble various I/O devices with different microcontrollers. (Creating)
- CO6:** Evaluate the performance of various microcontroller based embedded systems (Evaluating)

ECMI6051: MINI PROJECT

(2 credits)

The Mini Project work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

COURSE/LEARNING OUTCOMES

At the end of Mini Project, students will be able to:

- CO1:** Able to choose various topics for self learning
- CO2:** Able to explain different problems and recent trends related to the topic
- CO3:** Able To apply the knowledge to find out the solution of the problems related to the topic
- CO4:** Able to compare various real life problems related to the topic
- CO5:** Able to evaluate various design problems related to the topic
- CO6:** Able To develop oral and written communication skills to present and defend their work in front of technically qualified audience

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Vision

To be a centre of technological excellence for outstanding education and research in electrical and electronics engineering, contributing to the world socially committed engineers capable of accepting the continuous challenges of technological advancements.

Mission

The department of Electrical and Electronics Engineering of Don Bosco College of Engineering and Technology, School of Technology, Assam Don Bosco University seeks to:

1. Achieve excellence in teaching, research, practice and extension activities in the fields of Engineering in general and Electrical and Electronics Engineering in particular.
2. Provide a strong foundation for the students to make them professionally competent for industry and research.
3. Create an environment for the holistic development of individuals, encouraging them to serve the society with commitment and integrity.
4. Offer necessary support and guidance to individuals to shape their ideas into reality.

Programme Educational Objectives (PEOs)

- (i) To create an environment, give opportunity and also encourage the individuals to build a strong foundation of Electrical and Electronics Engineering as well as in related interdisciplinary fields of study, to be able to contribute to the need of the industry and the society at large.
- (ii) To make students capable of generating ideas, apply their knowledge and analyse the situations for executing live projects in Electrical and Electronics Engineering, with modern tools, equipment and software.
- (iii) To inculcate the habit of teamwork and infuse management skills in the students for their future professional life.
- (iv) To guide students to become ethical professionals in their own fields of work and be conscious about the effect of technology on the environment.

Programme Learning Outcomes of B. Tech in Electrical and Electronics Engineering

- PO1:** Graduates will demonstrate knowledge of differential equations, vector calculus, complex variables, matrix theory, probability theory, physics, chemistry, computer science and electrical and electronics engineering
- PO2:** Graduates will demonstrate a systematic or coherent understanding of the fundamental concepts, principles and processes underlying the academic field of Electrical and Electronics Engineering, its different learning areas and applications
- PO3:** Graduates will demonstrate procedural knowledge that creates different types of professionals related to the disciplinary/subject area of EEE, including professionals engaged in research and development, teaching and government/public service;
- PO4:** Graduates will demonstrate skills in areas related to one's specialisation area within the disciplinary/subject area of EEE emerging developments in the field of EEE.
- PO5:** Graduate will be able to apply the knowledge of mathematics, basic science, computer science, and engineering sciences necessary for modeling, synthesis and

analysis of electrical circuits and apply relevant knowledge and skills to seek solutions to problems that emerge from the subfields of electrical engineering.

- PO6:** Graduate will be able to undertake the task of Analysing and designing of Electrical and Electronics systems and execute complex electrical and electronic live projects, containing hardware and software components, as appropriate to EEE to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- PO7:** Graduate will be able to Recognize and appreciate the importance of the electrical and electronic as engineering and its application in an academic, industrial, economic, environmental and social contexts and recognition of the need for, and an ability to engage in life-long learning.

Programme Outcomes of M.Tech. in Power Systems:

- PO1:** Ability to apply the enhanced knowledge in advanced technologies for modeling, Analysing and solving contemporary issues in power sector with a global perspective.
- PO2:** Ability to critically Analyse and carry out detailed investigation on multifaceted complex Problems in area of Power Systems and envisage advanced research in thrust areas.
- PO3:** Ability to identify, Analyse and solve real-life engineering problems in the area of Power Systems and provide strategic solutions satisfying the safety, cultural, societal and environmental aspects/ needs.
- PO4:** Ability for continued pursuance of research and to design, develop and propose theoretical and practical methodologies towards research and development support for the Power System infrastructure.
- PO5:** Ability to develop and utilize modern tools for modeling, Analysing and solving various Engineering problems related to Power Systems.
- PO6:** Willingness and ability to work in a team of engineers/ researchers with mutual understandings to take unsophisticated challenges, in the field of Power Systems, lead and motivate the group to inculcate multidisciplinary and collaborative approach.
- PO7:** Willingness and ability to take up administrative challenges including the management of various projects of interdisciplinary nature and carry out the same in an efficient manner giving due consideration to societal, environmental, economical and financial factors.
- PO8:** Ability to express ideas clearly and communicate orally as well as in writing with others in an effective manner, adhering to various national and international standards and practices for the documentation and presentation of the contents.

Programme Outcomes of M.Tech in Control Systems

- PO1:** Ability to apply knowledge of mathematics, allied sciences, and engineering to problems related to System Engineering and Control.
- PO2:** Ability to conduct independent research both of an academic and applied nature in the area of mathematical and applied control theory.
- PO3:** Ability to use the techniques, skills, and modern control engineering tools necessary for engineering practice.
- PO4:** Ability to be conversant with practical control system.
- PO5:** Ability to conduct design, operation, control, and testing issues.

- PO6:** Ability to communicate effectively to convey the ideas acquired through research.
- PO6:** Enhanced knowledge and skill set required in control.
- PO7:** Engineering program for problem solving so as to arrive at appropriate technological solutions.
- PO8:** An understanding of professional and ethical responsibility.

DETAILED SYLLABUS

EEEM0021: ELECTRICAL MACHINES

(4 credits – 60 hours)

Objective: This course on Electrical Machines, generally offered for students who do not major in Electrical Engineering, is an introductory course in electro-mechanical energy conversion devices. This course gives an introduction to DC as well as AC machines and transformers, to enable the students to use this knowledge for applying to situations arising in their disciplines.

Module I: D.C. Machines (15 hours)

Constructional details, emf equation, Methods of excitation, Self and separately excited generators, Characteristics of series, shunt and compound generators, Principle of operation of D.C. motor, Back emf and torque equation, Characteristics of series, shunt and compound motors, Starting of D.C. motors, Types of starters, Testing, Hopkinson's test and Swinburne's test, Speed control of D.C. shunt motors.

Module II: Transformers (18 hours)

Constructional details, Principle of operation, emf equation, Transformation ratio, Transformer on no load, Parameters referred to HV/LV windings, Equivalent circuit, Transformer on load, Regulation, Testing – Load test, open circuit and short circuit tests, Efficiency of Transformers, All day efficiency, Auto Transformers, Introduction to 3-phase transformers.

Module III: Induction Motors (15 hours)

Construction, Types, Principle of operation of three-phase induction motors, Torque-slip Characteristics, Equivalent circuit and performance, Losses and Efficiency, Starting and speed control, Single-phase induction motors.

Module IV: Synchronous and Special Machines (12 hours)

Construction of synchronous machines, Types, Induced emf, Voltage regulation; Brushless alternators, 3-phase synchronous motor, Stepper motor, Servo motor, techo generators, brushless dc motors.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain principle of operation of various electrical machines. (Understanding)
- CO2:** Identify different types of dc and ac machines. (Applying)
- CO3:** Classify different types of dc and ac machines. (Analysing)
- CO4:** Compare the performances in terms of losses, efficiency, and regulation of different types of dc and ac machines. (Evaluating)
- CO5:** Test dc motor, dc generator and transformer, Induction motor and synchronous machines to determine their performances. (Creating)

Suggested Readings

1. BL Thereja, AK Thereja, A Textbook of Electrical Technology, Vol II, S Chand.
2. P.S. Bimbhra, Electrical Machines, 17th edition, Khanna Publishers
3. P.S. Bimbhra, Generalised Theory of Electrical Machines, Khanna Publishers

4. I.J. Nagrath, D.P. Kothari, Electrical Machines, Third edition, TMH
5. Parker Smith, Problems in Electrical Engineering, CBS Publishers and distributors
6. J.B. Gupta, Theory and Performance of Electrical Machines, S.K. Kataria and Sons

EECE0022: CONTROL SYSTEM ENGINEERING

(4 credits – 60 hours)

Objective: To familiarize the students with concepts related to the operation analysis and stabilization of closed loop and open loop control systems using various control techniques. The course is also aimed at developing knowledge on various controllers and digital control system.

Module I (16 hours)

Basic concepts of control systems, Open and closed loop systems; Mathematical model of physical systems, transfer function, block diagram algebra, signal flow graph (SFG), Mason's gain formula, application of SFG to control systems; Feedback theory: Types of feedbacks, effect of degenerative feedback on control system, regenerative feedback; Components: A.C. Servo motor, DC servo motor, AC tacho meter, synchro, amplidyne, stepper motor. State space model, state variable i/p and o/p , continuous time model, state equations.

Module II (17 hours)

Time domain analysis: Standard test signals: Step, ramp, parabolic and impulse signals. Time response of first and second order systems to unit step and unit ramp inputs. Time response of second order systems to unit step input. Time response specifications. Steady state errors and error constants of different types of control systems. Concepts of stability: Necessary conditions of stability, Hurwitz stability criterion, Routh stability criterion, application of Routh stability criterion to linear feedback systems, relative stability Root locus techniques: Root locus concepts, rules for construction of root loci, determination of roots from root locus, root contours. Systems with transportation lag.

Module III (20 hours)

- a) Frequency domain analysis: Introduction, Bode plots, determination of stability from Bode plots, polar plots, Nyquist stability criterion, application of Nyquist stability criterion to linear feedback systems. Closed loop frequency response: Constant M circles, constant N circles, use of Nicolas chart
- b) Controllers: Introduction, Proportional, derivative and integral control actions, P, PI and PID controllers and their applications to feedback control systems, Zeigler- Nichols method of tuning PID controllers for known dynamic model of the plant.

Module IV (7 hours)

State variable analysis: Introduction, concept of state variables, state vector, input and output vector, general state model representation of linear time invariant, SISO and MIMO systems and their block diagram representations, state model representations of physical systems

COURSE/LEARNING OUTCOMES

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

- CO1:** Define feedback and feed-forward control architecture. (Remembering)
- CO2:** Illustrate the concepts related to the operation analysis and stabilization of closed loop and open loop control systems using various control techniques. (Understanding)

- CO3:** Apply block diagram representations for simplifying complex control systems. (Applying)
- CO4:** Examine different controllers based on empirical tuning rules. (Analysing)
- CO5:** Assess the ability of a designed control system to perform a specific engineering task. (Evaluating)
- CO6:** Discuss the importance of performance, robustness and stability in control design. (Creating)

Suggested Readings

1. Benjamin C Kuo, Automatic Control System, 7 ed, PHI
2. L. J. Nagrath, M. Gopal, Control Systems Engineering, New Age International.
3. K. Ogata, Modern Control Engineering, PHI.
4. R. Anandanatarajan, P. Ramesh Babu, Control Systems Engineering, Scitech Publications.
5. D. Roy Choudhury, Modern Control Engineering, PHI.
6. BS Manke, Linear Control System, Khanna Publishers
7. Eronini I. Umez-Eronini, System Dynamics and Control, PWS Publishing, CL-Engineering.

EEMN0023: ELECTRO-MECHANICAL ENERGY CONVERSION II

(4 credits – 60 hours)

Objective: The course is aimed to introduce electro-mechanical energy conversion principles and three-phase systems, induction, and synchronous machines and the power systems employing these devices.

Module I (13 hours)

Synchronous Machine I: Constructional features, Armature winding, EMF equation, Winding coefficients, Equivalent circuit and phasor diagram, Armature reaction, O.C. and S.C. tests, Voltage Regulation using Synchronous Impedance method, MMF Method, Potier's Triangle Method, Parallel operation of synchronous generators, operation on infinite bus, synchronizing power and torque coefficient.

Module II (10 hours)

- a) Synchronous Machine II: Two reaction theory, Power flow equations of cylindrical and salient pole machines, Operating characteristics.
- b) Synchronous motor: Starting methods, Effect of varying field current at different loads, V-Curves, Hunting and damping, Synchronous condenser.

Module III (17 hours)

- a) Transformer-I: Three phase transformer Construction, Three – phase unit transformer and Bank of three single phase transformers with their advantages, Three-phase transformer Groups (Phasor groups) and their connections, Y- Δ connection, Open delta connection, Three-phase/ 2 phase Scott connection and its application.
- b) Transformer-II: Sumpner's test, All day efficiency, polarity test Excitation Phenomenon in Transformers, Harmonics in Single phase and 3-phase transformers, Parallel operation and load sharing of Single phase and three phase transformers, Three winding transformers, Tertiary winding
- c) Three phase Induction Machine-I: Constructional features, Rotating magnetic field, Principle of operation, Phasor diagram, Equivalent circuit, Torque and power equations, Torque-slip characteristics, No load and blocked rotor tests, efficiency, Induction generator.

Module IV (20 hours)

- a) Three phase Induction Machine-II: Starting, Deep bar and double cage rotors, Cogging and Crawling, Speed control (with and without emf injection in rotor circuit.)
- b) Single phase Induction Motor: Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, repulsion motor. AC Commutator Motors: Universal motor, Single phase a.c. series compensated motor, Stepper motors.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Select* the different machines according to their applications. (Remembering)
- CO2:** *Demonstrate* the starting, input, output, unloaded and loaded conditions of ac machines. (Understanding)
- CO3:** *Experiment with* different types of ac machines. (Applying)
- CO4:** *Classify* different types of ac motors and generators used for different purposes. (Analysing)
- CO5:** *Compare* the performances in terms of losses, efficiency, and regulation of different types of ac machines. (Evaluating)
- CO6:** *Solve* the technical problems in ac machines by using basic theorems of electric circuits. (Creating)

Suggested Readings

1. P.S. Bimbhra, Electrical Machines, 17th editions, Khanna Publishers
2. P.S. Bimbhra, Generalised Theory of Electrical Machines, Khanna Publishers
3. I.J. Nagrath, D.P. Kothari, Electrical Machines, Third edition, TMH
4. Parker Smith, Problems in Electrical Engineering, CBS Publishers and distributors
5. J.B. Gupta, Theory and Performance of Electrical Machines, S.K. Kataria and Sons

EEPS0024: ELECTRICAL POWER SYSTEMS I

(3 credits – 45 hours)

Objective: *This is a basic course which aims to make students aware of the basic concepts of electrical power systems and spells out the various components of an electrical power system. This course will be a stepping stone to other courses in power systems such as Power System Operation and Control, Electrical Power System II, etc.*

Module I (20 hours)

- a) Line Constants: Introduction to power system, Single line diagram. Resistance – Conductor materials. ACSR, expanded ACSR, hollow and bundle conductors. Use of standard wire tables. Inductance - Inductance of solid cylindrical conductor, composite conductor. Concept of G.M.D. Inductance of single conductor with ground return, 2- conductor single phase line, inductance of three phase single circuit and double circuit lines with symmetrical and unsymmetrical spacing. Skin effect and proximity effect. Bundle conductors. Internal impedance of conductor. Bessel real and Bessel imaginary. Capacitance- Capacitance of isolated conductor, 2-conductor single phase line, three phase single circuit and double circuit lines with symmetrical and unsymmetrical spacing. Method of image and effect of ground. Charging current.

- b) Performance of Lines: Representation of lines, short transmission lines, medium length lines, long transmission lines, ABCD constants, Ferranti effect.

Module II (10 hours)

- a) Insulators: Different types of insulators. Leakage path, wet flashover and dry flashover distances, potential distribution over a string of suspension insulators, Methods of equalizing the potential. String efficiency.
- b) Cables: Insulating materials. Construction of single core and multi-core cables, Armouring, laying and jointing. H.V cables: pressure cables- oil filled and gas filled cables. Stress and capacitance of single core cable, most economical size of conductor. Capacitance and inter-sheath grading. Dielectric stress in bushing insulator. Capacitance and stress in 3 core cable, sheath effects, sheath current, insulation resistance, breakdown voltage and mechanism of breakdown. Thermal characteristics of cables.

Module III (15 hours)

- a) Neutral grounding: Effectively grounded system. Under grounded system. Arching ground. Methods of neutral grounding. Resonant grounding (Peterson coil). Earthing transformer. Generator neutral breaker. Grounding practice as per Indian electricity rules. Equipment grounding.
- b) Circuit breakers: Fuses: Function: Important terms and classification. HRC fuses: Characteristics and advantages. Time delay fuse. Switchgears: Functions, principles of circuit breaking. DC and AC circuit breaking. Arc voltage and current waveforms. Restriking and recovery voltages, Current zero pause. Current chopping, capacitive current breaking. AC circuit breaker ratings. Arc in oil, arc irruption theories and processes. Bulk oil CB and MOCB, air circuit breaker, air –blast CBs. Vacuum and SF6 CBs. Testing of circuit breakers.
- c) Static Substation: Classification. Interconnection of substations, Necessity. Function and arrangement of substation equipment. Layout diagram- single line diagram with different bus-bar arrangements. Current limiting reactors: Types and construction, substation grounding.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Define* the various terms related to electrical power transmission and distribution systems. (Remembering)
- CO2:** *Illustrate* the use of different devices in Power System. (Understanding)
- CO3:** *Choose* the correct equipment according to the needs and requirement of power systems. (Applying)
- CO4:** *Analyse* the system performance and the parameters in electrical transmission and distribution systems. (Analysing)
- CO5:** *Justify* the use switchgear and protection systems in Power System. (Evaluating)
- CO6:** *Combine* the concept of transmission and distribution systems for better understanding of the working of an electrical power system. (Creating)

Suggested Readings

1. C.L. Wadhwa, Electrical Power Systems, Fourth edition, New Age International Publishers
2. BR Gupta, Power System Analysis and Design, S. Chand
3. D.P. Kothari, I.J. Nagrath, Power System Engineering, Second edition, TMH

4. VK Mehta, Principles of Power System, S. Chand
5. W.D. Stevenson Jr., Elements of Power System Analysis, McGraw Hill
6. O.I. Elgerd, Electric Energy System Theory, McGraw Hill
7. Allen J. Wood, Brune F. Wollenberg, Power Generation, Operation and Control, 2/e, John Wiley and Sons, Inc.

EEPE0025: POWER ELECTRONICS

(4 credits – 60 hours)

Objective: *The course helps to develop an in-depth understanding of power electronic circuits for voltage and current control and protection and helps in learning switching characteristics of transistors and SCRs, triggering methods of SCR, and study of power supplies to electronic devices.*

Module I (15 hours)

- a) Power Electronic Devices: Thyristor- SCR, Construction, Gate Characteristics, Turn-on and Turn-off mechanisms, Device ratings; Gate Triggering Circuits; Series and Parallel operation of Thyristors.
- b) Phase Controlled Thyristors, Inverter Grade Thyristors, ASCR, RCT, DIAC, TRIAC, SUS, SBS, SCS, LASCR, Power MOSFET, IGBT, GTO, MCT, IGCT, MTO, ETO, PIC, Silicon Carbide Devices.

Module II (15 hours)

- a) Controlled Rectifiers- Half controlled and full controlled, Single Phase and Three phase rectifiers.
- b) Dual converters - Ideal and practical, Non-circulating and circulating current mode.
- c) Choppers - Configuration, Jones and Morgan Chopper, A.C. Choppers, Multiphase choppers, Flyback converters, Buck, Boost, Buk-Boost and Cuk converters.

Module III (15 hours)

- a) Inverters- Half Bridge and Full Bridge inverters, PWM inverter, Three phase inverters, Series and Parallel inverters, Current source inverters; Cycloconverters; AC Regulators.
- b) Resonant Converters- Zero voltage and zero current switching, load resonant converter, resonant switch converter.

Module IV (15 hours)

- a) Protection and Cooling of Power Switching Devices; Control of D.C. and A.C. drives.
- b) Applications of Power Electronics- UPS, SMPS, HVDC, SVAR compensators, RF heating, Welding, Lamp ballast, Battery charger, Emergency lighting system, Static Circuit Breaker etc.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Define* various terms related to power electronic devices and circuits. (Remembering)
- CO2:** *Explain* the working of different power converters such as rectifiers, choppers and inverters. (Understanding)
- CO3:** *Identify* different power electronic devices and their characteristics. (Applying)
- CO4:** *Categorize* different protecting circuits for semiconductor devices. (Analysing)
- CO5:** *Compare* the various output types of different power electronics converters. (Evaluating)

CO6: Choose a suitable type of converter for electrical application. (Creating)

CO7: Construct simple power converters. (Creating)

Suggested Readings

1. M.D. Singh, K.B. Khanchandani, Power Electronics, 2/e, TMH
2. V.R. Moorthi, Power Electronics - Devices, Circuits and Industrial Applications, 1/e, Oxford University Press
3. M.R. Rashid, Power Electronic Circuits, Devices and Applications, Third Edition, PHI
4. N. Mohan, T.M. Underlone and W.P. Robbins, Power Electronic Converters, Applications and Design, John Wiley and Sons

EEPD0026: POWER ELECTRONICS AND DRIVES

(4 credits - 60 hours)

Objective: The course helps to develop an in-depth understanding of power electronic circuits for voltage and current control and protection and helps in learning switching characteristics of transistors and SCRs, triggering methods of SCR, and study of power supplies to electronic devices.

Module I (15 hours)

- a) Power Semiconductor Devices: Power diodes, Power Transistors and Thyristors, Static V- I Characteristics of SCR, TRIAC, GTO and IGBT, Turn-On and Turn-OFF Mechanism of SCR, its gate characteristics, Device Specification and rating, series and parallel operation, thyristor protection circuits, design of snubber circuit.
- b) Triggering Circuits: Types of triggering schemes: DC, AC and pulsed triggering, UJT triggering scheme, R-C triggering scheme, cosine – law triggering scheme.
- c) Commutation: Principle of natural commutation and forced commutation, circuits for forced commutation (Resonant commutation, voltage commutation, current commutation, load commutation).

Module II (15 hours)

- a) Control Rectifiers (AC to DC Converter) : Single Phase- Circuit Configuration and Principle of operation of half wave, full wave controlled rectifiers (full converters and semi converters) wave form of voltage and current at the output and across the thyristor for R-L and R-L-E load, effect of source inductance, importance of freewheeling diode for inductive loads. Input power factor for R and R-L load, Ripple factor. Average output voltage and currents.
- b) Three Phase Controlled Rectifiers: Half wave and full wave full controlled bridge rectifiers. Three phase semi-converters, average output voltage and current for R and R- L load.

Module III (15 hours)

- a) Inverters (DC to AC Converters): Single Phase – Series Inverters: Circuit description and principle of operation for simple and improved circuit. Parallel inverter: Basic circuit description and principle of operation without and with feedback diodes.
- b) Bridge Inverters: Principle of operation : Principle of operation of modified Mc Murray and Mc Murray Bedford inverters. Concept of voltage source inverter and current- source inverter.

- c) Three Phase Inverters: Concept of three phase bridge inverters, principle of operation (180° conduction mode and 120° conduction mode), wave form of output voltage and current for R and RL load.

Module IV (15 hours)

- a) DC Choppers: Basic Principles of class A, B, C, D, E Choppers, voltage commutated chopper, current commutated chopper and load commutated chopper. Jones Chopper and Morgan Chopper.
- b) Cyclo Converter (Single Phase): Basic Principle of Single phase Mid Point Cyclo Converters and bridge types cyclo converters.
- c) Application: Over voltage protection, zero voltage switch, integral cycle triggering (or Burst Firing), Uninterruptible power supply (UPS), Arc welding, HVDC transmission.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Define* various terms related to power electronic circuits and electric drives. (Remembering)
- CO2:** *Explain* the working of different power converters such as rectifiers, choppers and inverters. (Understanding)
- CO3:** *Experiment with* basic power electronic devices and circuits. (Applying)
- CO4:** *Analyse* different power electronics converters. (Analysing)
- CO5:** *Assess* the power quality of the converters. (Evaluating)
- CO6:** *Construct* simple power converters. (Creating)

Suggested Readings

1. Singh and Kanchandani, Power Electronics, TMH.
2. M. H. Rashid, Power Electronics Circuits, Devices and Applications, PHI.
3. Vithayathil, Power Electronics – Principles and Applications, McGraw-Hill.
4. Lander, Power Electronics, McGraw-Hill.

EEPS0027: ELECTRICAL POWER SYSTEMS II

(4 credits – 60 hours)

Objective: *This is an advanced course in Electrical Power Systems and builds upon an earlier course, which is a pre-requisite for this course. This course studies in detail HVDC Transmission, design of transmission lines, voltage protection, load flows and distribution systems, among other things.*

Module I (8 hours)

HVDC Transmission: Rectification, Inversion, Kinds of D.C. links, Parallel and Series connection of Thyristors, Power flow, Parallel operation of D.C. links with A.C. network, Ground return, Circuit breaking, Advantages and disadvantages, Economic distance for d.c. transmission.

Module II (8 hours)

- a) Corona: Critical disruptive voltage, Corona loss, Line design based on Corona, Disadvantages of Corona, Radio interference, Inductive interference between power and communication lines.

- b) Mechanical design of transmission lines: Catenary curve, sag calculations, stringing chart, sag template, equivalent span, stringing of conductors, vibration dampers.

Module III (15 hours)

- a) Symmetrical components and fault calculations: 3-phase systems, Positive, Negative and Zero sequence components, Sequence impedances, fault calculations, sequence network equations, L-G faults, Faults on Power Systems, Phase shift Δ -Y Transformers, Reactors, Short-Circuit capacity of a Bus.
- b) Travelling waves and voltage control

Module IV (15 hours)

- a) Load Flows: Bus classification, Nodal admittance matrix, Load flow equations, Iterative methods, N-R method, Line flow equations, Fast-decoupled load flow
- b) Economic Load Dispatch: System constraints, Economic dispatch, Optimum load dispatch, Exact transmission loss formula, Automatic load dispatching, PLCC.

Module V (14 hours)

- a) Distribution System: Effect of System voltage on transmission efficiency. Economic choice of conductor size, Kelvin's law, types of distributors and feeders (radial and ring), voltage drop and load calculation for concentrated and distributed loads.
- b) Power system synchronous stability : the swing equation, equal area criterion, critical clearing angle.

COURSE/LEARNING OUTCOMES

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

- CO1:** *List* the components used for different electrical transmission systems. (Remembering)
- CO2:** *Explain* the various techniques of load flow analysis in power systems.
- CO3:** *Solve* various power flow problems in a power system network. (Applying)
- CO4:** *Classify* various types of the faults existing in electric distribution and transmission systems. (Analysing)
- CO5:** *Assess* effect of system voltage on transmission efficiency, economic conductor size, voltage drop and load value. (Evaluating)
- CO6:** *Develop* programs for simulation of simple electrical power system networks. (Creating)

Suggested Readings

1. C.L. Wadhwa, Electrical Power Systems, Fourth edition, New Age International Publishers.
2. D.P. Kothari, I.J. Nagrath, Power System Engineering, Second edition, Tata McGraw Hill.
3. W.D. Stevenson Jr., Elements of Power System Analysis, Mc Graw Hill.
4. O.I. Elgerd, Electric Energy System Theory, Mc Graw Hill.
5. Allen J. Wood, Brune F. Wollenberg, Power Generation, Operation and Control, 2/e, John Wiley and Sons, Inc.
6. B.J. Cory, B.M. Weedy, Electric Power System, 4/e, John Wiley and Sons Inc.

EEHV0028: HIGH VOLTAGE ENGINEERING**(3 credits – 45 hours)**

Objective: *The subject helps in the detailed analysis of breakdown that occur in gaseous, liquids and solid dielectrics and information about generation and measurement of High voltage and current along with High voltage testing methods.*

Module I (15 hours)

- a) Introduction: Electric Field Stresses, Gas/Vacuum as Insulator, Liquid Dielectrics, Solids and Composites, Estimation and Control of Electric Stress, Numerical methods for electric field computation, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.
- b) Breakdown in Gaseous and Liquid Dielectrics: Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids.

Module II (8 hours)

- a) Breakdown in Solid Dielectrics: Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.
- b) Generation of High Voltages and Currents: Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators.

Module III (12 hours)

- a) Measurement of High Voltages and Currents: Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.
- b) Over Voltage Phenomenon and Insulation Coordination: Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.

Module IV (10 hours)

- a) Non-Destructive Testing of Material and Electrical Apparatus: Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements.
- b) High Voltage Testing of Electrical Apparatus: Testing of Insulators and bushings, Testing of Isolators and circuit breakers, Testing of cables, Testing of Transformers, Testing of Surge Arresters, Radio Interference measurements.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Define* the intrinsic breakdown, Townsends's breakdown, Paschen's law etc, along with Non-Destructive testing and various high voltage testing methods. (Remembering)
- CO2:** *Explain* the breakdown phenomena in various types of dielectrics. (Understanding)
- CO3:** Choose the correct testing methods for high voltage apparatuses. (Applying)

- CO4:** Classify the types of high voltage materials used as dielectrics. (Analysing)
- CO5:** Interpret the high voltage test results of different types of insulating materials used in electrical systems. (Evaluating)
- CO6:** Discuss the suitable working conditions of the dielectrics along with high voltage devices in electrical systems. (Creating)

Suggested Readings

1. M.S.Naidu and V. Kamaraju, High Voltage Engineering, TMH.
2. E.Kuffel, W.S.Zaengl, J.Kuffel, High Voltage Engineering: Fundamentals, Elsevier.
3. C.L.Wadhwa, High Voltage Engineering, New Age Internationals.
4. Ravindra Arora, Wolfgang Mosch, High Voltage Insulation Engineering, NAI.

EECE0029: ADVANCED CONTROL SYSTEM ENGINEERING

(4 credits – 60 hours)

Objective: This course presents advanced control concepts and techniques in terms of state space, describing function, phase plane and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

Module I: Sampled Data Systems (10 hours)

Sampling process, mathematical analysis of sampling process, application of Laplace transform. Reconstruction of sampled signal, zero order, first order hold. Z-transform definition, evaluation of Z-transform, inverse Z-transform, pulse transfer function, limitations of Z-transform, state variable formulation of discrete time systems, solution of discrete time state equations. Stability definition, Jury's test of stability, extension of Routh-Hurwitz criterion to discrete time systems.

Module II: State Space Analysis (15 hours)

- a) State Space Representation, Solution of State Equation, State Transition Matrix, Canonical Forms – Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form.
- b) Controllability and Observability: Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality, Controllability and observability form Jordan canonical form and other canonical forms.

Module III: Describing Function Analysis (13 hours)

- a) Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems.
- b) Phase-Plane Analysis: Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

Module IV: Stability Analysis (12 hours)

- a) Stability in the sense of Lyapunov, Lyapunov's stability and Lyapunov's instability theorems. Direct method of Lyapunov for the Linear and Nonlinear continuous time autonomous systems.
- b) Modal Control: Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer.

Module V (10 hours)

- a) Calculus of Variations : Minimization of functionals of single function, Constrained minimization. Minimum principle. Control variable inequality constraints. Control and state variable inequality constraints. Euler-Lagrange Equation.
- b) Optimal Control: Formulation of optimal control problem. Minimum time, Minimum energy, minimum fuel problems. State regulator problem. Output regulator problem. Tracking problem, Continuous-Time Linear Regulators.

COURSE/LEARNING OUTCOMES

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

- CO1:** Find the stability of a control system based on the inputs provided. (Remembering)
- CO2:** Explain the conditions of stability of a control system. (Understanding)
- CO3:** Choose appropriate controllers for a system. (Applying)
- CO4:** Analyse stability of a system. (Analysing)
- CO5:** Evaluate stability of a system after application of appropriate control mechanism. (Evaluating)
- CO6:** Formulate mathematical model of a system. (Creating)

Suggested Readings

1. M. Gopal, Modern Control System Theory, New Age International.
2. K. Ogata, Modern Control Engineering, PHI.
3. I.J. Nagarath, M.Gopal, Control Systems Engineering, NAI.
4. Stainslaw H. Zak, Systems and Control, Oxford Press.
5. M. Gopal, Digital Control and State Variable Methods, Tata McGraw-Hill.
6. K. Ogata, Discrete-Time Control Systems, Pearson.

EEPP0030: POWER SYSTEM PROTECTION

(4 credits – 60 hours)

Objective: This course introduces the basic theory, construction, usage of current and voltage transformers, relays and circuit breakers. This course introduces the protection systems used for electric machines, transformers, bus-bars, overhead and underground lines, and for over-voltages.

Module I (15 hours)

Faults on power system and their classification, evolution of a power system, protection system attributes, system transducer, principles of power system protection, over current protection: over current relay, IDMT and DTOC relays, Directional over-current relays, Feeder protection.

Module II (15 hours)

Differential Protection: Simple differential protection, Zone of protection, Percentage differential relay, Earth Leakage protection; Transformer Protection: Over current protection, Differential protection of single and three phase transformers, Star-delta and Delta star connections, Harmonic restraint for magnetizing inrush; Inter-turn and incipient faults in transformers, Busbar protection.

Module III (15 hours)

Distance relaying: Introduction, impedance, Reactance, and MHO relays, Three stepped distance protection, Carrier added protection of transmission lines; Generators protection: Stator and rotor faults, Abnormal operating conditions, Generator, differential protection, earth fault relays.

Module IV (15 hours)

Static comparators as relays, Amplitude and phase comparators, Synthesis of distance relaying using static comparators, electronic circuits for Static relays; Microprocessor based numerical protection, Digital filtering, Numerical overcurrent, differential, and distance protection, effect of CT and PT saturation's on Numerical relays.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Recall* the basic theories, construction and usage of different types of power system protective equipment such as CT, PT, relays, circuit breakers, and microprocessor based numerical protection etc.(Remembering)
- CO2:** *Classify* different protection systems used for electric machines, transformers, bus-bars, overhead and underground lines, and for over- voltages. (Understanding)
- CO3:** *Apply* the knowledge to select suitable protective scheme for various sections of electrical power systems such as protection of alternator, motor, transformer, transmission lines, feeders, etc. and solve power system protection related problems to ensure high reliability of the system. (Applying)
- CO4:** *Analyse* the protection against various faults such as earth fault, phase fault, etc. across different sections in electrical power systems using protective schemes like DTOC relays, IDMT relays, distance relays, differential protection, 3-zone protection, comparators, static and numerical relays etc.
- CO5:** *Assess* the overall power system protection scheme in an application. (Evaluating)
- CO6:** *Design* a protection system against various types of faults in an electric supply system. (Creating)

Suggested Readings

1. Sunil S Rao, Switchgear Protection and Power Systems, Khanna Publishers
2. JB Gupta, Switchgear and Protection, SK Kataria and Sons
3. Y.G. Paithankar, S.R. Bhide, Fundamental of Power System Protection, PHI.
4. P.M. Anderson, Power System Protection, Wiley-IEEE Press.

EEPE0031: POWER PLANT ENGINEERING

(4 credits – 60 hours)

Objective: *The course provides students with a broad understanding of electricity generation by conversion of various forms of energy to electrical energy and associated technology, operation and decision making on power plants.*

Module I: Hydel Power (16 hours)

Introduction to different sources of energy and general discussion on their application to generation. Hydel power: Hydrology - Catchment area of a reservoir and estimation of amount of water collected due to annual rainfall, flow curve and flow duration curve of a river and estimation of amount stored in a reservoir formed by a dam across the river, elementary idea about Earthen

and Concrete dam. Turbines- Operational principle of Kaplan. and Francis turbine and Pelton wheel, specific speed, workdone and efficiency. Hydroplant - head gate, perstock, surge tank, scroll case, draft tube and tailrace, classification of plants, turbines for different heads, plant capacity as a base load and peakload station, plant auxiliaries.

Module II: Thermal Power (16 hours)

Overall plant components in Block dams indicating the air, circuit, coal and ash circuit, water and steam circuit, cooling water circuit; various types of steam turbines, ash and coal handling system, elementary idea about a water tube boiler, Super heater, Reheaters, Economiser air preheater dust collection, draft fans and chimney; condensers, feed water heaters, evaporate and makeup water, bleeding of steam; cooling water system; Governors, plant layout and station auxiliaries.

Module III: Nuclear Power (16 hours)

Introduction to fission and fusion, reactor construction, controlled chain reaction, operational control of reactors, Brief study of various types of reactors (Boiling water, pressurised water, sodium graphite, breeder) layout of nuclear power plant. Electrical System: Different types of alternators, methods of cooling; Excitation system - Shaft mounted D. C. generator, elements of static and brush less excitation, field flashing, AVR

- magnetic amplifier and thyristor convertor types. Main transformer, unit transformer and station reserve transformer. Commissioning tests of alternators and transformers.

Module IV (12 hours)

Choice of size and number of generating units - Review of the terms maximum demand, load factor, diversity factor, plant capacity and use factor, load and load duration curve and their effect on the generating capacity. Reserve units (hot, cold and spinning reserve) Effect of power factor on the generating capacity and economy. Different types of power tariffs. Brief idea about national grid and its operational problems.

COURSE/LEARNING OUTCOMES

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

- CO1:** *List* the various energy resources and energy systems available for the production of electric power. (Remembering)
- CO2:** *Explain* the environmental impact of electric power production on air quality, climate change, water, and land. (Understanding)
- CO3:** *Identify* elements and their functions for thermal, hydro, nuclear, wind and solar power plants. (Applying)
- CO4:** *Analyse* economics of power plants of various types. (Analysing)
- CO5:** *Asses* load factor, diversity factor, plant capacity and use factor as well as their effect on generating capacity. (Evaluating)
- CO6:** *Test* the working of smaller power plants for their determining their efficiencies. (Creating)

Suggested Readings

1. P.K. Nag, Power Plant Engineering, 3/e, TMH
2. GK Nagpal, Power Plant Engineering, Khanna Publishers
3. BR Gupta, Generation of Electrical Energy, S Chand and Company
4. M.V Despande, Elements of Electrical Power System Design, A. H. Wheeler.

5. B.G.A. Skrotizki and W.A.Vopat, Power Station Engineering And Economy, TMH.
6. S. L. Uppal, Electrical Power, Khanna Publishers.

EEUE0032: UTILIZATION OF ELECTRICAL ENERGY

(4 credits – 60 hours)

Objective: *This course deals with the fundamentals of illumination and its classification and the electric heating and welding. It is a detailed study of all varieties of electric drives and their application to electrical traction systems.*

Module I (15 hours)

- a) Electric drives: Type of electric drives, Types of motor used in electric drives, Choice of motor, Speed control, Temperature rise, Applications of Electric drives, Advantages and disadvantages of electric drives, Types of industrial loads- continuous, intermittent and variable loads, load equalization.
- b) Electric heating: Advantages and methods of electric heating, Resistance heating, induction heating and dielectric heating, Industrial applications.

Module II (10 hours)

- a) Electric welding: Resistance and arc welding, electric welding equipment, Comparison between A.C. and D.C. Welding.
- b) Illumination fundamentals: Introduction, terms used in illumination, Laws of illumination, Polar curves, Photometry, integrating sphere, Sources of light.

Module III (20 hours)

- a) Illumination methods: Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.
- b) Electric vehicles: Main components and working of electric vehicles and its comparison with combustion engine driven vehicles, Hybrid electric vehicles.

Module IV (15 hours)

- a) Electric traction-II: Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves.
- b) Electric traction-III: Calculations of tractive effort, power, specific energy consumption for given run, Effect of varying acceleration and braking retardation, Adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Choose* a particular type of electric drive for a specific application. (Remembering)
- CO2:** *Explain* mechanism of electric train movement and methods of electric braking. (Understanding)
- CO3:** *Identify* heating and welding scheme for a given applications. (Applying)
- CO4:** *Examine* size of the lamps and their fittings for a particular illumination. (Analysing)
- CO5:** *Assess* effect of varying acceleration and braking retardation. (Evaluating)
- CO6:** *Estimate* the required parameters related to electric drives for industrial applications. (Creating)

Suggested Readings

1. E. Openshaw Taylor, Utilisation of Electric Energy, Orient Longman.
2. Partab, Art and Science of Utilization of Electrical Energy, Dhanpat Rai and Sons.
3. N.V. Suryanarayana, Utilization of Electrical Power including Electric drives and Electric traction, New Age International.
4. C.L. Wadhwa, Generation, Distribution and Utilization of electrical Energy, New Age International.

EEED0033: ELECTRICAL DRIVES**(4 Credits – 60 hours)**

Objective: This course provides a good knowledge on AC and DC drives including control of DC motor drives with converters and choppers and voltage control of AC motor drives along with stability considerations and applications.

Module I: Introduction To Electrical Drives and Its Dynamics (15 hours)

Electrical drives, Advantages of electrical drives, Parts of electrical drives, choice of electrical drives, Dynamics of electrical drives, Fundamental torque equation, speed- torque conventions and multi-quadrant operation. Equivalent values of drive parameters, components of load torques, nature and classification of load torques, calculation of time and energy loss in transient operations, steady state stability, load equalization. Selection of motor power rating: Thermal model of motor for heating and cooling, Classes of motor duty, determination of motor rating.

Module II: DC Motor Drives (15 hours)

Starting braking, transient analysis, single phase fully controlled rectifier, control of separately excited dc motor, Single-phase half controlled rectifier control of separately excited dc motor. Three phase fully controlled rectifier – control of separately excited dc motor, three phase half controlled rectifier – control of separately excited dc motor, multi-quadrant operation of separately excited dc motor fed from fully controlled rectifier. Control of dc series motor, chopper controlled dc drives for separately excited dc motor and series motor.

Module III: Induction Motor Drives (15 hours)

Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting braking, transient analysis. Stator voltage control: Variable voltage and variable frequency control, voltage source inverter control, closed loop control, current source inverter control, rotor resistance control, slip power recovery, speed control of single phase induction motors.

Module IV: Synchronous Motor Drives (10 hours)

Operation from fixed frequency supply, synchronous motor variable speed drives, and variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thyristor inverter.

Module IV: Industrial Drives (5 hours)

Steel mill drives, cement mill drives, paper mill drives and sugar mill drives. Microprocessor for control of electric drives.

COURSE/LEARNING OUTCOMES

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

- CO1:** Select a suitable rotating machine for an electrical motor drive. (Remembering)

- CO2:** Explain the working of various DC and AC drives. (Understanding)
CO3: Identify the need and choice of various electrical drives. (Applying)
CO4: Model electrical motor drives and their sub systems including converters, rotating machines and loads. (Applying)
CO5: Categorize the drives according to their design and use of motors. (Analysing)
CO6: Predict the class of motor duty. (Creating)

Suggested Readings

1. G.K. Dubey, Fundamentals of Electrical Drives, Narosa
2. S.K. Pillai, A First Course On Electric Drives, Wiley Eastern Ltd.
3. N.K. De and P.K. Sen, Electrical Drives, PHI.
4. V. Subrahmanyam, Electric drives, TMH.
5. M.H. Rashid, Power Electronics and AC drives, Pearson.
6. B.K. Bose, Modern Power Electronics and AC drives, Pearson.

EEAM0034: ENERGY AUDIT AND MANAGEMENT

(3 credits – 45 hours)

Objective: The objective of the course is to introduce energy audit need, measurement, energy performance diagnosis and analysis and carry out financial analysis and cost prediction for energy saving. The course also addresses energy management issues in various sectors.

Module I (8 hours)

Need for Energy Conservation, standards and practices in energy conservation; Energy Audit: Principles of energy audit, preliminary energy audit and detailed energy audit. Procedures for carrying out energy audit. Energy- production relationship, specific energy consumption, least square method, Cusum technique, data energy flow diagram. Sankey diagram. Instruments used for energy audit.

Module II (15 hours)

Thermal Energy Audit: Purpose, Methodology with respect to process Industries - Power plants and Boilers. Steam System - Losses in Boiler, Methodology of Upgrading Boiler Performance; Energy conservation in Pumps, Fans and Compressors, Air conditioning and refrigeration systems, Steam Traps-Types, Function, Necessity; Electrical Energy Audit: Potential areas for Electrical Energy Conservation in Various Industries-Energy Management Opportunities in Electrical Heating, Lighting system, Cable selection - Energy Efficient Motors - Factors involved in determination of Motor Efficiency

Module III (12 hours)

Concept of energy management: Energy inputs in industrial, residential, commercial, agriculture and public sectors, Comparison of different energy inputs on the basis of availability, storage feasibility, cost (per unit output) etc. Electrical Energy Management- energy Accounting, Measurement and management of power factor, voltage profile, current energy requirement, power demand monitoring, target setting.

Module IV (10 hours)

Concept of Supply Side Management and Demand Side Management (DSM), Load Management, Voltage profile management from receiving end. Methods of implementing DSM. Advantages of DSM to consumers, utility and society; Simple payback period analysis, advantages and

limitations of payback period. Time value of money, net present value method. Internal rate of return method, profitability index for cost benefit ratio.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Show* the need of energy audit which would give a positive orientation to the energy cost reduction and decide preventive measures and quality control programmes for the conservation of energy. (Remembering)
- CO2:** *Explain* different energy conservation techniques for enhancing the energy performance of various sectors. (Understanding)
- CO3:** *Apply* different financial analysis techniques in energy audit and management programmes in industries. (Applying)
- CO4:** *Analyse* the possibility of reducing the energy wastages in industries for energy saving and conservation. (Analysing)
- CO5:** *Compare* different systematic approaches for decision making in the area of energy management in order to balance the total energy input with its use. (Evaluating)
- CO6:** *Estimate* the energy dynamics parameters of the system under study in order to seek opportunities to reduce the amount of energy input into the system without negatively affecting the output. (Creating)

Suggested Readings

1. S.C. Tripathy, Electric Energy Utilization and Conservation, TMH.
2. C.B. Smith, Energy Management Principles, Pergamon Press.
3. S. Rao, Energy Technology- Non-conventional Renewable and Conventional, Khanna Publishers.
4. P.R. Trivedi and K.R. Jolka, Energy Management, Commonwealth Publication.

EEOC0035: POWER SYSTEM OPERATION AND CONTROL

(4 credits – 60 hours)

Objective: *This course aims at making the student aware of the basic concepts of power systems and spells out the constraints in power system operation. The course also covers principles of frequency control, voltage and power flow control and economic operation of power systems.*

Module I (10 hours)

Fundamental of power System: concepts of real and reactive powers, Complex power per unit representation of power system. Transmission capacity, series and shunt compensation, Load characteristics, Real power balance and its effect on system frequency, Load frequency mechanism, reactive power balance and its effect on system voltage, on load tap changing transformer and regulating of transformer, Introduction to FACT devices.

Module II (10 hours)

Load Flow Analysis – The static load flow equation (SLFE), Definition of the load flow problem, Network model formulation, A load flow sample study, Computational aspects of the load flow problem, effect of regulation transformers.

Module III (10 hours)

Load frequency Control: Dynamic incremental state variable, PF versus QV control MW frequency of an individual generator, modeling of speed governing system, Turbine, Division of power system into control areas, P-F control of single control area and two area control, Economic dispatch controller.

Module IV (15 hours)

- a) Economic Operation of Power System : Distortion of load between units within a plant, Transmission losses as function of plant generation, Calculation of loss coefficients, Distribution of loads between plants with special reference to steam and hydel plants, Automatic load dispatching, Unit commitment
- b) Power System Stability: Steady state stability, transient stability, Swing equation, Equal area criterion for stability.

COURSE/LEARNING OUTCOMES

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

- CO1:** Find the basic constraints in power system operation and control. (Remembering)
- CO2:** Illustrate the principles of frequency control, voltage and power flow control and economic operation of power systems. (Understanding)
- CO3:** Apply suitable method to solve various power system operation and control related issues such as real and reactive power balance, load flow problem, load frequency control, economic operation of power system, power system stability. (Applying)
- CO4:** Analyse power system operation related problems to eliminate them using various devices and controllers. (Analysing)
- CO5:** Assess the operation of various components and instruments for appropriately applying to power system operation and control. (Evaluating)
- CO6:** Predict performances of a power system network for its operation and control using different methods, devices and controllers by applying right procedure. (Creating)

Suggested Readings

1. CL Wadhwa, Electrical Power Systems, New Age International
2. Hadi Saadat, Power System Analysis, TMH.
3. B. R. Gupta, Power System Analysis and Design, S. Chand and Co.
4. O.I. Elgerd, An introduction to Electric Energy System Theory, TMH.
5. W.D. Stevenson, Elements of Power System Analysis, TMH.
6. PSR Murty, Operation and Control in power system, BS Publications
7. WD Stevenson, Elements of power system analysis, TMH Publications
8. J Wood and BF Wollenburg, Power generation operation and control, John Wiley & Sons.

EEIT0036: INSTRUMENTATION AND TELEMETRY

(4 credits-60 hours)

Objective: After completing this course student will be able to explain different types and operating principles of transducers and will understand the techniques of measurement of non-electrical quantities with electrical transducers. Students will also be aware of different optical measurement techniques and use optical fibre sensors for measurements. Last module includes basics of data acquisition and communication of the measured parameters.

Module I Primary Sensing Elements and Transducers (15 hours)

- a) Functional elements of a measurement system, Primary sensing elements Transducers, Classification of transducers, Basic requirements of a transducer, Selection criteria of transducers.

- b) Passive and Active Electrical transducers- Resistive transducers: working principle; Potentiometer; Strain gauge, Inductive transducers: working principle; LVDT; RVDT; Synchros, Capacitive transducers: working principle, Piezoelectric Transducers: working principle, Photoelectric transducers and Digital Transducers.

Module II Measurement of non-electrical quantities (22 hours)

- a) Measurement of temperature: Thermal-Expansion methods, Thermoelectric Thermocouples), Electrical-Resistance (RTD), Semiconductor (Thermistors), LM35.
- b) Measurement of pressure: Manometers, Elastic transducers, High pressure measurement, Low Pressure measurement.
- c) Measurement of flow: Turbine, electromagnetic, hot-wire anemometer, orifice, venturi-meter, ultrasonic methods.
- d) Measurement of force: Elastic type, Piezoelectric type.
- e) Measurement of level: Resistive, float, force-balance, bubbler or purge, capacitive and ultrasonic methods.

Module III Optical Instrumentation (10 hours)

- a) Devices: Photoconductive cells, photovoltaic cells, photo-junctions (diodes and transistors), LDR.
- b) Fibre optic measurements: Optical fibre sensors, Intrinsic and extrinsic types, intensity modulated and interferometric type optical fiber sensors, distributed sensing with fiber optics, Optical power measurements.

Module IV Telemetry, Transmitters and Data Acquisition System (13 hours)

- a) Telemetry: Introduction and characteristics, Landline Telemetry, Radio Telemetry, Pneumatic telemetry
- b) Signal Conditioning, 4-20 mA transmitter, grounded load and floating load concept of I to V converter., Smart transmitters with Modbus.
- c) Data Acquisition: Components of Analog and Digital Data Acquisition System, Types of Multiplexing Systems, Uses of Data Acquisition System, Use of recorders in Digital systems, Modern Digital Data Acquisition System.

COURSE/LEARNING OUTCOMES

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

- CO1:** Identify different functional elements of an instrumentation system. (*Knowledge*)
- CO2:** Classify and explain various types of transducers. (*Comprehension*)
- CO3:** Apply knowledge of different transducers to build instrumentation system. (*Application*)
- CO4:** Compare the performances of different transducers for measurement of pressure, flow, temperature Level. (*Analysis*)
- CO5:** Assemble different elements of a telemetry system for transmitting sensor data. (*Synthesis*)
- CO6:** Decide on the type of optical fiber sensor suitable for measurement of different quantities. (*Evaluation*)

Suggested Readings

1. E.O. Doebelin, Dhanesh Manik, Measurement Systems Application and Design, Tata- McGraw Hill
2. A.K. Sawhney, Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai
3. J.B. Gupta, A course in Electrical and Electronic Measurements and Instrumentation, S.K. Kataria and Sons
4. S.K. Singh, Industrial Instrumentation & Control, Tata-McGraw Hill
5. D. Patranabis, Sensors and Transducers, PHI
6. D Patranabis - Telemetry principles - Tata McGraw Hill.
7. Bishnu P. Pal- Fundamental of fiber optics in telecommunication and sensor systems, New Age International (P) Limited.

EEBE0038: BASIC ELECTRICAL ENGINEERING

(4 credit - 60 hours) (L – T – P: 3 – 1 – 0)

Objectives:

- *To understand and Analyse basic electric and magnetic circuits.*
- *To study the working principles of electrical machines and power converters.*
- *To introduce the components of low voltage electrical installations.*

Module I: DC Circuits (8 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module II: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, R-L, R-C, R-L-C combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module III: Electrical Machines (14 hours)

DC Machines: Principle of operation of generators and motors, construction of DC machine, EMF and Torque Equations, Classification and applications of DC machines. Transformer: Construction and principle of operation of a single phase transformer, EMF equation, introduction of auto-transformer.

Induction Motor: Classification and applications, Construction and principle of operation of single phase and three-phase induction motor

Module IV: Power Converters (6 hours)

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module V: Electrical Installations (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Define* basic terminologies related to electrical circuits and machines. (Remembering)
- CO2:** *Explain* the working principle, construction, applications of dc machines and ac machines. (Understanding)
- CO3:** *Explain* basics of converters, domestic wiring and Electrical Installations. (Understanding)
- CO4:** *Apply* network theorems to solve a complex circuit. (Applying)
- CO5:** *Analyse* basic DC as well as AC circuits. (Analysing)

Suggested Readings

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

EERS0039: RENEWABLE ENERGY SYSTEMS

(4 credits - 60 hours)

Module I: Physics of Wind Power: (6 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module II: Wind generator topologies: (11 Hours)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronic converters. Generator-Converter configurations, Converter Control.

Module III: The Solar Resource: (5 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Module IV: Solar Photovoltaic: (10 Hours)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Module V: Network Integration Issues: (12 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems, Integration in Smart Grid System.

Module VI: Solar thermal power generation: (4 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel reflector, solar pond, elementary analysis.

Module VII: Micro Hydel Generation: (9 Hours)

Operating principles. Power and Efficiency of Micro Hydel plant. Control, Automation and Monitoring in a Small Hydro Plant. Components of a microhydel power plant. Types, specifications and characteristics of turbines, generator and governors. Selection and modification. Load balancing.

Module VIII: Bioconversion: (3 Hours)

Biomass, physical and biological thermal methods of bioconversion. Solid fuels, ethanol, methanol, vegetable oils. Biomass fuels in IC engines. Alcohol fuels, vegetable oils, producer gas.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Select* the suitable type of renewable energy for a particular application. (Remembering)
- CO2:** *Explain* the working of the different types of renewable energy sources. (Understanding)
- CO3:** *Apply* the theoretical knowledge gained into practical fields of Renewable energy generation. (Applying)
- CO4:** *Compare* the performance characteristics of different types of renewable energy sources. (Analysing)
- CO5:** *Evaluate* the new energy conversion systems from Energy Conservation and Management point of view. (Evaluating)
- CO6:** *Develop* renewable energy sources with improved performance and enhanced efficiency. (Creating)

Suggested Readings:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. G.D. Rai, Non-conventional energy sources, Khanna publishers.
4. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
5. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems", John Wiley and Sons Ltd., 2006.
6. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
7. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

EEAD0040: ANALOG AND DIGITAL COMMUNICATION

(3 credits - 45 hours)

Module I: Analog Modulation Techniques (12 Hours)

Review of signals and systems, Introduction to Communication Systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. Review of probability and random processes. Gaussian and white noise

characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Module II: Pulse and Data Communication (7 Hours)

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Data Communication Circuits – Data Communication Codes – Data communication Hardware – serial and parallel interfaces.

Module III: Signal Detection (7 Hours)

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion.

Module IV: Digital Modulation (12 Hours)

Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Module V: Multi-User Radio Communication (7 Hours)

Global System for Mobile Communications (GSM), Code Division Multiple Access (CDMA), Cellular Concept and Frequency Reuse, Channel Assignment and Handover Techniques.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the basic terminologies and explain the basic concepts related to analog and digital communication systems. (Remembering, Understanding)
- CO2:** *Experiment with* different analog modulation schemes for their efficiency and bandwidth. (Applying)
- CO3:** *Analyse* the behavior of a communication system in presence of noise. (Analysing)
- CO4:** *Determine* the bit error performance of the communication systems. (Evaluating)
- CO5:** *Test* for system performance of pulsed modulation system. (Creating)

Suggested Readings

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., "Principles of Communication Engineering", John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., "Digital Communications", 4th Edition, McGraw Hill, 2000.

EECA0041: ELECTRICAL CIRCUIT ANALYSIS

(4 credits - 60 Hours)(L-T-P:3-0-0)

Objective: *The objective of this course is to understand the physical laws that govern the response of electrical circuits and networks. The students obtain equations to solve circuits in steady and in the transitory state through the application of mathematical tools.*

Module I: Network Theorems (16 Hours)

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Tellegen's theorem, Substitution theorem, Voltage and current divider rule. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Source transformation. Concept of Duality and Dual networks.

Module II: Solution of First and Second order networks (10 Hours)

Solution of first and second order differential equations for Series and Parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Module III: Sinusoidal steady-state analysis (9 Hours)

Representation of sine function as rotating phasor, phasor diagrams, Impedances and Admittances, AC circuit analysis, Effective or RMS values, Average power and Complex power. Three-phase circuits. Mutually coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Module IV: Electrical Circuit Analysis Using Laplace Transforms (11 Hours)

Review of Laplace Transforms, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, Inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), Series and Parallel Resonances.

Module V: Two-Port Network and Network Functions (8 Hours)

Two-Port Networks, terminal pairs, relationship of two-port variables, Impedance parameters, Admittance parameters, Transmission parameters and Hybrid parameters, interconnections of two-port networks.

Module VI: Graph Theory (6 Hours)

Graph of Network. Concept of tree branch, tree link. Incidence matrix, Tie-set matrix and loop currents, Cut set matrix and node pair potentials.

COURSE/LEARNING OUTCOMES

At the end of this course, students will demonstrate the ability to

- CO1:** *Define* and explain the various network theorems used for circuit analysis. (*Remembering*)
- CO2:** *Analyse* circuits in the sinusoidal steady-state (single-phase and three-phase) and two-port circuit behaviour. (*Analysing*)
- CO3:** *Determine* the transient and steady-state response of electrical circuits. (*Evaluating*)
- CO4:** *Evaluate* graph of a network, tie-set matrix, loop currents, cut-set matrix and their node-pair potentials (*Evaluating*)
- CO5:** *Design* an electric circuit for simple applications. (*Creating*)

Suggested Readings

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. Abhijit Chakrabarti, "Circuit Theory (Analysis and Synthesis)", Dhanpat Rai & Co, 7th Edition, 2018.
3. Ravish R. Singh, "Network Analysis and Synthesis", Mc Graw Hill Education, 2013
4. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
5. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
6. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
7. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

EEAE0042: ANALOG ELECTRONICS**(3 Credits-45 hours)(L-T-P:3-0-0)**

Objectives: This course aims to familiarize the student with the concept of diode circuits, BJT circuits, MOSFET circuits etc. Also, the course introduces OpAmp and its different applications in electronic circuits.

Module I: Diode circuits (4 Hours)

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Module II: BJT circuits (10 hours)

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Module III: MOSFET circuits (8 hours)

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high-frequency equivalent circuit.

Module IV: Differential, multi-stage and operational amplifiers (7 hours)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module V: Linear applications of op-amp (10 hours)

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

Module VI: Non-linear applications of op-amp (6 Hours)

Hysteresis Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain the characteristics of transistors. (Understanding)

- CO2:** *Classify* various mode of transistors working (Understanding)
- CO3:** *Compare* different OP-AMP circuits. (*Evaluating*)
- CO4:** *Design* various rectifier, amplifier circuits and oscillators. (*Creating*)
- CO5:** *Construct* appropriate analog amplifiers. (*Creating*)

Suggested Readings

1. 1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. 2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. 3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. 4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. 5. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

EEEF0043: ELECTROMAGNETIC FIELDS

(3 Credits–45 Hours)(L-T-P: 3-0-0)

Objective: *The objective of the course is to introduce the students to various electromagnetic field related quantities, including vector differential and integral operators, electrostatics, magnetostatics and related applications.*

Module I: Review of Vector Calculus (8 hours)

- a) Vector algebra- addition, subtraction, components of vectors, scalar and vector multiplications, triple products.
- b) Three orthogonal coordinate systems (rectangular, cylindrical and spherical).
- c) Vector calculus differentiation, Partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors.
- d) Conversion of a vector from one coordinate system to another.

Module II: Static Electric Field (6 Hours)

- a) Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications.
- b) Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Module III: Conductors, Dielectrics and Capacitance (7 hours)

- a) Current and current density, Ohms Law in Point form, Continuity of current.
- b) Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two-wire line.
- c) Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Module IV: Static Magnetic Fields (6 hours)

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Module V: Magnetic Forces, Materials and Inductance (6 hours)

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Module VI: Time-Varying Fields and Maxwell's Equations (6 hours)

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Module VII: Electromagnetic Waves (6 hours)

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Relate* the basic laws of electromagnetism with the applications. (Remembering)
- CO2:** *Explain* the behaviour of the field quantities based on different laws of electromagnetism. (Understanding)
- CO3:** *Analyse* time-varying electric and magnetic fields. (Analysing)
- CO4:** *Assess* the behaviour of various forms of electric and magnetic field sources in different media. (Evaluating)
- CO5:** *Predict* the electric and magnetic field values in a given design of electromagnetic equipment. (Creating)

Suggested Readings

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
8. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.
10. U.A. Bakshi, A.V. Bakshi, "Electromagnetic Fields", Technical Publications, 2013.

EEMC0044: ELECTRICAL MACHINES-I

(3 credits-45 hours)(L-T-P:3-0-0)

Objectives: *The objective of this course is to equip the students with a basic understanding of DC machines and Transformer fundamentals, different parts of these machines and help to gain the skills for operating DC machines and Transformers. The course also equips students with ability to understand and Analyse the different circuits of DC machines and Transformers.*

Module I: Magnetic fields and magnetic circuits (6 hours)

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current-carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Module II: Electromagnetic force and torque (9 hours)

B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency.

Module III: DC machines (8 hours)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear computation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Module IV: DC machine - motoring and generation (10 hours)

Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. DC motor starters. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Module V: Transformers (12 hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Explain* the principle of operation of dc motor and dc generator. (Understanding)
- CO2:** *Identify* different types of dc machines. (Applying)
- CO3:** *Analyse* different circuits used in dc motors and generators. (Analysing)
- CO4:** *Compare* the performances in terms of losses, efficiency, and regulation of different types of dc machines. (Evaluating)

CO5: Test dc motor, dc generator and single phase transformer to determine their performances. (Creating)

Suggested Readings

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Education, 2013.
2. J.B. Gupta, "Theory and performance of Electrical machines" S.K. Kataria and sons. 2017
3. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
4. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
5. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
6. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

EEDE0045: DIGITAL ELECTRONICS

(3 Credits-45 hours)(L-T-P:3-0-0)

Objective: The objectives of this course are to introduce the concept of digital and binary systems and give students the concept of digital electronics. The course also provides fundamental concepts used in the design of digital systems, the basic tools for the design and implementation of digital circuits, modules and subsystems.

Module I: Fundamentals of Digital Systems and logic families (9 hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal, hexadecimal number, binary, arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module II: Combinational Digital Circuits (10 hours)

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module III: Sequential circuits and systems (10 hours)

A 1-bit memory, the circuit properties of bistable latch, the clocked SR flip flop, J- K-T and D types flip-flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Module IV: A/D and D/A Converters (8 hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

Module V: Semiconductor memories and Programmable logic devices (8 hours)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read-only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge decoupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

COURSE / LEARNING OUTCOMES

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

- CO1:** *Define* the basic terminologies related to digital electronics and logic design. (Remembering)
- CO2:** *Explain* the fundamentals of logic gates and boolean algebra. (Understanding)
- CO3:** *Apply Boolean formulas, K-map and Quine-McClusky methods for minimizing logic functions.*(Applying)
- CO4:** *Distinguish* between combinational and sequential circuits and Analyse their behavior. (Analysing)
- CO5:** *Design* and implement combinational and sequential logic circuits. (Creating)

Suggested Readings

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

EEMS0046: ELECTRICAL MACHINES-II

(3 credits-45 hours) (L-T-P:3-0-0)

Objective: *This course provides a basic understanding of AC machinery fundamentals, machine parts and helps to gain the skills for operating AC machines. The course also equips students with the ability to understand and analyse the phasor diagrams and equivalent circuits of AC Induction and Synchronous Machines.*

Module I: Fundamentals of AC machine windings (8 Hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Module II: Pulsating and revolving magnetic fields (4 Hours)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module III: Induction Machines (13 Hours)

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque-speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Module IV: Single-phase induction motors (8 Hours)

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Module V: Synchronous machines (12 Hours)

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine – two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

COURSE/ LEARNING OUTCOMES

At the end of this course, students will demonstrate the ability to

- CO1:** *Demonstrate* the operation of ac machines. (Understanding)
- CO2:** *Explain* the concepts of rotating magnetic fields. (Evaluating)
- CO3:** *Analyse* performance characteristics of ac machines. (Analysing)
- CO4:** *Compare* the performances of different types of ac motors. (Analysing)
- CO5:** *Develop* equivalent circuit of different ac motors and generator and transformer. (Creating)

Suggested Readings

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

EEPE0047: POWER ELECTRONICS**(3 credits-45 hours) (L-T-P:3-0-0)**

Objective: *The course helps to develop an in-depth understanding of the power electronics devices and circuits for current and voltage control and protection. The course helps in the learning of switching characteristics and various arrangement of power switching devices for realizing rectifier, inverter and choppers and triggering methods of SCRs.*

Module I: Power switching devices (8 hours)

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module II: Thyristor rectifiers (9 hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module III: DC-DC buck converter (5 hours)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Module IV: DC-DC boost converter (5 hours)

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module V: Single-phase voltage source inverter (10 hours)

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.

Module VI: Three-phase voltage source inverter (8 hours)

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Explain* the characteristics of different power electronic devices consisting of power switches. (Understanding)
- CO2:** *Explain* the working of different power converters such as rectifiers, choppers and inverters. (Understanding)
- CO3:** *Explain* the operation of single phase and three-phase voltage source inverter and three-phase sinusoidal modulation. (Understanding)
- CO4:** *Categorize* different protecting circuits for power electronics devices. (Analysing)
- CO5:** *Estimate* different parameters of power electronics converters. (Creating)

Suggested Readings

1. M. H. Rashid, “*Power electronics: circuits, devices, and applications*”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “*Power Electronics: Converters, Applications and Design*”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “*Fundamentals of Power Electronics*”, Springer Science & Business Media, 2007.
4. L. Umanand, “*Power Electronics: Essentials and Applications*”, Wiley India, 2009.

EESA0048: POWER SYSTEM ANALYSIS**(3 Credits-45 hours)(L-T-P:3-0-0)**

Objectives: *The objective of this course is to give the knowledge of various methods of load flow, analysis of various types of faults in power system, concept of security & contingency analysis of power systems and their needs for maintain security of the system. It also introduces the concept of state estimation and the phenomenon of voltage instability in power system.*

Module I: Load flow (10 hours)

Overview of Newton-Raphson, Gauss-Siedel, fast-decoupled methods, convergence properties, sparsity techniques, handling Q- max violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variable in load flow.

Module II: Fault Analysis (7 hours)

Simultaneous faults, short circuit and open conductor faults, generalized method of analysis of simultaneous fault in power system.

Module III: Security Analysis (7 hours)

Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking

Module IV: Power System Equivalent (5 hours)

WARD equivalents (Kron reduction), WARD equivalent circuits for power flow studies, REI equivalents for power systems.

Module V: State Estimation (8 hours)

Sources of errors in measurement, Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WLS method, bad data correction.

Module V: Voltage Stability (8 hours)

Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Find* different parameters for the analysis of power system. (Remembering)
- CO2:** *Explain* methods of state estimation in power system. (Understanding)
- CO3:** *Organize* various contingencies according to their severity. (Applying)
- CO4:** *Analyse* simultaneous fault using generalized method. (Analysing)
- CO5:** *Determine* voltage magnitude and phase-angles at all buses for the given data using various methods of load flow. (Evaluating)

Suggested Readings

1. J. J. Grainger & W. D. Stevenson, "Power system analysis", McGraw Hill, 2003.
2. A. R. Bergen & Vijay Vittal, "Power System Analysis", Pearson, 2000.
3. L. P. Singh, "Advanced Power System Analysis and Dynamics", New Age International, 2006.
4. G. L. Kusic, "Computer aided power system analysis", Prentice Hall India, 1986.
5. A. J. Wood, "Power generation, operation and control", John Wiley, 1994.
6. P. M. Anderson, "Faulted power system analysis", IEEE Press, 1995.

EESD0049: POWER SYSTEM DYNAMICS-I

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives: *The objective of this course is to give the concept of power system dynamics and its physical interpretation, development of mathematical models for synchronous machine and modeling of induction motor, prime mover controller, load modeling in power systems and stability analysis with and without power system stabilizer.*

Module I: Synchronous Machine: (8 hours)

- a) Armature and field structure, MMF waveforms, Direct and quadrature axes, Basic equations of synchronous machine
- b) Per unit systems, Park's Transformation (modified), Flux-linkage equations.

Module II: Synchronous machine equations (8 hours)

Voltage and current equations, phasor representation, rotor angle, Formulation of State-space equations, Equivalent circuit.

Module III: Modeling and Analysis of synchronous machine (6 hours)

Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines

Module IV: Small signal model (8 hours)

Introduction to frequency model. Models of governor, turbine, power system stabilizer and FACTS devices.

Module V: Excitation system and load (8 hours)

Excitation systems requirements, Elements of an excitation system, types of excitation systems and Philips-Heffron model, PSS Load modeling.

Module VI: Induction Motors (7 hours)

Modeling of Induction Motors, equation of induction machines, steady state characteristics modeling of Prime mover, Prime mover controllers.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Illustrate* the modeling of synchronous machine in details. (Understanding)
- CO2:** *Explain* the load modeling in power system. (Understanding)
- CO3:** *Analyse* stability of power system with and without power system stabilizer. (Analysing)
- CO4:** *Determine* different parameters of synchronous machines. (Evaluating)
- CO5:** *Formulate* simulation of power system dynamics using simulation. (Creating)

Suggested Readings

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia, New Delhi, 1981.
2. J. Machowski, J. Bialek & J. R. W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997.
3. P. Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
4. E. W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002.
5. D. Mondal, A. Chakrabarti & A. Sengupta, "Power System Small Signal Stability Analysis and Control", Academic Press, 2014.

EEHP0050: HIGH POWER CONVERTERS**(3 Credits-45 hours) (L-T-P:3-0-0)**

Objective: *Students will be able to understand the need of high power rated converters and Analyse the different topologies involved for these converters. It will provide a holistic approach to comprehend the design of protection circuits for these converters.*

Module I: Power switching Devices (10 Hours)

Power electronic systems: an overview of PSDs, multi-pulse diode rectifier, multi-pulse SCR rectifier.

Module II: Power Inverters (15 Hours)

Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter, Cascaded, H bridge multilevel inverter. Diode clamped multilevel inverters, flying capacitor multilevel inverter, PWM current source inverters.

Module III: Power Inverters (13 Hours)

DC to DC switch mode converters, AC voltage controllers: Cyclo-converters, matrix converter.

Module IV: Power Inverters (7 Hours)

Power conditioners and UPS, design aspects of converters, protection of devices and circuits.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Define* the characteristics of PSDs *such as* SCRs, GTOs, IGBTs and use them in practical systems. (Remembering)
- CO2:** *Explain* the working of multi-level VSIs, DC-DC switched mode converters, Cyclo-converters and PWM techniques. (Understanding)
- CO3:** *Formulate* knowledge of power conditioners and their applications. (Creating)
- CO4:** *Propose* the ability to design power circuit and protection circuit of PSDs and converters. (Creating)
- CO5:** *Compare* various types of Power Inverters. (Evaluating)

Suggested Readings

1. N. Mohan, T. M. Undel & W. P. Robbins, "Power Electronics: Converter, Applications and Design", John Wiley and Sons, 1989.
2. M. H. Rashid, "Power Electronics", Prentice Hall of India, 1994.
3. B. K. Bose, "Power Electronics and A.C. Drives", Prentice Hall, 1986.
4. Bin Wu, "High power converters and drives", IEEE press, Wiley Enter science.

EEWS0051: WIND AND SOLAR SYSTEMS**(3 Credits- 45 hours) (L-T-P:3-0-0)****Objectives:**

- *To expose the students to wind and solar energy systems.*
- *To make the students understand the factors involved in installation and commissioning of a Solar or Wind plant.*
- *To facilitate the students learn the dynamics involved when solar and wind energy systems are interconnected with power system grid.*

Module I (8 hours)

Historical development and current status of wind and solar systems. Characteristics of wind and solar power generation. Network integration issues of renewable energy systems.

Module II (8 hours)

Generators and power electronics for wind turbines, Use of DFIG for wind energy, power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems.

Module III (8 hours)

Isolated wind systems, reactive power and voltage control, economic aspects.

Module IV (8 hours)

Impact of wind energy systems on power system dynamics and stability, Wind energy systems grid connection and power system interconnection issues.

Module V (6 hours)

Introduction of solar systems, merits and demerits of solar energy conversion systems, solar concentrators, various applications of solar energy conversion systems.

Module VI (7 hours)

Solar thermal power generation, PV power generation, Energy Storage device. Designing the solar system for small installations.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Choose* between wind and solar energy generation systems for potential locations of applications. (Remembering)
- CO2:** *Demonstrate* the knowledge of the physics of wind power and solar power generation in solving practical problems at site. (Understanding)
- CO3:** *Identify* the potential fields of solar and wind power applications. (Applying)
- CO4:** *Examine* the grid integration possibilities of wind and solar energy systems. (Analysing)
- CO5:** *Solve* practical problems related to wind and solar power generation systems. (Creating)

Suggested Readings

1. Thomas Ackermann (Editor), "Wind Power in Power Systems", John Wiley & Sons. Ltd., 2005.
2. Siegfried Heier, "Grid Integration of Wind Energy Conversion Systems", 2nd Edition, John Wiley and Sons Ltd, 2006.
3. K. Sukhatme & S. P. Sukhatme, "Solar Energy", 3rd Edition, Tata McGraw Hill, 1996.

EEP0052: ELECTRICAL POWER DISTRIBUTION SYSTEM

(3 Credits – 45 hours) (L-T-P:3-0-0)

Objective: *The objective of this course is to make the students familiar with topics on electrical distribution system planning, load characteristics, application of distribution transformers, design of sub-transmission lines, distribution substations, primary systems, and secondary systems, voltage drop and power-loss calculations, application of capacitors, harmonics on distribution systems, voltage regulation, and smart grid concepts.*

Module I: Distribution System Planning and Automation (8 hours)

Introduction, Distribution System Planning, Factors Affecting System Planning, Present Distribution System Planning Techniques, Central Role of the Computer in Distribution Planning, Distribution System Automation, load characteristics, Diversified demand, Non-coincident demand, Coincidence factor, Contribution factor problems, Relationship between the Load and Loss Factors, Load Forecasting, Rate structure, Customer billing.

Module II: Application of Distribution Transformers (8 hours)

Types of Distribution transformers, Regulation, Efficiency, single-phase transformer connections, Three-phase transformer connections, Auto-transformer, Booster transformer, phasor diagrams, Grounding Transformers.

Module III: Design of sub-transmission lines and distribution substations (8 hours)

Sub-station bus schemes, Rating of distribution substation, Service area with multiple feeders, Sub-station application curves, Percent voltage drop calculations, Substation Grounding, Types of Ground Faults.

Module IV: Design Considerations of Primary and Secondary Systems (8 hours)

Radial type, Loop type primary feeder, primary feeder loading, Radial Feeders with Uniformly Distributed Load, Introduction to Secondary Systems, secondary Banking, Secondary networks, Network transformers, Economic Design of Secondaries - General Total Annual cost (TAC), equation with and without constraints, Unbalanced loads and voltages.

Module V: Voltage-Drop and Application of capacitors (8 hours)

3-phase and Non 3-phase primary lines, Single-phase two-wire laterals with ungrounded neutral, Single-phase two-wire ungrounded laterals, Application of capacitors to distribution systems, Effect of series and shunt capacitors, power factor correction, Economic justification for capacitors, Optimum location for capacitor bank.

Module VI: Concept of Smart Grid (5 hours)

Need for Establishment of Smart Grid, Distributed Automation, SCADA, Integration of Smart Grid with the Distribution Management System, Evolution of Smart Grid, Smart Microgrids, Topology of a Microgrid, Consumer Information Service (CIS), Automatic Meter Reading (AMR).

COURSE / LEARNING OUTCOMES

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

- CO1:** *Demonstrate* the knowledge of various distribution transformers, load characteristics, and associated factors. (Understanding)
- CO2:** *Illustrate* primary and secondary distribution networks. (Understanding)
- CO3:** *Analyse* voltage drops in distribution systems. (Analysing)
- CO4:** *Choose* proper measures to counteract voltage drops in distribution systems. (Evaluating)
- CO5:** *Design* simple Micro Grids. (Creating)

Suggested Readings

1. Turan Gönen, "Electric Power Distribution Engineering", CRC Press, 2014.
2. A. S. Pabla, "Electric Power Distribution", McGraw Hill Education (India) Private Limited, 2011.
3. T. A. Short, "Electric Power Distribution Equipment And Systems", CRC Press, 2004.
4. Kamalash Das, "Electrical power Systems for Industrial Plants", Jaico Publishing House, 2007.

EEMM0053: MATHEMATICAL METHODS OF POWER ENGINEERING

(3 Credits- 45 hours) (L-T-P:3-0-0)

Objective: *The objective of this course is to make the students understand the relevance of mathematical methods to solve engineering problems and to facilitate the students to learn how to apply the mathematical methods for a given engineering problem.*

Module I: Vectors and Linear Transformation (6 hours)

Definition of group and field, Vectors and vector spaces, Characterization of vector spaces, Linear transformation, Singular and Non-singular transformation, Matrix representation of linear transformation.

Module II: Eigen Vectors of Linear Operator (6 hours)

Eigen values and Eigen vectors of linear operator, Eigen spaces, Eigen basis for matrices, Eigen decomposition.

Module III: Introduction to Linear Programming (9 hours)

Linear programming problems, Graphical method, Simplex method, Dual-Simplex method, Duality, Non Linear programming problems.

Module IV: Introduction to Non-Linear Programming (8 hours)

Unconstrained problems, Newton's method, Hessian matrix, Search methods, Constrained problems.

Module V: Constrained Optimization (8 hours)

Lagrange method, Interpretation of Lagrange multipliers, Quadratic Programming problem, Kuhn-Tucker conditions, Random variables, Distributions.

Module VI: Stochastic Model/ Process: Definition (8 hours)

Independent random variables, Marginal and Conditional distributions, Elements of Stochastic process, State space, Index set.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Demonstrate* an understanding about vector spaces, linear transformation, Eigen values and eigenvectors of linear operators. (Understanding)
- CO2:** *Apply* the knowledge of linear programming problems in various fields of power engineering. (Applying)
- CO3:** *Utilize* various techniques of nonlinear programming for solving constrained and unconstrained nonlinear programming problems. (Applying)
- CO4:** *Make use of* the concept of random variables, functions of random variable and their probability distribution in power engineering problems. (Applying)
- CO5:** *Justify* the use of stochastic processes in the field of power engineering. (Evaluating)

Suggested Readings

1. Kenneth Hoffman & Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992.
2. Erwin Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, 2004.
3. Irwin Miller & Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edition, PHI, 2002.
4. J. Medhi, "Stochastic Processes", New Age International, New Delhi, 1994.

5. A Papoulis, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill, 2002.
6. John B. Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000.
7. Hillier F. S. and Liebermann G. J., "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001.
8. Simmons D M, "Non Linear Programming for Operations Research", PHI, 1975.

EEMC0054:MATHEMATICAL METHODS IN CONTROL

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives: *This course aims to give the students an understanding of foundational concepts in linear algebra and random processes for use in control systems. Students will understand Probability and Random variables.*

Module I (10 hours)

Linear Spaces – Vectors and Matrices, Transformations, Norms, Matrix Factorization.

Module II (10 hours)

Eigen value, Eigenvectors and Applications, SVD and Applications, Projections and Least Square Solutions.

Module III (10 hours)

Probability, Random variables, Probability distribution and density functions, Joint density and conditional distribution, Functions of random variables and random vectors.

Module IV (5 hours)

Characteristic functions and correlation matrices, Random Processes and properties.

Module V (5 hours)

Response of Linear systems to stochastic inputs, PSD theorem.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Define* vector space vector space axioms, vector space properties (Remembering)
- CO2:** *Explain* responses of linear systems to any given input signal. (Understanding)
- CO3:** *Apply* matrix properties and functions to a given problem. (Applying)
- CO4:** *Evaluate* Eigen values and Eigen vectors. (Evaluating)
- CO5:** *Solve* problems of control system Engineering using probability theory. (Creating)

Suggested Readings

1. G. Strang, "Introduction to Linear Algebra", 4th Edition, Wellesley-Cambridge Press, 2009
2. Papoulis & Pillai, "Probability, random variable and stochastic processes", McGraw Hill, 2002
3. H. Stark & J. W. Woods, "Probability and random processes with application to signal processing", Pearson Education Asia, 2002
4. J. A. Gubner, "Probability and Random processes for Electrical and Computer engineers", Cambridge Univ. Press. 2006

EENS0055: NON - LINEAR SYSTEMS

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives: *This course aims at introducing fundamental concepts of nonlinear dynamical systems and understanding basic tools for mathematical analysis as well as applications.*

Module I (10 hours)

Introduction to nonlinear systems: Examples of phenomena, models & derivation of system equations.

Module II (15 hours)

Fundamental properties: Existence & uniqueness, Dependence on initial conditions & parameters. Phase plane analysis. Limit cycles & oscillations. Describing function method and applications. Circle criterion.

Module III (12 hours)

Lyapunov stability of autonomous systems. Perturbation theory & Averaging. Singular perturbation model and stability analysis.

Module IV (8 hours)

Basic results on Lie algebra. Controllability and Observability of nonlinear systems. Bifurcations. Chaos. Synchronization.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Choose* tools for stability analysis and response evaluation of control problems with significant nonlinearities. (Remembering)
- CO2:** *Identify* the design problem and distinguish between the controls strategies. (Applying)
- CO3:** *Analyse* non linear system using describing function method.(Analysing)
- CO4:** *Interpret* stability of non-linear system from phase plane analysis.(Understanding)
- CO5:** *Combine* design parameters and the system performance. (Creating)

Suggested Readings

1. H. K. Khalil, "Nonlinear systems", 3 rd edition, Prentice Hall, 2001.
2. J. J. E. Slotine and W. Li, "Applied nonlinear systems", Prentice Hall, 1991.
3. A. Nijemjer and A. van der schaft, "Nonlinear dynamical control systems", Springer, 1989.
4. M. Vidyasagar, "Nonlinear Systems Analysis, Society for Industrial and Applied Mathematics", 2002.
5. S. Strogatz, "Nonlinear Dynamics and Chaos", West view Press, 2001.

EECL0056: DIGITAL CONTROL

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives: *This course aims to familiarize the student with the concept of discretization. Introduce to discrete-time system representations and digital control and learn to design controller for digital systems.*

Module I (15 hours)

Introduction to discrete-time systems, Frequency domain approach – Analysis and discretization, Time domain approach, analysis and discretization, State space formulation for discretized systems.

Module II (15 hours)

Engineering aspects of computer controlled systems, Sampled data systems, Control of Sampled data systems.

Module III (15 hours)

Concept of differential sampling, Closed loop analysis of differentially sampled systems, Control design based on differential sampling, Recent applications of Digital Control.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Define* discrete time system.(Remembering)
- CO2:** *Explain* digital systems in state space representation. (Understanding)
- CO3:** *Model* digital filters and systems. (Applying)
- CO4:** *Analyse* digital systems in time domain and frequency domain. (Analysing)
- CO5:** *Design* controllers for digital systems in state space representation. (Creating)

Suggested Readings

1. K. Ogata, "Discrete-time Control Systems", 2nd Ed., Prentice-Hall, 1995.
2. Benjamin C. Kuo, "Digital Control Systems", 2nd Ed., Oxford University Press, 1999.

EENC0057: NONLINEAR CONTROL**(3 Credits-45 hours) (L-T-P:3-0-0)**

Objectives: *This course aims to study concepts and techniques for stability analysis and learning control design of nonlinear systems.*

Module I (8 hours)

Overview of nonlinear Control-Introduction to Advanced Calculus, Elementary notions of Topology, Smooth Manifolds, Sub-manifolds, Tangent Vectors, Vector Fields.

Module II (7 hours)

Lyapunov stability for autonomous and non-autonomous systems, Input-Output Stability and Input-to-State Stability Absolute Stability.

Module III (8 hours)

Passivity analysis and applications to control design, Lyapunov-based feedback control design. Feedback linearization and back stepping.

Module IV (7 hours)

Sussmann's Theorem and global Decompositions, The Control Lie Algebra, the observation space.

Module V (8 hours)

Local Co-ordinates, Transformations, Exact Linearization via Feedback, The Zero dynamics, Local Asymptotic Stabilization, Asymptotic Output Tracking.

Module VI (7 hours)

Disturbance Decoupling, High Gain Feedback, Additional Results on Exact Linearization, Observers with Linear Error Dynamics.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Define* tangent vectors, vector fields (Remembering)
- CO2:** *Explain* Passivity analysis and applications to control design.(Understanding)
- CO3:** *Apply* deeper ideas from mathematics and specifically from geometry to engineering problems. (Applying)
- CO4:** *Analyse* and design nonlinear controllers with the aid of software tools. (Analysing)
- CO5:** *Design* control system using disturbance decoupling.(creating)

Suggested Readings

1. H. K. Khalil, "Nonlinear Systems", 3rd edition, Prentice Hall, 2001.
2. H. K. Khalil, "Nonlinear Control", Pearson, 2015.
3. J. J. E. Slotine and W. Li, "Applied nonlinear systems", Prentice Hall, 1991.
4. A. Nijemjer and A. van der schaft, "Nonlinear dynamical control systems", Springer, 1989.
5. M. Vidyasagar, "Nonlinear Systems Analysis, Society for Industrial and Applied Mathematics", 2002
6. Alberto Isidori, "Nonlinear Control Systems", Third Edition, Springer, 1995.

EESC0058: SCADA SYSTEM AND APPLICATIONS

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives: *This course aims to familiarize the student with the concept of SCADA and its functions, to know SCADA communication and to get an insight into its application.*

Module I (15 hours)

Introduction to SCADA: Data acquisition system, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation and Industries SCADA.

Module II (15 hours)

Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices(IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems, SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850.

Module III (15 hours)

SCADA Communication: various industrial communication technologies - wired and wireless methods and fiber optics, Industries - oil, gas and water. Case studies, Implementation, Simulation Exercises.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Tell* the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications. (Remembering)
- CO2:** *Summarize* SCADA applications in transmission and distribution sector, industries, etc. (Understanding)

- CO3:** *Make use of* knowledge about SCADA architecture, various advantages and disadvantages of each system.(Applying)
- CO4:** *Compare* SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server. (Analysing)
- CO5:** *Develop* automation systems with single unified standard architecture IEC 61850. (Creating)

Suggested Readings

1. Stuart A. Boyer, "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cybersecurity for SCADA systems", Penn Well Books, 2006.
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", Penn Well 1999.

EEDA0059: DESIGN ASPECTS IN CONTROL

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives:*This course aims to familiarize the student to the tools and techniques of control system design. Introduction to various aspects of controller design philosophy. Learning PID Controller.*

Module I (15 hours)

System Modelling, review of concepts, FOPDT and SOPDT systems and identification Smith Predictor and its variations.

Module II (15 hours)

PID Controllers – review PID Tuning – Ziegler Nichols, Cohen-Coon techniques. State feedback review – pole placement, Eigen structure assignment, Eigen structure – time response relation, Controller gain selection, controller robustness, disturbance rejection.

Module III (15 hours)

Frequency Domain Loop Shaping, Lag, Lead and Lag-lead compensators, Zero dynamics in servo control, Unstable zero dynamics – control design, Observer – concept and design, Case studies – Applications.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Tell* about FOPDT and SOPDT systems.(Remembering)
- CO2:** *Explain* zero dynamics in servo control.(Understanding)
- CO3:** *Model* a control system given its parameters. (Applying)
- CO4:** *Decide* gains of the controllers like PI, PID in a given control system. (Evaluating)
- CO5:** *Design* observer. (Creating)

Suggested Readings

1. Karl J. Astrom, Richard M. Murray, "Feedback Systems: An Introduction for Scientists and Engineers", Princeton University Press, 2010.
2. Thomas Kailath, "Linear Systems", Prentice-Hall.

EEDP0060: DIGITAL PROTECTION OF POWER SYSTEM

(3 Credits- 45 hours) (L-T-P:3-0-0)

Objectives:

- To provide an overview of the numerical relays and their working
- Introduce a mathematical approach towards protection
- To provide a detailed treatment of algorithms for numerical protection

Module I (6 hours)

Evolution of digital relays from electromechanical relays, Types of digital relays, Performance and operational characteristics of digital protection.

Module II (6 hours)

Mathematical background to protection algorithms, Finite difference techniques.

Module III (8 hours)

Interpolation formulae, forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis.

Module IV (8 hours)

Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing. Error, sample and hold circuits, multiplexers, analog to digital conversion, digital filtering concepts, digital relay as a unit consisting of hardware and software.

Module V (8 hours)

Mathematical basis of numerical techniques and relay algorithms, Sinusoidal wave based algorithms, Sample and first derivative (Mann and Morrison) algorithm. Fourier and Walsh based algorithms.

Module VI (8 hours)

Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm. Least Squares based algorithms. Differential equation based algorithms. Traveling Wave based Techniques. Digital Differential Protection of Transformers. Digital Line Differential Protection. Recent Advances in Digital Protection of Power Systems.

COURSE/LEARNING OUTCOMES

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

- CO1:** Name the performance and operational characteristics of digital relays. (Remembering)
- CO2:** Illustrate the use of mathematical methods for relaying purposes. (Understanding)
- CO3:** Apply the digital relaying techniques in power system protection. (Applying)
- CO4:** Categorize the relaying algorithms based on their applications. (Analysing)
- CO5:** Develop digital relay based protection systems for power system applications. (Creating)

Suggested Readings

1. A.G. Phadke & J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009.

2. A.T. Johns & S. K. Salman, "Digital Protection of Power Systems", IEEE Press, 1999.
3. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006.
4. S. R. Bhide, "Digital Power System Protection" PHI Learning Pvt. Ltd., 2014.

EED0061: POWER SYSTEM DYNAMICS-II

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives: *The objective of this course is to give the concept of power system dynamics, interpretation of power system dynamic phenomena and various forms of stability problems in power systems & their mitigation technique.*

Module I: Power system stability (8 hours)

Basic Concepts of Dynamic Systems and Stability Definition, Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System, Analysis of stability.

Module II: Damper (8 hours)

Effect of Damper, Flux Linkage Variation and AVR.

Module III: Large Signal stability (8 hours)

Large Signal Rotor Angle Stability, Dynamic Equivalents and Coherency, Direct Method of Stability Assessment, Stability Enhancing Techniques, Mitigation Using Power System Stabilizer.

Module IV: Multi-Machine Stability (6 hours)

Asynchronous Operation and Resynchronization, concept of multi-Machine Stability.

Module V: Voltage Stability (6 hours)

Dynamic Analysis of Voltage Stability, Voltage Collapse and classification, typical scenario of voltage collapse, Prevention of voltage collapse.

Module V: Frequency Stability (6 hours)

Introduction to Frequency Stability, Automatic Generation Control, Primary and Secondary Control, Sub-Synchronous Resonance and Counter Measures.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Recall* the Basic Concepts of Dynamic Systems and Stability Definition. (Remembering)
- CO2:** *Explain* the different stability problems arise in power system. (Understanding)
- CO3:** *Analyse* the stability problems and implement modern control strategies. (Analysing)
- CO4:** *Assess* direct method of stability in power system. (Evaluating)
- CO5:** *Formulate* small signal and large signal stability problems using simulation. (Creating)

Suggested Readings

1. P. Kundur, "Power System Stability and Control", McGraw Hill Inc, 1994.
2. J. Machowski, J. Bialek & J. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997.
3. L. Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press, 2007.
4. V. Ajarapu, "Computational Techniques for voltage stability assessment & control"; Springer, 2006.

EERP0062: RESTRUCTURED POWER SYSTEMS

(3 Credits – 45 hours) (L-T-P:3-0-0)

Objective: *The objective of this course is to introduce the concepts of restructuring and deregulation of electricity market. Students will be able to understand what is meant by restructuring of the electricity market. This will enable the students to understand the need behind requirement for deregulation of the electricity market. This course focuses on the understanding of the money, power & information flow in a deregulated power system.*

Module I: Introduction to electricity market (10 hours)

Fundamentals of electricity market deregulation and restructured system, Market power, Market models and architecture, Independent System Operator (ISO), Power Exchange (PX), Market Clearing Price (MCP), Day-Ahead and Hour-Ahead Markets, Elastic and Inelastic Markets, Social welfare maximization.

Module II: Optimal power flow (11 hours)

OPF: Role in vertically integrated systems and in restructured markets, Transmission Open Access, Power Wheeling, Congestion management, Transfer Capability: Definitions and calculations-Available Transfer Capability (ATC).

Module III: Hedging Tools for Managing Risks in Electricity Markets (8 hours)

Optimal bidding; Risk assessment, Hedging; Transmission Pricing; Electricity Pricing: Volatility, Risk and Forecasting.

Module IV: Ancillary Services & Distributed generations (6 hours)

Ancillary Services, Distributed generation in restructured markets, IT applications in restructured markets.

Module V: Indian sector and Global Electric Utility Markets (10 hours)

Developments in India, Working of restructured power systems in various countries, Standard Market Design (SMD), PJM, Recent trends in Restructuring.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Explain* the various types of regulations in power systems. (Understanding)
- CO2:** *Illustrate* the Technical and Non-technical issues in Deregulated Power Industry. (Understanding)
- CO3:** *Identify* the need of regulation and deregulation. (Applying)
- CO4:** *Interpret* different market mechanisms and various entities in the market. (Evaluating)
- CO5:** *Construct* models for solution of transmission congestion problems. (Creating)

Suggested Readings

1. Mohammad Shahidepour & Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.
2. Kankar Bhattacharya, Jaap E. Daadler & Math H. J. Boelen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
3. Lorrin Philipson & H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub., 1998.

4. L. L. Lai, "Power System Restructuring and Deregulation: Trading, Performance and Information Technology", Wiley, 2001.
5. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.

EEAS0063: ADVANCED DIGITAL SIGNAL PROCESSING

(3 Credits- 45 hours) (L-T-P:3-0-0)

Objective: *The course helps to develop an in-depth understanding of the digital signal processing techniques. The course helps in learning of the methods used to structure and design various filters and understand their characteristics.*

Module I: Fundamentals of Discrete-Time Signal and System (8 hours)

Discrete time signals, Linear shift invariant systems, Stability and causality, Sampling of continuous time signals, discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z transform-Properties of different transforms.

Module II: Discrete-Time Signals in the Transfer Domain (8 hours)

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bi-linear transformation method.

Module III: Digital Filter Structures and Design (8 hours)

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantization effects in IIR and FIR filters.

Module IV: Analysis of Finite Word length Effects (8 hours)

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models.

Module V: Linear Signal Models and Power Spectrum Estimation (7 hours)

All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals.

Module VI: Optimum Linear Filters (6 hours)

Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

COURSE/LEARNING OUTCOMES

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

- CO1:** *Demonstrate* knowledge about the time domain and frequency domain representations as well analysis of discrete time. (Understanding)
- CO2:** *Apply* the design techniques for IIR and FIR filters and their realization structures. (Applying)
- CO3:** *Utilize* knowledge about the finite word length effects in implementation of digital filters. (Applying)
- CO4:** *Make use of* the knowledge about the various linear signal models and estimation of power spectrum of stationary random signals.(Applying)
- CO5:** *Design of* optimum FIR and IIR filters. (Creating)

Suggested Readings

1. Sanjit K. Mitra, "Digital Signal Processing: A computer-based approach", Tata McGraw-Hill Edition, 1998.
2. Dimitris G. Manolakis, Vinay K. Ingle & Stephen M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill international edition 2000.

EEST0064: POWER SYSTEM TRANSIENTS

(3 Credits – 45 hours) (L-T-P:3-0-0)

Objective: *The objective of this course is to introduce the concepts of power system transients. Students will be able to learn the reasons for occurrence of transients in a power system. This will enable the students to understand the change in parameters like voltage & frequency during transient. This course also focuses on the lightning phenomenon and its effect on power system.*

Module I (8 hours)

Fundamental circuit analysis of electrical transients; Laplace Transform method of solving simple Switching transients; Damping circuits-Abnormal switching transients; Three-phase circuits and transients; Computation of power system transients.

Module II (7 hours)

Principle of digital computation-Matrix method of solution; Modal analysis- Z transform; Computation using EMTP; Lightning, switching and temporary over voltage; Physical phenomena of lightning.

Module III (6 hours)

Interaction between lightning and power system; Influence of tower footing resistance and Earth Resistance; Switching: Short line or kilometric fault; Energizing transients - closing and re-closing of lines; line dropping, load rejection - over voltages induced by faults.

Module IV: (8 hours)

Switching HVDC line; Travelling waves on transmission line, Circuits with distributed Parameters; Wave Equation; Reflection, Refraction, Behaviour of Travelling waves at the line terminations; Lattice Diagrams - Attenuation and Distortion; Multi-conductor system and Velocity wave.

Module V (8 hours)

Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS); Coordination between insulation and protection level; Statistical approach.

Module VI (8 hours)

Protective devices; Protection of system against over voltages, lightning arresters, substation earthing.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Explain* the reasons for occurrence of transients in a power system. (Understanding)
- CO2:** *Utilize* the knowledge of various transients that could occur in power system and their mathematical formulation. (Applying)

- CO3:** *Illustrate* the use of insulation in various equipments in power system. (Applying)
CO4: *Analyse* the power system for transient analysis. (Analysing)
CO5: *Design* various protective devices in power system for protecting equipment and personnel. (Creating)

Suggested Readings

1. Allan Greenwood, "Electrical Transients in Power System", Wiley & Sons Inc. New York, 1991.
2. Y. G. Paithankar, "Fundamentals of Power System Protection", Prentice Hall India Learning Private Limited, 2010.
3. Akihiro Ametani, Naoto Nagaoka, Yoshihiro Baba, Teruo Ohno & Koichi Yamabuki, "Power System Transients: Theory and Applications", CRC Press, 2016.
4. Prabha Kundur, "Power System Stability and Control", McGraw Hill Education, 2006.

EEFC0065: FACTS AND CUSTOM POWER DEVICES

(3 Credits-45 hours) (L-T-P:3-0-0)

Objective: *This course gives an introduction to the of flexible ac transmission systems to enhance controllability and power transfer capability in ac systems, involves applications of power electronics in power systems in the range of a few tens to hundred megawatts to improve reliability of power supply and opens up new opportunities for controlling power and enhancing the usable capacity of present, as well as new and upgraded lines.*

Module I: Power flow control (8 hours)

Reactive power flow control in Power Systems, Control of dynamic power unbalances in Power System - Power flow control, Constraints of maximum transmission line loading, Benefits of FACTS Transmission line compensation, Uncompensated line -Shunt compensation, Series compensation Phase angle control, Reactive power compensation Shunt and Series ensation principles, Reactive compensation at transmission and distribution level.

Module II: Shunt compensator (8 hours)

Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM, Operation and control of TSC, TCR and STATCOM -Compensator control, Comparison between SVC and STATCOM.

Module III: Series compensator and regulators (9 hours)

Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators, TCVR and TCPAR Operation and Control, Applications, Static series compensation, GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.

Module IV: Combined compensator (8 hours)

SSR and its damping Unified Power Flow Controller, Circuit Arrangement, Operation, and control of UPFC, Basic Principle of P and Q control, Independent real and reactive power flow control- Applications, Introduction to interline power flow controller.

Module V: Power quality (12 hours)

Modeling and analysis of FACTS, Controllers, Simulation of FACTS controllers, Power quality problems in distribution systems, harmonics, loads that create harmonics, modeling, harmonic propagation, series and parallel resonances mitigation of harmonics, passive filters, active filtering – shunt, series and hybrid and their control, Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners, IEEE standards on power quality.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Define* various FACTS devices. (Remembering)
- CO2:** *Explain* fundamental principles of Passive and Active Reactive Power Compensation Schemes. (Understanding)
- CO3:** *Classify* different types of FACTS devices. (Understanding)
- CO4:** *Apply* FACTS technologies to increase power transfer capability of the line. (Applying)
- CO5:** *Discuss* various Power quality problems and their mitigation techniques. (Creating)

Suggested Readings

1. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007.
2. X. P. Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer, Verlag, Berlin, 2006.
3. N. G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K. S. Suresh Kumar & S. Ashok, "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
5. G. T. Heydt, "Power Quality", McGraw-Hill Professional, 2007.
6. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, New York, 1982.

EEOC0066: OPTIMAL CONTROL THEORY

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives: *This course aims at introducing the basic and fundamental concepts of optimal control theory, controller design. The course also introduces computational aspects of optimal control.*

Module I (15 hours)

Review of Matrix Computations. Maximization of functional of a single and several functions using calculus of variations, Constrained externals, Euler-Lagrange Equation, Necessary conditions for optimal control, Pontryagin's minimum principle and state inequality constraints, Minimum time problems, Minimum control effort problems.

Module II (15 hours)

Linear quadratic regulator problems, Riccati Equation, Singular intervals in optimal control problems, The principle of optimality, Application of the principle of optimality to decision making, Dynamic programming applied to routing problems.

Module III (15 hours)

Solving optimal control problems using dynamic programming, Discrete linear regulator problem, Hamilton -Jacobi -Bellman Equation, Numerical Techniques to determine optimal trajectories, Numerical Aspects of Optimization.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Relate* the mathematical methods used in optimal control to derive the solution to variations of the problems studied in the course. (Remembering)
- CO2:** *Explain* dynamic programming and its use in control system engineering (Understanding)

- CO3:** *Apply* principle of optimality to decision making. (Applying)
- CO4:** *Utilise* the standard algorithms for numerical solution of optimal control problems and use Matlab to solve fairly simple but realistic problems. (Applying)
- CO5:** *Combine* the tools learnt during the course and apply them to more complex problems. (Creating)

Suggested Readings

1. M. Athans and P. L. Falb, "Optimal Control: An Introduction to the Theory and Its Applications", Dover Books on Engineering, 2006.
2. D. S. Naidu, "Optimal Control Systems", CRC Press, 2002.
3. D. Liberzon, "Calculus Of Variations and Optimal Control Theory: A Concise Introduction", Princeton University Press, Dec 2011.
4. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control, 3rd Edition, Wiley, 2012.

EESF0067: STOCHASTIC FILTERING AND IDENTIFICATION

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives: *This course aims at introducing fundamental concepts of stochastic filtering, prediction, control. The course introduces non-linear system identification.*

Module I (15 hours)

Introduction to Parameter Estimation and System Identification, MMSE estimation including LMS, Gaussian case, Wiener filtering & prediction, Kalman filtering & prediction, Extended Kalman filtering and its variations, Predictors for difference equation based models including ARMA, Box Jenkins & others.

Module II (15 hours)

Statistical properties of Least Squares estimation and its relationship with Bayes estimation (ML, MAP), convergence analysis, CR bound, Recursive Least Squares, Iterative methods for nonlinear Least Squares Identification problem: Different approaches for linear dynamical system, Offline identification methods including Least Squares, Prediction error framework, Pseudo-linear regression (PLR) & Instrument variable methods. Recursive Identification of linear dynamical system: RLS, PLR, Prediction error framework & its application to ARMA & Innovations representation, Convergence Analysis of Recursive Identification methods: Associated ODE, Martingale.

Module III (15 hours)

Nonlinear system identification, Subspace based method of system identification, Applications including LQG and adaptive control.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Tell* about different filtering and prediction methods for system design. (Remembering)
- CO2:** *Develop* skills in Analysing and interpreting the results. (Applying)
- CO3:** *Take part* in convergence analysis of Recursive Identification methods. (Analysing)
- CO4:** *Elaborate* essential stochastic modeling tools including Markov chains and queuing theory. (Creating)
- CO5:** *Formulate* and solve problems that involve setting up stochastic models. (Creating)

Suggested Readings

1. Papoulis & Pillai, "Probability, random variable and stochastic processes", McGraw Hill, 2002.
2. T. Soderstrom and P. Stoica, "System Identification", Prentice-Hall, 1989.
3. Lennart Ljung, "System Identification, Prentice-Hall", 2nd edition, 1999.
4. S. Thomas Alexander: "Adaptive Signal processing, Theory and applications", Springer-Verlag, 1986.
5. R. Isermann and M. Munchhof, "Identification of Dynamic Systems", Springer-Verlag, 2011.
6. B. D. O. Anderson and J. B. Moore, "Optimal Filtering, Dover Books on Electrical Engineering", 2005.

EECS0068: ADVANCE CONTROL SYSTEM

(3 Credits-45 hours) (L-T-P:3-0-0)

Objective: The course provides glimpses into the advanced methods of modelling and analysis of the dynamical systems. The course is a strong step in inculcating the research aptitude in the students.

Module I (15 hours)

Math Modelling of Dynamical Systems: Newtonian and Lagrangian approaches, Concept of dynamical state of a system, Concept of equilibrium point, linearization of non-linear model. Review of Linear Algebra concepts: Field, Vector space, linear combination, linear independence, bases of a vector space, representation of any vector on different basis, matrix representation of a linear operator, change of basis, rank, nullity, range space and null space of a matrix, Eigen value and Eigen vector of a matrix, similarity transform, Diagonalisation

Module II (15 hours)

Modern Control Analysis: Concept and computation of systems modes, controllability theorem and its proof, Observability theorem and its proof, Controllable and observable subspaces. Stability Analysis: Stability of linear systems, stability types and their definitions for any general system, Stability of an equilibrium point, Lyapunov stability theory for LTI systems, Quadratic forms and Lyapunov functions.

Module III (15 hours)

Modern Control Design: Converting the math model to controllable canonical form and its use for pole placement, Concept of linear observer and its design, Design of reduced order observer, Compensator design using separation principle, Poles of compensator, Open loop and close-loop systems. Optimal Control Theory: Introduction to the philosophy of optimal control, formulation of optimal control problem, different performance criterion, Linear quadratic regulator (LQR) and optimum gain matrix, Riccati equations, conceptual models and statistical models for random processes, Kalman filter.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define different approaches for modeling of dynamic system.(Remembering)
- CO2:** Explain philosophy of optimal control system.(Understanding)
- CO3:** Apply the concepts of linear algebra and their applications to control system. (Applying)
- CO4:** Analyse the system dynamics and Lyapunov stability theory. (Analysing)
- CO5:** Design linear quadratic controller. (Creating)

Suggested Readings

1. Bernard Friedland, "Control System Design: An Introduction to State-Space Methods", Dover Publications, Inc. Mineola, New York, 2012.
2. Thomas Kailath, "Linear Systems", Prentice-Hall Inc., New Jersey, 1986.
3. M. Gopal, "Modern Control System Theory", , New Age International (P) Limited, New Delhi, 2000.

EEAL0069: ADAPTIVE LEARNING AND CONTROL**(3 Credits-45 hours) (L-T-P:3-0-0)**

Objectives: *The course introduces adaptive and learning techniques for control design for uncertain dynamical systems. The course also introduces learning based control.*

Module I (15 hours)

Introduction to adaptive control, Direct and indirect adaptive control, Model reference adaptive control, Parameter convergence, Persistence of excitation, Review of Lyapunov stability theory.

Module II (15 hours)

Adaptive back stepping, Adaptive control of nonlinear systems, Composite adaptation, Robust adaptive control, Neural Network-based control.

Module III (15 hours)

Reinforcement learning-based control, Repetitive learning control, Predictive control

COURSE / LEARNING OUTCOMES

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

- CO1:** *Recall* detailed knowledge of classical system identification and the development and properties of various methods. (Remembering)
- CO2:** *Explain* robust adaptive control.(Understanding)
- CO3:** *Utilise* detailed knowledge of on-line parameter estimation. (Applying)
- CO4:** Apply adaptive and learning technique for control design for uncertain dynamical system.(Applying)
- CO5:** *Design* Neural Network based control system.(Creating)

Suggested Readings

1. Bernard Friedland, "Control System Design: An Introduction to State-Space Methods", Dover Publications, Inc. Mineola, New York, 2012
2. Thomas Kailath, "Linear Systems", Prentice-Hall Inc., New Jersey, 1986
3. M. Gopal, "Modern Control System Theory", New Age International (P) Limited, New Delhi, 2000

EEMR0070: MODEL REDUCTION IN CONTROL**(3 Credits-45 hours) (L-T-P:3-0-0)**

Objective: *The course introduces the concept of model reduction of large scale dynamics models from various engineering disciplines. The course also introduces model reduction in control.*

Module I (15 hours)

Introduction to Model Reduction, Source of Large Models – Circuits, EM systems, Mechanical Systems. Classical Model Reduction Methods – Modal reduction.

Module II (15 hours)

Pade approximation and moment matching, Routh Approximants, Modern Methods - SVD (Grammian) based methods , Krylov based methods , SVD-Krylov based methods , MOR for Nonlinear Systems – SVD & POD Methods.

Module III (15 hours)

Model Reduction in Control, Sliding Mode Control – Review, SMC as model reducing control, Higher Order Sliding Mode.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Identify* Source of Large Models.(Remembering).
- CO2:** *Explain* sliding mode control for control system design.(Understanding)
- CO3:** *Make use of* Pade approximation for control system design.(Applying)
- CO4:** *Apply* model reduction techniques for a given control design problem. (Applying)
- CO5:** *Design* control loops for all techniques. (Creating)

Suggested Readings

1. A. C. Antoulas, “Approximation of Large Scale Dynamical Systems”, SIAM, 2005.
2. Ed. Alfio Quarteroni & Gianluigi Rozza, “Reduced Order Methods for Modeling and Computational Reduction”, Springer, 2014.
3. M. Jamshidi, “Large-scale systems: modelling & control”, North Holland, New York, 1983.
4. C. Edwards and S. Spurgeon, “Sliding Mode Control: Theory and Applications”, CRC Press,1998.
5. B. Bandyopadhyay, S. Janardhanan and S. Spurgeon, “Advances in Sliding Mode”, Springer, 2013.

EERC0071: ROBUST CONTROL

(3 Credits-45 hours) (L-T-P:3-0-0)

Objectives: *This course introduces the concept of to control techniques with greater emphasis on robustness to modelling uncertainty. The course introduces how to handle parameter variations, and presence of disturbances and noise.*

Module I (15 hours)

Modelling of uncertain systems, Signals and Norms, Lyapunov theory for LTI systems.

Module II (15 hours)

Passive systems – frequency domain, Passive systems – time domain, Robust Stability and performance, Stabilizing controllers – Co prime factorization.

Module III (15 hours)

LQR, LQG problems, Ricatti equations and solutions, Ricatti equation solution through LMI, H-infinity control and mu-synthesis, Linear matrix inequalities for robust control.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Define* LTI systems and its applications. (Remembering)
- CO2:** *Explain* Passive system for frequency domain and time domain.(Understanding)
- CO3:** *Apply* Lyapunov theorem for any stability problem. (Applying)

CO4: Assess stability and performance of passive systems.(Evaluating)

CO5: Design passive systems in frequency and time domain. (Creating)

Suggested Readings

1. L. Fortuna, M. Frasca (Eds.), "Optimal and Robust Control", CRC Press, 2012.
2. K. Zhou, J. C. Doyle and K. Glover, "Robust and Optimal Control", Prentice Hall, 1996.
3. J. C. Doyle, B. A. Francis and A. R. Tannenbaum, "Feedback Control Theory", Macmillan, 1992.

EEEM6012: ELECTRICAL MACHINES LAB

(2 credits)

1. To obtain magnetization characteristics of a d.c. shunt generator
2. To obtain load characteristics of a dc shunt generator
3. To obtain efficiency of a dc shunt machine using Swinburn's test
4. To obtain speed-torque characteristics of a dc shunt motor
5. To obtain speed control of dc shunt motor using
 - (i) armature resistance control
 - (ii) field control
6. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test
7. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
8. To perform load test on a three phase induction motor and draw:
 - (i) Torque -speed characteristics
 - (ii) Power factor-line current characteristics
9. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by
 - (i) EMF method
 - (ii) MMF method
10. To study speed control of three phase induction motor by keeping V/f ratio constant.
11. To study speed control of three phase induction motor by varying supply voltage.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to

CO1: Define and label the different Electrical Machines. (Remembering)

CO2: Explain the working of various Electrical Machines and its excitation systems. (Understanding)

CO3: Apply the theoretical concept of electrical machines in doing practical experiment. (Applying)

CO4: Analyse or study the different methods to calculate efficiency and voltage regulation of different electrical machines. (Analysing)

CO5: Evaluate the experimental results with the theoretical calculation. (Evaluating)

CO6: Compile a technical report on the different experiments. (Creating)

EECE6018: CONTROL AND SIMULATION LAB

(2 credits)

Software based experiments (Use MATLAB, SCILAB, LABVIEW software, etc.)

1. To determine time domain response of a second order systems for step input and obtain performance parameters.
2. To convert transfer function of a system into state space form and vice-versa.
3. Transfer function of DC motor.
4. To plot root locus diagram of an open loop transfer function
5. To determine range of gain 'k' for stability using root locus.
6. To plot a Bode diagram of an open loop transfer function and examine the stability of the closed loop system.
7. To draw a Nyquist plot of an open loop transfer function and examine the stability of the closed loop system.
8. Effect of feedback on DC servo motor.
9. Solution of state equation using ODE45 and Isim.
10. To study behaviour of separately excited dc motor in open loop and closed loop conditions at various loads.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to

- CO1:** *Define* time domain and frequency domain analysis. (Remembering)
- CO2:** *Explain* root locus, Bode diagram etc. (Understanding)
- CO3:** Experiment with the concepts learned to propose solution for practical problems. (Applying)
- CO4:** *Analyse* stability of different systems. (Analysing)
- CO5:** *Evaluate the* performance of feedback systems. (Evaluating)
- CO6:** *Predict* output from different systems subjected to different inputs. (Creating)
- CO7:** *Formulate* mathematical models of systems. (Creating)

EEMN6019: ELECTROMECHANICAL ENERGY CONVERSION LAB II

(2 credits)

At least eight experiments are to be performed from the following, out of which there should be at least two software based experiments.

1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three phase induction motor and draw:
 - (i) Torque -speed characteristics
 - (ii) Power factor-line current characteristics
3. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.

4. To study speed control of three phase induction motor by keeping V/f ratio constant.
5. To study speed control of three phase induction motor by varying supply voltage.
6. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) MMF method.
7. To determine V-curves and inverted V-curves of a three phase synchronous motor.
8. To determine X_d and X_q of a three phase salient pole synchronous machine using the slip test and draw the power-angle curve.
9. To study synchronization of an alternator with the infinite bus by using: (i) dark lamp method (ii) two bright and one dark lamp method.
10. Scott connection of 3-phase transformer
11. Load test of 3-phase transformer
12. Load test on a 3-phase slip-ring induction motor Software based experiments (Develop Computer Program in 'C' language or use Scilab/MATLAB or other software)
13. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance, or capacitance in the rotor circuit.
14. No load and block rotor test of single phase induction motor.
15. To determine speed-torque characteristics of a three phase induction motor by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.
16. Draw O.C. and S.C. characteristics of a three phase alternator from the experimental data and determine voltage regulation at full load, and unity, 0.8 lagging and leading power factors.
17. To determine steady state performance of a three phase induction motor using equivalent circuit.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to

- CO1:** Study the method of synchronization of alternators with the infinite bus. (Remembering)
- CO2:** Explain the procedure for performing experiments related to AC machines. (Understanding)
- CO3:** Solve and find out practically the resistances and reactances of single phase and three phase Induction Motors. (Applying)
- CO4:** Compare the different characteristics of rotating and non-rotating machines. (Analysing)
- CO5:** Determine the characteristics of different types of AC machines and their performances. (Evaluating)
- CO6:** Combine the different components to perform a particular experiment on AC machines. (Creating)

EEMI6020: MINI PROJECT II

(2 credits)

Mini projects are assigned to students individually or in groups by the Department under the supervision of the designated faculty member. The objective of the mini project is to train the students to design, simulate or study mini electrical or electronic systems which will give them hands on experience in re-creating the principles they have studied in their engineering classes. Mini projects executed during the fifth semester must display a greater maturity of knowledge than those in the fourth semester.

COURSE/LEARNING OUTCOMES

At the end of Mini Project II students will be able to

- CO1:** *Choose* different components for designing a circuit. (Remembering)
- CO2:** *Illustrate* the working of different circuits used in the projects. (Understanding)
- CO3:** *Build* a circuit based on the output requirement from a specified input. (Applying)
- CO4:** *Examine* a designed circuit for expected output. (Analysing)
- CO5:** *Justify* the use of a particular component for a desired output. (Evaluating)
- CO6:** *Test* the designed circuits for the expected results. (Creating)

EPPD6021: POWER ELECTRONICS AND DRIVES LAB

(2 credits)

Any 10 out of the following to be performed

1. Study of the half-wave controlled rectifier with resistive load.
2. Study of the half-wave controlled rectifier with R-L load.
3. Study of fully controlled bridge rectifier with resistive load.
4. Study of fully controlled bridge rectifier with R-L load.
5. Study of the characteristics of DIAC and plotting of its V-I characteristics curve.
6. Study of the characteristics of UJT.
7. Study of the full-wave controlled rectifier (mid-point configuration) with resistive load.
8. Study of the full-wave controlled rectifier (mid-point configuration) with R-L load.
9. Study of the resistor triggering circuit.
10. Study of the resistor capacitor triggering circuit (half-wave).
11. Study of voltage-commutated chopper.

COURSE/LEARNING OUTCOMES

At the end of Power Electronics and Drives Lab students will be able to

- CO1:** *Define* and label the different types of semiconductor devices. (Remembering)
- CO2:** *Explain* the transfer and output characteristics of power semiconductor devices. (Understanding)
- CO3:** *Identify* different types of converter based on input and output. (Applying)
- CO4:** *Analyse* different types of triggering circuits such as R and RC etc. (Analysing)
- CO5:** *Evaluate* the threshold values of different parameter of the semiconductor devices with that of data given in the datasheets. (Evaluating)
- CO6:** *Predict* output of different converters. (Creating)

EEMI6022: MINI PROJECT III**(2 credits)**

Mini projects are assigned to students individually or in groups by the Department under the supervision of the designated faculty member. The objective of the mini project is to train the students to design, simulate or study mini electrical or electronic systems which will give them hands on experience in re-creating the principles they have studied in their engineering classes. The mini projects taken up in the sixth semester are expected to be more advanced than the mini projects taken up in previous semesters.

COURSE/LEARNING OUTCOMES

At the end of Mini Project III students will be able to

- CO1:** *Show* the difference between the circuits using controllers and those not using it. (Remembering)
- CO2:** *Demonstrate* the benefits of using microcontrollers and microprocessors in circuits. (Understanding)
- CO3:** *Choose* among the different controllers and processors available to identify the best one for their work. (Applying)
- CO4:** *Examine* the various components and related parameters used in the project. (Analysing)
- CO5:** *Evaluate* the performance of a circuit by using microcontrollers and microprocessors. (Evaluating)
- CO6:** *Construct* a fully automotive circuit depending upon the requirement. (Creating)

EECE6023: CONTROL SYSTEM ENGINEERING LAB**(2 credits)**

1. Effect of P, PD, PI, PID Controller on a second order systems.
2. To study P, PI and PID temperature controller for an oven and compare their performance.
3. To study and calibrate temperature using resistance temperature detector (RTD)
4. To study DC position control system.
5. To study synchro-transmitter and receiver and obtain output V/S input characteristics.
6. To determine speed-torque characteristics of an ac servomotor.
7. To study performance of servo voltage stabilizer at various loads using load bank.
8. To test controllability and observability using SCILAB functions
9. To design Lag, Lead and Lag-Lead compensators using SCILAB (both Analog and Digital version)
10. To design controller gains using pole placement.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to

- CO1:** *Choose* appropriate transmitters to transmit signals from the sensors. (Remembering)
- CO2:** *Explain* the working of different controllers. (Understanding)
- CO3:** *Experiment with* different temperature sensors. (Applying)
- CO4:** *Analyse* stability of different systems. (Analysing)

CO5: Evaluate performance of different control algorithms. (Evaluating)

CO6: Formulate state space models of systems. (Creating)

EETS6024: TRAINING SEMINAR

(2 credits)

Objective: During the semester break at the end of the third year, students are required to undergo an Industrial Training. The purpose of the Industrial Training is to expose students to real-life industry situations, so that they may be able to apply the engineering knowledge and skills that they have gained through class-room teaching and lab activities, in an on-the-job situation. After the period of training, students are to present their experience in the form of reports and seminar presentations. Students will be evaluated on the seminar, viva voce examination and written reports.

COURSE/LEARNING OUTCOMES

At the end of the Training Seminar students will be able to

CO1: Relate theory and practical with real life examples. (Remembering)

CO2: Explain the engineering processes involved in the industry. (Understanding)

CO3: Identify the importance of learning the practical aspects of engineering education. (Applying)

CO4: Analyse application of the theory into the practical field. (Analysing)

CO5: Value the engineering education and its utility. (Evaluating)

CO6: Discuss the actual technological advancements in the industry. (Creating)

EEMP6025: MAJOR PROJECT (PHASE I)

(4 credits)

During the last year of their study, B. Tech. students are required to take up a major project. This may be an individual project or a group project. The Major Project is an integral learning experience that encourages students to break away from the compartmentalization of the different courses they have studied during the three years of their study and aims to provide opportunities to explore the inter-relationships and inter-connectedness of the various courses and gather them together into a single learning experience.

The major project focuses upon the following:

- **Interdisciplinary:** The major project provides a platform for students to apply the knowledge and skills acquired from different courses.
- **Collaboration:** It encourages students to work in groups over an extended period of time. They clarify the task, plan their work, share the responsibilities and work towards the successful completion of the project.
- **Process and Product:** Project work focuses on both process and product. The process would include collaboration, gathering and processing of information. The product may take the form of a working model, a complete software package, etc.
- **Written and Oral presentation:** Project work provides students with opportunities to present their findings as a written thesis in a prescribed format and orally with an intended audience and purpose in mind.

During the first phase in the seventh semester, students are expected to choose the project, prepare a synopsis under the guidance of a project supervisor appointed by the department, present the synopsis to the committee set up for the purpose, get approval for the synopsis and start the project work. Students are expected to submit weekly activity reports and present a progress seminar during this phase. They will also undergo a viva voce examination, in which they will be examined on all the basic areas of the discipline in which they have chosen their project.

COURSE/LEARNING OUTCOMES

After completing the Major Project (phase I) the students would be able to:

- CO1:** Find different areas of research in the field of electrical engineering. (Remembering)
- CO2:** Explain the importance of research in the chosen topic of interest. (Understanding)
- CO3:** Apply theoretical knowledge to find out an appropriate topic of importance for research in the undergraduate level. (Application)
- CO4:** Analyse research work of technological importance published in various reputed national and international journals. (Analysing)
- CO5:** Decide on a research problem and objective of research to be carried out within a semester. (Evaluating)
- CO6:** Compile the part of project work completed in this semester. (Creating)

E-resource for learning

LaTeX, www.spoken-tutorial.org

EEMP6026: MAJOR PROJECT (PHASE II) AND VIVA VOCE

(8 credits)

During the second phase students are expected to focus on process and completion of the projects and prepare project reports under the guidance of the Supervisors. The internal assessments shall be evaluated by the DPEC and the external assessment shall be done by the external examiner(s) assisted by the DPEC and the supervisor. The modality and components of the internal assessment and their weightages shall be notified at the beginning of each semester. The External assessment shall have the following components:

- Project Implementation: 40 marks
- Seminar presentation: 20 marks
- Viva voce examination: 20 marks
- Project documentation: 20 marks

COURSE/LEARNING OUTCOMES

At the end of the Major Project Phase II students will be able to

- CO1:** Show different stages of project work for the selected topic. (Remembering)
- CO2:** Summarize the contribution of the project to the benefit of the society. (Understanding)
- CO3:** Make use of observations, experimental and theoretical findings for establishing a conclusion. (Applying)
- CO4:** Analyse the observations and results obtained during the project work. (Analysing)
- CO5:** Evaluate the results obtained from the project work. (Evaluating)
- CO6:** Compile a technical report on the project work. (Creating)

EEBL6027: BASIC ELECTRICAL ENGINEERING LAB

(1 credit) (L-T-P: 0-0-2)

List of experiments:

1. Calibration of a Voltmeter.
2. Calibration of an Ammeter.
3. Calibration of milliammeter as a voltmeter.
4. Calibration of a millivoltmeter as an ammeter.
5. Verification of Thevenin's theorem.
6. Resonance in series RLC circuit
7. Reversal of direction of rotation of 3-phase induction motor by changing phase sequence.
8. Different types of Connections of the transformer.
9. Demonstration of DC and AC machines.
10. Demonstration of LT switchgear.

COURSE/LEARNING OUTCOMES

After the experiments, the students will be able to:

- CO1:** *Find* different parameters related to basic electrical circuits. (Remembering)
- CO2:** *Explain* the procedure for performing experiments related to DC and AC circuits. (Understanding)
- CO3:** *Identify* various rotating AC and DC machines. (Applying)
- CO4:** *Compare* the theoretical prediction with experimental results. (Analysing)
- CO6:** *Combine* the different components to perform a particular experiment. (Creating)

EEAE6028: ANALOG ELECTRONICS LAB

(1 Credit)(L-T-P:0-0-2)

Objective: *This course aims to familiarize hands-on experiments on different circuits based on diodes, BJT, JFET etc. The course also aims to familiarize simple electronic amplifier designs, OpAmp configurations and wave generators.*

List of experiments:

1. To study the Characteristics of a diode.
2. To Study the Characteristics of Zener Diodes.
3. Half-wave and Full-wave rectifiers.
4. Clamping and Clipping circuits.
5. Static Characteristics of a Bipolar Junction Transistor (CE Mode).
6. To Study The Characteristics of JFET.
7. Series voltage Regulator.
8. Design of amplifiers: Transistor amplifiers with and without feedback.
9. Inverting and non-inverting op-amps.
10. Op-amp linear applications: adders, subtractors.
11. Op-amp based active filters.
12. Square wave generators.

COURSE/ LEARNING OUTCOMES:

At the end of the Lab experiments students will be able to:

- CO1:** *Explain* the working principle and operate the various components used in the laboratory. (Understanding)
- CO2:** *Identify* different electronic components and devices. (Applying)
- CO3:** *Experiment with* various electronic components. (Applying)
- CO4:** *Analyse* the characteristics of various electronic components and circuits such as diodes, BJTs, FETs, Voltage Regulators, amplifiers and filters. (Analysing)
- CO5:** *Design* various electronic circuits based on the requirement. (Creating)

EEMC6029: ELECTRICAL MACHINES LAB–I

(1 credit) (L-T-P:0-0-2)

Objectives: *The objective of this course is to equip the students with a basic understanding of DC machines and Transformer fundamentals, different parts of these machines and help to gain the skills for operating DC machines and Transformers.*

List of experiments:

1. To obtain magnetization characteristics of a d.c. shunt generator
2. To obtain load characteristics of a d.c. compound generator (a) Cumulatively compounded (b) Differentially compounded
3. To obtain load characteristics of a dc shunt generator
4. To obtain load characteristics of a dc series generator
5. To obtain efficiency of a dc shunt machine using Swinburn's test
6. To perform Hopkinson's test and determine losses and efficiency of DC machine
7. To obtain speed-torque characteristics of a dc shunt motor
8. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control
9. To obtain speed control of dc separately excited motor using the Ward Leonard method
10. To study polarity and ratio test of single phase transformers
11. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test

COURSE/ LEARNING OUTCOMES:

At the end of the lab experiments, the students will be able to:

- CO1:** *Select* various dc machines and single-phase transformers for different applications. (Remembering)
- CO2:** *Explain* the starting procedures of different dc machines. (Understanding)
- CO3:** *Utilize* different machines for different applications, e.g., speed control, voltage control, load tests etc. (Applying)
- CO4:** *Analyse* performances of different motors and generators using standard procedure. (Analysing)
- CO5:** *Evaluate* efficiency, voltage regulation speed regulation of dc machines and single phase transformer. (Evaluating)

EEDE6030: DIGITAL ELECTRONICS LAB

(1 Credit) (L-T-P:0-0-2)

Objective: This course will enable students to get practical experience in design, realization and verification of Demorgan's Theorem, SOP, POS forms. They will be able to realize Full/Parallel Adders, Subtractors, Multiplexer, Demultiplexers, Decoders, Flip-Flops, Shift registers and counters using logic gates.

List of Experiments:

1. To verify the truth tables of the basic logic gates.
2. To verify De-morgan's Theorem for 2 variables using universal gates.
3. To verify the sum-of product and product-of-sum expressions using universal gates.
4. To design and implement (a) Full Adder using basic logic gates.
5. To design and implement Full subtractor using basic logic gates.
6. To design and implement 4-bit Parallel Adder/ subtractor using IC 7483.
7. To realize 4:1 Multiplexer using gates.
8. To realize 1:8 Demux and 3:8 Decoder using IC74138.
9. To realize the following flip-flops using NAND Gates. (a) Clocked SR Flip-Flop (b) JK Flip-Flop.
10. To realize the following shift registers using IC7474 (a) SISO (b) SIPO (c) PISO (d) PIPO.
11. To realize the Ring Counter and Johnson Counter using IC7476.
12. To realize the Mod-N Counter using IC7490.

COURSE / LEARNING OUTCOMES:

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

- CO1: *Demonstrate* the truth table of various expressions and combinational circuits using logic gates.(Understanding)
- CO2: Identify different components of digital Electronics.(Applying)
- CO3: *Evaluate* various combinational circuits such as adders, subtractors, comparators, multiplexers and demultiplexers. (Evaluating)
- CO4: *Design* various combinational circuits. (Creating)
- CO5: *Construct* flips-flops, counters and shift registers. (Creating)

EEMS6031:ELECTRICAL MACHINES LAB-II

(1 credit) (L-T-P:0-0-2)

Objective: This course provides a basic understanding of different characteristics of AC machines, machine parts and helps to gain the skills for operating AC machines.

List of experiments:

1. To perform no load and blocked rotor tests on a three-phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three-phase induction motor and draw:
 - (i) Torque -speed characteristics
 - (ii) Power factor-line current characteristics
3. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.

4. To study speed control of three phase induction motor by keeping the V/f ratio constant.
5. To study speed control of three phase induction motor by varying supply voltage.
6. To perform open circuit and short circuit tests on a three-phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) MMF method.
7. To determine V-curves and inverted V-curves of a three-phase synchronous motor.
8. To study synchronization of an alternator with the infinite bus by using: (i) dark lamp method (ii) two bright and one dark lamp method.
9. Scott connection of 3-phase transformer
10. Load test of 3-phase transformer

COURSE/LEARNING OUTCOMES

At the end of the lab experiments the students will be able to:

- CO1:** *Study* the method of synchronization of alternators with the infinite bus. (Remembering)
- CO2:** *Explain* the procedure for performing experiments related to AC machines. (Understanding)
- CO3:** *Compare* the different characteristics of rotating and non-rotating machines. (Evaluating)
- CO4:** *Combine* the different components to perform a particular experiment on AC machines. (Creating)
- CO5:** *Determine* the characteristics of different types of AC machines and their performances. (Evaluating)

EEPE6032: POWER ELECTRONICS LAB

(1 credit) (L-T-P:0-0-2)

Objective: *The objective of the course is to Analyse the various characteristic of the power electronics devices, design and test various arrangement of power devices based rectifier and inverters and choppers under power electronics system.*

List of Experiments:

1. Study of R, RC and UJT firing circuits.
2. Study UJT firing circuits.
3. Study of V-I characteristics of SCR.
4. Determination of Holding current and Latching current of SCR.
5. Single phase half-wave controlled rectifier
6. Single phase full-wave controlled bridge rectifier.
7. Study of V-I characteristics of MOSFET.
8. Study of UJT firing circuit.
9. Study of BUCK converter.
10. Study of BOOST converter.
11. Study of BUCK-BOOST converter.
12. Study of Single-phase square wave inverter.
13. Study of PWM inverter.

COURSE/LEARNING OUTCOMES

At the end of the experiments, students will be able to:

- CO1:** *Analyse* the performance of different types of power converters. (Analysing)
- CO2:** *Determine* the V-I characteristics of different types of power electronics switches. (Evaluating)
- CO3:** *Determine* the holding current and latching current of SCR. (Evaluating)
- CO4:** *Design* circuits for AC to DC, DC to DC and DC to AC conversions. (Creating)
- CO5:** *Construct* different types of Power converters. (Creating)

EESS6033: POWER SYSTEM STEADY STATE ANALYSIS LAB

(2 Credits)(L-T-P:0-0-2)

List of Experiments:

1. Simulation of IGBT Inverters
2. Simulation of Thyristor Converters
3. Transient Stability Studies
4. Short Circuit Studies
5. Evaluation of Z-Bus and Y-Bus
6. Economic Load Dispatch
7. Study of FACTS devices in power systems
8. Load Flow Studies
9. Load Forecasting and Unit Commitment

COURSE / LEARNING OUTCOMES:

- CO1:** *Demonstrate* the knowledge of Y-bus and Z-bus formation. (Understanding)
- CO2:** *Explain* the characteristics of IGBT and Thyristor converters. (Understanding)
- CO3:** *Apply* the knowledge of Short circuit faults in power system for its restoration. (Applying)
- CO4:** *Analyse* the load flow problem in power systems. (Analysing)
- CO5:** *Solve* economic dispatch problems of electrical energy. (Creating)

EERE6034: RENEWABLE ENERGY LAB

(2 Credits) (L-T-P:0-0-2)

List of Experiments:

1. Power Curves
2. Build a Wind Farm model.
3. Test the Capabilities of Solar PV array in partial shading condition.
4. Effect of Temperature on Solar Panel Output
5. Variables Affecting Solar Panel Output
6. Effect of Load on Solar Panel Output
7. Wind Turbine Output: The Effect of Load
8. Test the Capabilities of Solar Panels and Wind Turbines

COURSE/LEARNING OUTCOMES

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

- CO1:** *Identify* the V-I characteristics of Solar panel. (Applying)
- CO2:** *Utilize* the concepts of Solar Energy and Wind Energy conversion techniques in practical situations. (Applying)
- CO3:** *Determine* the power output from Solar and Wind Farms. (Evaluating)
- CO4:** *Determine* the different parameters such as Power, Voltage, current, solar irradiance, tip speed ration of wind turbine etc. (Evaluating)
- CO5:** *Construct* different types of Wind and Solar Energy farms. (Creating)

EECT6035: CONTROL LAB 1

(2 Credits) (L-T-P:0-0-2)

List of experiments:

1. Design and simulation of Linearised models using MATLAB/PSPICE.
2. Simulation and analysis of State space models for continuous time and discrete time systems using MATLAB/PSPICE
3. Design and Simulation of LTI models of Feedback Control System using MATLAB/PSPICE
4. Simulation and analysis of Digital Control System using MATLAB/PSPICE.
5. Simulation and Stability analysis of control system with common non-linearities using MATLAB/PSPICE
6. Familiarization and use of MATLAB command associated with Robust Control Systems.
7. Familiarization and use of PSIM software.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Name* the MATLAB command associated with Robust control system.(Remembering)
- CO2:** *Model* common non-linearities used in control systems. (Applying)
- CO3:** *Model* and analyse digital control system. (Applying)
- CO4:** *Design* and simulate control system models. (Creating)
- CO5:** *Design* and simulate linearised models using MATLAB/PSPICE.(Creating)

EECL6036: CONTROL LAB 2

(2 Credits) (L-T-P:0-0-2)

List of experiments:

1. Designing of Ladder logic for various practical applications.
2. Execution of the Ladders using PLC's.
3. Study of Analog and Digital Servo Systems.
4. Experiment on Position Control System.
5. Experiment on Velocity Control System.
6. Experiment on Adaptive Control System.
7. Experiment on Non-Linear Control Systems.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Compare* position, velocity, and adaptive control. (Understanding)
- CO2:** *Explain* adaptive control system (understanding)
- CO3:** *Explain* analog and digital servo system. (Understanding)
- CO4:** *Construct* PLC based system.(Creating)
- CO5:** *Design* ladder logic for PLC. (Creating)

EEPL6037: POWER SYSTEM PROTECTION LAB

(2 Credits) (L-T-P:0-0-2)

List of experiments:

1. Introduction to Power System Protection
2. Impact of Induction Motor Starting on Power System
3. Modelling of Differential Relay using MATLAB
4. Radial Feeder Protection
5. Parallel Feeder Protection
6. Principle of Reverse Power Protection
7. Differential Internal Protection of Transformer
8. Differential External Protection of Transformer
9. To the study Time vs. Voltage characteristics of over-voltage induction relay

COURSE / LEARNING OUTCOMES

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

- CO1:** *Show* the ability to propose model for radial and parallel feeder protection. (Remembering)
- CO2:** *Experiment with* the various components of power system protection. (Applying)
- CO3:** *Apply* the knowledge different types of relays in practical power system applications. (Applying)
- CO4:** *Examine* the performance characteristics of relays in equipment protection. (Analysing)
- CO5:** *Design* protective scheme using different types of relays. (Creating)

EEPA6038: POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS LAB

(2 Credits) (L-T-P:0-0-2)

List of experiments:

1. Active power filters
2. Multi-level inverters
3. Vector control of inverters
4. Solar panel integration to grid
5. Isolated DC- DC converter
6. Non-isolated DC- DC converter
7. Controllers of FACTS devices
8. Characteristics of FACTS devices

9. Improvement of power quality using shunt compensation
10. Improvement of power quality using series compensation

COURSE / LEARNING OUTCOMES

- CO1:** *Experiment with various power electronic circuits used in power system applications. (Applying)*
- CO2:** *Apply the knowledge different types of FACTS devices for power quality improvement. (Applying)*
- CO3:** *Examine the performance characteristics of different types of FACTS devices. (Analysing)*
- CO4:** *Select the suitable power electronic devices for designing different power electronic converters. (Evaluating)*
- CO5:** *Design different types of power electronic converters. (Creating)*

EEAL6039: ADVANCE CONTROL LAB 1**(2 Credits) (L-T-P:0-0-2)****List of experiments:**

1. State space modelling of discrete time systems and study of responses.
2. Pole placement design for regulator and tracking discrete time systems.
3. Observer design for discrete time systems.
4. Design of digital Kalman filter.
5. Optimal control design of digital systems.
6. Analysis of non linear systems using describing function method.
7. Phase plane analysis of non-linear systems.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Analyse non-linear systems. (Analysing)*
- CO2:** *Examine responses of discrete time systems from state space modeling. (Analysing)*
- CO3:** *Design and simulate pole placement design for regulator. (Creating)*
- CO4:** *Design of digital Kalman filter. (Creating)*
- CO5:** *Design and simulate discrete control system models. (Creating)*

EEAC6040: ADVANCE CONTROL LAB 2**(2 Credits) (L-T-P:0-0-2)****List of experiments:**

1. Characteristics of Synchros: (a) Synchro transmitter characteristics. (b) Implementation of error detector using synchro pair.
2. Determination of Magnetic Amplifier Characteristics with different possible connections.
3. To determine the time response of closed loop second order process with P Control, PI Control and PID control and to determine the effect of disturbance on a process.
4. To study the compensation of the second order process by using: (a) Lead Compensator. (b) Lag Compensator. (c) Lead- Lag Compensator
5. To determination of AC servomotor Characteristics.
6. To study the position control of DC servomotor with P, PI control actions.

COURSE / LEARNING OUTCOMES

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

- CO1:** *Demonstrate* the position control of DC servomotor with P, PI control actions. (Understanding)
- CO2:** *Determine* Magnetic Amplifier Characteristics with different possible connections. (Evaluating)
- CO3:** *Measure* the AC servomotor Characteristics. (Evaluating)
- CO4:** *Determine* the time response of closed loop second order process with P Control, PI and PID control. (Evaluating)
- CO5:** *Design compensation systems using* lead, lag and lead-lag compensator. (Creating)

EEMP6041: MINI PROJECT

(2 Credits) (L-T-P:0-0-2)

Process:

1. Literature Review
2. Synopsis Presentation
3. Progress Presentation
4. Hardware/Software Project Execution
5. Final Presentation and Demonstration of the Project

COURSE/LEARNING OUTCOMES

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

- CO1:** *Apply* practical knowledge within the chosen area of technology for project development. (Applying)
- CO2:** *Demonstrate* the skills to carry out research work independently. (Understanding)
- CO3:** *Plan* for executing projects with a comprehensive and systematic approach. (Applying)
- CO4:** *Take part in* development of technical projects as an individual or in a team. (Analysing)
- CO5:** *Develop* effective communication skills for presentation of project related activities. (Creating)

DEPARTMENT OF CIVIL ENGINEERING

Vision

To be a recognized leader in Civil Engineering education and learning experiences providing state of the art education guided by innovative research and consultancy, inclusive technology and managerial skills for industry as well as societal needs towards sustainable development.

Mission

- To make the department a centre of excellence in Civil Engineering education which equips students with a strong conceptual foundation coupled with practical insight to meet the global industrial and environmental challenges.
- To produce spiritually inspired, socially committed and intellectually competent professionals of high calibre and strong ethical principles to serve the society and nation through team work and societal leadership.
- To establish the department as a recognized centre of research for developing sustainable solutions to engineering problems by providing knowledge base and consultancy services to the community.

Program Educational Objectives (PEOs)

1. To equip the students with necessary technical skills and professional expertise that make them competent for immediate employment or to pursue postgraduate studies in Civil Engineering disciplines.
2. To produce graduates who are spiritually motivated for life-long learning and morally committed for successful careers as civil engineers, managers, administrators, educators, engineering consultants and entrepreneurs.
3. To enhance students' abilities to identify and take up project and research topics which would be highly useful for the society considering the present environmental and industrial needs of the country.
4. To make the students able to communicate their innovative ideas to be effective in collaboration with other civil engineering teams that will make them achieve leadership position to solve different challenges of civil engineering problems.
5. To develop a sense of understanding of the multidisciplinary approach and an ability to relate engineering issues to the broader context of individual and society for sustainable development.

DETAILED SYLLABUS

CVFM0021: FINITE ELEMENT METHODS

(3 credits-45 hours)

Objective: The objective of the course is to apprise the students about the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems in Civil Engineering. It is intended to cover the analysis methodologies for 1-D, 2-D and 3-D problems with the advantages and disadvantages clearly spelt out. It is expected that once the students are exposed to the course, they will be in a position to develop computer code for any physical problem using Finite Element techniques.

Module I (5 Hours)

Introduction to Finite Element Analysis: Introduction, Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis

Module II (12 Hours)

- a) **Finite Element Formulation Techniques:** Virtual Work and Variational Principle, Galerkin Method, Finite Element Method, Displacement Approach, Stiffness Matrix and Boundary Conditions
- b) **Coordinates and Elements:** Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements, Numerical Integration: One Dimensional, Numerical Integration: Two and Three Dimensional, Worked out Examples

Module III (8 Hours)

Analysis of Frame Structures: Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame

Module IV (15 Hours)

- a) **Finite Element Method (FEM) for Two and Three Dimensional Solids:** Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Lecture, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axisymmetric Element, Finite Element Formulation of Axisymmetric Element, Finite Element Formulation for 3 Dimensional Elements, Worked out Examples
- b) **FEM for Plates and Shells:** Introduction to Plate Bending Problems, Finite Element, Analysis of Thin Plate, Finite Element Analysis of Thick Plate, Finite Element Analysis of Skew Plate, Introduction to Finite Strip Method, Finite Element, Analysis of Shell

Module V (5 Hours)

Additional Applications of FEM: Finite Elements for Elastic Stability, Finite Elements in Fluid Mechanics, Dynamic Analysis

COURSE/LEARNING OUTCOMES

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

- CO1:** Know the Basic Concepts in mathematical modelling with partial differential equation, and fundamental properties for elliptic, parabolic and hyperbolic equations.

- CO2:** Appraise the basics of the finite element technique, in solving problems of solid mechanics in different Civil Engineering applications. Make judgement on the results obtained from the analysis.
- CO3:** Apply the formulation of the subject based on equilibrium, constitutive and compatibility condition, develop computer coding for any structural element, find the approximate solutions of any complex structural analysis problems in Civil engineering and apply isoparametric formulation, stiffness matrix, etc. in frame structure analysis.
- CO4:** Analyse truss members, continuous beam, plane frame, grid and space frame structure.
- CO5:** Solve parabolic and hyperbolic partial differential equations using the finite element method in space and finite differences in time, and to compare different time stepping algorithms and choose appropriate algorithms for the problem at hand. Communicate the output of the software. And simulate the real time structure accordingly.
- CO6:** Verify the results obtained from the various analysis, validate and evaluate the results obtain under the same field data.

Suggested Readings

1. C. S. Krishnamoorthy, Finite Element Analysis, Tata McGraw-Hill
2. David V. Hutton, Fundamentals of Finite Element Analysis, McGraw Hill
3. Erik G. Thompson, Introduction to the Finite Element Method: Theory, Programming and Applications, John Wiley
4. H. C. Martin and G. F. Carey, Introduction to Finite Element Analysis - Theory and Application, New York, McGraw-Hill
5. K. J. Bathe, Finite Element Procedures, Prentice-Hall of India, New Delhi, India
6. M. Mukhopadhyay, Matrix, Finite Element, Computer and Structural Analysis, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India
7. O. C. Zienkiewicz and Y. K. Cheung, The Finite Element Method in Structural and Solid Mechanics, McGraw Hill, London
8. R. D. Cook, Concepts and Applications of Finite Element Analysis, Wiley
9. S. S. Rao, Finite Element Analysis, Elsevier Butterworth-Heinemann
10. W. Weaver Jr. and J. M. Gere, Matrix Analysis of Framed Structure, CBS Publishers and Distributors, New Delhi, India

CVSA0022: STRUCTURAL ANALYSIS II

(4 credits — 60 hours)

Objective: *This course is in continuation with the courses of Strength of Materials and Analysis of structures I dealt with in earlier semesters and deals with understanding the behavior of components of civil engineering structures under the action of external loads. This forms a key step towards designing any civil engineering structure.*

Module I (20 hours)

- a) Arches:
- i) Analysis of three hinged arches: Circular arches, parabolic arches, and arches with supports at different levels, temperature effect on three hinged arches

- ii) Analysis of two hinged arches: circular arches, parabolic arches, effect of rib shortening, temperature stresses, analysis of fixed arches: elastic centre method, effect of temperature change and yielding of supports
- b) Cable and suspension Bridges: Cables under point load, uniformly distributed load, stresses in cables and shape of cable under self-weight, temperature stresses, three hinged stiffening girder and two hinged stiffening girder

Module II (10 hours)

Unsymmetrical bending: Introduction to centroidal principal axes of sections, principal moment of inertia, bending stresses in beam subjected to unsymmetrical bending, shear centre, shear centre for channel, angles and z-sections

Module III (10 hours)

Analysis of beams curved in plan: Analysis of circular beam loaded uniformly and supported on symmetrically placed columns, semi-circular beam simply supported on three supports equally spaced, semi-circular beams fixed at two ends and subjected to central concentrated load

Module IV (20 hours)

- a) moving loads and influence lines: Application to determinate structures-influence lines for support reactions, shear force, bending moment for beams, trusses, 3-hinged arch, suspension bridges
- b) Muller-Breslau's principles: Influence lines for statically indeterminate beams, influence lines for support reactions, bending moment, shear force in propped cantilever, two span continuous beams and for two hinged arch

COURSE /LEARNING OUTCOMES

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

- CO1:** Define structures like arches, cables and suspension bridges, curved beams; recognize the significance of influence line diagrams; recall the difference between symmetrical and unsymmetrical bending. (Remembering)
- CO2:** Explain the different classes of loads on arches, suspension bridges and curved beams; (Understanding)
- CO3:** Illustrate the phenomenon of unsymmetrical bending; interpolate the influence line diagrams of a girder to interpret the response of a bridge under moving loads. (Applying)
- CO4:** Apply the conventional methods of structural analysis to compute the reactions, shear, bending and torsional moments in arches, curved beams and suspension bridges; construct influence line diagrams for different types of rolling loads; find out stresses due to unsymmetrical bending (Applying)
- CO5:** Assess the theoretical results obtained from analysis in real time design of these structures and identify the structural requirements; point out the factors affecting the performance of these structures (Analysing)
- CO6:** Conclude precisely the maximum values of design parameters for these structures and summarize the generalized structural requirements under different load cases. (Creating)
- CO7:** Determine the suitable principles of analysis based on the determinacy of structures and assess the output diagrams for economic design of these structures. (Evaluating)

Suggested Readings

1. S. Ramamrutham, Theory of Structures, Dhanpat Rai Publishing Company (P) Ltd.
2. S. Ramamrutham, Strength of Materials, Dhanpat Rai Publishing Company (P) Ltd.
3. Prof. V.N. Vazirani, Analysis of Structures Vol. I and II, Khanna Publishers
4. Dr. R. K. Bansal, Textbook of Strength of Materials, Laxmi Publications (P) Ltd.
5. B. C. Punmia, Theory of Structures, Laxmi Publications

CVDS0023: DESIGN OF STRUCTURES I**(4 credits — 60 hours)**

Objective: *This is the first course of design of structures which deals with all fundamental concepts of R.C.C design. RCC has been the predominant structural entity in the present day civil engineering constructions; hence the importance.*

Module I (24 hours)

- a) Introduction: Different design philosophies, principles of working stress and limit state methods (limit state method in detail)
- b) Beams: Analysis of singly and doubly reinforced beams of rectangular and flanged sections, design for bending, compression, shear and torsion – design of singly and doubly reinforced beams of rectangular and flanged sections using limit state method, design of continuous beams, limit state of serviceability – deflections and cracking

Module II (10 hours)

Columns: Effective lengths, design of short columns and long columns with axial loads, uniaxial moment and biaxial moments - use of SP-16 charts

Module III (16 hours)

- a) Slabs: Design of one way, two way, continuous and cantilever slabs, design of flat slab
- b) Staircases: Design of straight flight and dog-legged staircases

Module IV (10 Hours)

Footings : Design of isolated footings- axial and eccentric loading- design of combined footings- rectangular and trapezoidal footings, design of strap footing, design of Piles.

COURSE /LEARNING OUTCOMES

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

- CO1:** Recognize the standard philosophies of structural design; list out the different elements of a building viz. beams, column, slabs, staircases, footings etc.; state their functionalities and define the various classes of loading acting on these structures. (Remembering)
- CO2:** Differentiate between working stress and limit state methods of design; explain the suitability of these design methodologies; classify the different design parameters viz. bending, shear, torsion, compression, tension etc. and illustrate the applicability of singly reinforced and doubly reinforced sections (Understanding)
- CO3:** Apply the standard methodologies as per IS Codes to predict the response spectrum of different structural elements of a building; compute the bending moments and shear forces at different sections of these structures; predict the maximum and minimum values of design parameters.(Applying)

- CO4:** Analyse different elements of a building under various loadings; identify their deflection and cracking patterns; and point out the parameters influencing their design. (Analysing)
- CO5:** Evaluate the structural design of various components of a building to determine the reinforcement required for an economic design; assess the performance of these elements by examining their serviceability requirements. (Evaluating)
- CO6:** Assemble the theoretical results synthesized from structural analysis and combine those outputs to carry out an organized structural design of a building; conclude the structural design with workable diagrams of bending, shear and axial forces. (Creating)

Suggested Readings

1. IS 456-2000- Code of practice for R.C.C design.
2. S. Unnikrishna Pillai and Devadas Menon, Reinforced Concrete Design, Tata McGraw-Hill
3. S. Ramamrutham and R.Narayan, Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company (P) Ltd.
4. P. C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India Ltd
5. N. Krishnaraju, Structural Design and Drawing - Reinforced Concrete and Steel, Universities Press Ltd.
6. Dr. B.C Punmia, Ashok Kr Jain and Arun Kr Jain ,Reinforced Concrete Structures Vol. I- Laxmi Publications
7. S.S. Bhavikatti, Design of R.C.C structural Elements Vol. I-New age international publishers.
8. H. Mehra and V. N Vazirani, Limit State Design, Khanna Publishers

CVGE0024: GEOTECHNICAL ENGINEERING I

(4 credits — 60 hours)

Objective: *Knowing the composition and characteristics of soil mass is of paramount importance for any Civil Engineer in order to estimate and predict its behavior. This course deals with estimating behavior of soil in quantitative matter which is a prerequisite for designing foundation of any structure.*

Module I (10 hours)

Formation of soil, types of soil deposits based on origin, phase–relationships, index properties, particle size distribution: sieve analysis, identification and classification of soils, consistency of clays: Atterberg limits and, plasticity, sensitivity and thixotropy, clay minerals – montmorillonite, elite and kaolinite, fabric and structure, classification of rocks, RQD, RMR system

Module II (15 hours)

- a) Permeability of soils: Darcy’s law – factors affecting permeability - constant head and falling head permeability tests - average permeability of stratified deposits
- b) Principle of effective stress: Total, neutral and effective stress variation diagrams, quick sand condition, critical hydraulic gradient
- c) Seepage through soils: Laplace equation, flow nets–construction of flow net, definition of phreatic line and exit gradient, applications of flow net

Module III (15 hours)

- a) Compaction of soils: Factors affecting compaction, compaction test, optimum moisture content and zero air void line, field methods of control of compaction, methods of compaction of various types of deposits in field.

- b) Compressibility and consolidation of soils: Introduction to the process of consolidation (spring-piston analogy), e-p curves, methods of estimating preconsolidation pressure, over consolidation ratio, Terzaghi's theory of one dimensional consolidation, consolidation test and determination of C_v , m_v and C_c , primary and secondary consolidation, compression characteristics of clays and settlement analysis of clays and sands.

Module IV (20 hours)

- a) Shear strength of soils: Stress at a point, Mohr's stress circle, Mohr-coulomb failure criteria, definition of stress path, shear testing of soil - direct shear, unconfined compression, vane shear, triaxial, undrained and drained strengths, shear characteristic of sand, normally loaded and over consolidated clays, Skempton's pore pressure parameters
- b) Stability of slopes: Finite and infinite slopes, concept of factor of safety, Swedish method, friction circle method, Taylor's stability number and chart, effect of submergence, steady seepage and sudden drawdown conditions

COURSE /LEARNING OUTCOMES

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

- CO1:** Define the composition and characteristics of soil mass, predict the behaviour of soil mass in a quantitative manner, explain the interaction of soil with water, compaction, compressibility and consolidation, shear strength of soils and the stability of slopes. (Remembering)
- CO2:** Classify the soil and their basic properties to analyse the phase relationships and index properties of soils and to analyse the effect of compaction, compressibility and consolidation on a soil mass. (Understanding)
- CO3:** Identify the index properties of soils, effect of compaction, compressibility and consolidation on a soil mass. Compute the behaviour of soil with water, shear strength of soils and the stability of a given slope. (Applying)
- CO4:** Classify various problems and criticalities encountered in geotechnical engineering. (Analysing)
- CO5:** Evaluate the suitability of soil mass for different works and judge whether a soil mass need further modification in its properties. (Evaluating)
- CO6:** Build projects in geotechnical engineering and pursue research in the field of geotechnical engineering. (Creating)

Suggested Readings

1. Gopal Ranjan and A.S.R Rao, Basic and Applied Soil Mechanics, New age international publishers
2. B.C Punmia, Ashok Kr Jain and Arun Kr Jain, Soil Mechanics and Foundations, Laxmi publications
3. K.R. Arora, Geotechnical Engineering, Standard Publishers Distributors, New Delhi, 2006
4. Alam Singh, Modern Geotechnical Engineering-CBS publishers and distributors
5. Terzaghi and Peck, Soil Mechanics in Engineering Practice – John Wiley and Sons, New York, 196

CVTE0025: TRANSPORTATION ENGINEERING I

(4 credits — 60 hours)

Objective: This course introduces Transportation Engineering, a core civil engineering practice in the field with prime focus on the highway engineering sector. On completion a student should be competent enough for planning and designing of different types of roads with necessary quality control in road construction and maintenance.

Module I Planning, surveys and geometric design (24 hours)

- a) Introduction: Role of transportation, modes of transportation - advantages and limitations
- b) Transportation planning: Need, objectives, hierarchy of plans, salient points of 20 year road development plans in India, road development plan - vision:2021, brief introduction to IRC, NHAI, PMGSY
- c) Surveys and investigations: Various types of surveys with importance of each, route location survey - characteristics of ideal alignment, engineering survey-map study, reconnaissance, preliminary surveys, final location and detailed survey
- d) Traffic surveys: Traffic flow characteristics, traffic volume, speed and delay study, origin and destination study, axle load survey
- e) Geometric design: Design controls and criteria, highway cross section elements - sight distance, right-of-way, roadway width, kerbs, camber, super-elevation, horizontal and vertical alignment, widening on curves, gradients, summit curve and valley curve, road intersections - intersection at grade, e.g., channelized and un-channelized rotary, grade separated intersections

Module II Highway materials and design (20 hours)

- a) Materials: Subgrade soil, various classifications, strength of soil subgrade - direct shear test, C.B.R. test, plate load test, tests on aggregates and bituminous binder, IS and IRC specifications, bituminous materials, tar and new materials
- b) Pavement design: Functions of pavement, types of pavement and their comparison, factors to be considered in design - design wheel load, ESWL, repetition of loads, strength characteristics
- c) Design of flexible pavement: Standard methods: GI method, CBR method, triaxial method, McLeod method, I.R.C. guidelines
- d) Design of rigid pavement: Factors affecting design, Westergaard's analysis of stresses, temperature stresses, critical combination of stresses, structural components of rigid pavement, general design considerations and IRC guidelines

Module III Highway construction and maintenance (16 hours)

- a) General process of highway construction: Excavation, embankment preparation, compaction of subgrade, construction of WBM and bituminous roads, types of bituminous courses
- b) Construction of cement concrete roads: Concrete mix design, construction of dry lean concrete sub-base (DLC), antifriction layer, manual construction method, equipment- based technique using slip-forms, construction of joints using dowels and tie bars, use of admixtures and additives in concrete
- c) Highway maintenance: Pavement evaluation by present serviceability index, Bankelman beam method and dynamic cone penetrometer test, maintenance of gravel roads, WBM roads, bituminous surface and cement concrete surface

COURSE /LEARNING OUTCOMES

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

- CO1:** Recall the properties and testing procedures of pavement materials. (Remembering)
- CO2:** Classify and characterise the pavement materials. (Understanding)
- CO3:** Plan and perform quality control tests on pavements and pavement materials. (Applying)
- CO4:** Assess the quality and grade of bitumen. (Analysing)

CO5: Compare the quality of various pavement materials and their suitability in highway construction. (Evaluating)

CO6: Design basic vertical alignment and horizontal alignment of highways. (Creating)

Suggested Readings

1. Khanna S.K. and Justo C.E.G., Highway Engineering, Nem Chand and Bros, Roorkee
2. Kadiyali L.R and Lal N.B, Principles and Practices of Highway Engineering, Khanna Publishers
3. Bindra S.P, A course in Highway Engineering, Dhanpat Rai Publications
4. Rao, G. V, Transportation Engineering, Tata McGraw Hill
5. Kadiyali L. R, Traffic Engineering and Transport Planning, Khanna Publication

CVEE0026: ENVIRONMENTAL ENGINEERING I

(4 credits - 60 hours)

Objectives: Starting with an introductory lesson on environment vis-a-vis pollution of its components, this course basically deals with various issues related to water supply to community which constitutes a prime area of practice for civil engineers.

Module I (6 hours)

- a) Man and environment: Health and environment, interdisciplinary nature of environment, brief introduction to air, water and land pollutions
- b) Natural resources of environment: Water supply system, its objectives and components

Module II (26 hours)

- a) Water quantity: Various demands of water, design period, population forecasting, per- capita consumption – recommended rates, factors affecting consumption, variation of demand and its impact and design of water supply system, fire demand
- b) Water quality: Impurities of water and water borne diseases, water analysis physical, chemical and bacteriological, sampling method, water quality tests and standards
- c) Treatment of water: Methods, purposes, sequence of treatments, aeration, sedimentation – plain and with coagulation, coagulants and their dosage, feeding units, mixing basins and flocculation units, sedimentation tanks and their design, filtration – principle, type of filters, slow and rapid sand filters, pressure, diatomite and multimedia filters
- d) Other treatments of water: Disinfection, necessity of chlorinating - chlorine dose, break point chlorination, feeding units, Ozonisation, hardness and softening of water, lime process, lime and soda ash process, base exchange process, removal of taste and odour, iron and manganese, swimming pool water treatment

Module III (20 hours)

- a) Intake works and conveyance of water: River, reservoir and canal intakes, selection of intake, rising main – type of conduits, capacity and design, pipe flow formulae, different types of pipe materials and pipe joints, pumps – types and selection of pumps
- b) Distribution system: Introduction, general requirements, classification, gravity system, direct pumping system, system with pumping and storage, methods of supply, available pressure in distribution system, storage and distribution reservoirs, layout and design of distribution system, equivalent pipe method, Hardy Cross method
- c) Maintenance of distribution system: detection of leakage and wastage and their prevention

- d) Plumbing of buildings for water supply: Services connection, water storage, system of water supply in buildings, plumbing system, detection and remedies of defects in plumbing system, building drainage (traps)

Module IV (8 hours)

Introduction to Land Pollution and Noise Pollution: Source, characteristics, problems, methods of management

COURSE /LEARNING OUTCOMES

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

- CO1:** Define the interaction between human and environment, need of systematic utilization of natural resources. (Remembering)
- CO2:** List the components of water supply system. (Understanding)
- CO3:** Explain the principles and operation of water treatment systems and the required appurtenances and accessories. (Applying)
- CO4:** Identify and illustrate the processes namely coagulation, flocculation, and sedimentation, filtration, and disinfection processes. (Applying)
- CO5:** Analyse the suitability of the treatment plants and unit processes. (Analysing)
- CO6:** Assess the quantity and quality of water. (Analysing)
- CO7:** Evaluate and summarize process operations and performance. (Evaluating)
- CO8:** Design the treatment units and modify the existing processes where ever required. (Creating)

Suggested Readings

1. K.N. Duggal, Elements of Environmental Engineering, S. Chand and company Ltd.
2. S. K. Garg, Water Supply Engineering, Khanna Publishers.
3. Dr. B.C. Punmia, Water Supply Engineering, Laxmi Publications Pvt. Ltd.
4. Dr. P.N. Modi, Water Supply Engineering, Standard Book House, New Delhi.
5. Metcalf and Eddy, Waste Water Engineering, Tata McGraw hill Publishing Co. Ltd
6. G. S. Birdie, Water Supply and Sanitary Engineering, Dhanpat Rai Publishing Company

CVSA0027: STRUCTURAL ANALYSIS III

(4 credits — 60 hours)

Objectives: *This course is in continuation with the courses of Structural Analysis I and II dealt with in earlier semesters, and emphasizes on various methods of static and dynamic analyses of different structures under vertical and horizontal loading. This forms a key step towards designing any engineering structure.*

Module I: Approximate Analysis of Multi-Storey Frames (20 hours)

Approximate Analysis of Multi-Storey frames subjected to Vertical Loads, Method of Substitute Frames; Analysis of Building Frames subjected to Horizontal Loads, Portal Method and Cantilever Method

Module II: Matrix Analysis of Framed Structures (18 hours)

Basic concepts of Structural Analysis, Deformation in Framed Structures, Equilibrium, Compatibility, Static and Kinematic Indeterminacy, Action and Displacement Equations, Principle of Superposition, Equivalent joint loads, Energy Concepts, Virtual Work, Flexibility and Stiffness Matrices and their derivation and application, Local and global stiffness matrices, relationship between flexibility and stiffness matrix

Module III: Plastic Method of Analysis (15 hours)

Introduction, plastic moment of inertia, plastic section modulus, characteristic of plastic hinge, concept of Moment Redistribution, Static and kinematic method, combined mechanism for plastic collapse loads of beams, single bay two storey and two bay two storey portal frames, simple pitch roof frame, deflection at point of collapse

Module IV: Dynamic Analysis (7 hours)

Introduction, Degrees of freedom, Damping, Free Vibration, Natural frequency, Forced vibration, Simple Structures with single and two degrees of freedom

COURSE /LEARNING OUTCOMES

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

- CO1:** Define static and kinematic indeterminacies of structures; name the different types of loading in a multi-storey frame and state the methods applicable for these loading classes. (Remembering)
- CO2:** Explain basic concepts of plastic and elastic theories of analysis; explain the structural behaviour under dynamic loading and illustrate the failure mechanisms of structures. (Understanding)
- CO3:** Apply advanced methods of structural analysis viz. matrix methods to compute the forces and deflections in structures; construct workable diagrams for different design parameters and find out collapse loads for multi-storey structures. (Applying)
- CO4:** Analyse the failure mechanisms and determine the factor of safety for horizontal and vertical loads under static and dynamic conditions. (Analysing)
- CO5:** Interpret the approximate methods and principles suitable for Analysing different frames based on their indeterminacies and compare the results with conventional methods. (Evaluating)
- CO6:** Assemble the results from different methods of analysis and combine those results to summarize the collapse mechanism of structures. (Creating)

Suggested Readings

1. V. N. Vazirani, M. M. Ratwani and S. K. Duggal, Analysis of Structures, Volume I and II, Khanna Publishers
2. R. Vaidyanathan and P. Perumal, Structural Analysis, Volume I and II, Laxmi Publications
3. Thandavamoorthy, Structural Analysis, Oxford Press
4. Gupta, Pandit and Gupta, Theory of Structures, McGraw Hill
5. B. C. Punmia, Theory of Structures, Laxmi Publications
6. S. Ramamrutham, Theory of Structures, Dhanpat Rai Publishing Company (P) Ltd.
7. V. K. M. Selvam, Fundamentals of Limit Analysis of Structures, Dhanpat Rai Publications

CVDS0028: DESIGN OF STRUCTURES II

(4 credits — 60 hours)

Objectives: This is the second course of design of structures which deals with the basic concepts and their applications in the field of design of steel structures. Keeping in mind the skyrocketing trend of application of steel as a construction material in present day construction engineering, this course is intended to be the stepping stone for the students to the modern construction industry.

Module I (4 hours)

Introduction and Design Approach: Properties of Structural Steel, I. S. Rolled Sections, I. S. Specifications, Factor of Safety, Permissible and Working Stresses, Plastic Method, Limit State Design Method, Introduction to Elastic Method

Module II (16 hours)

Connections: Type of Connections, Bolted and Welded Connections, Strength and Efficiency of Bolted and Welded Joints, Design of Bolted Joints - Lap and Butt Joint, Modes of Failure of a Bolted Joint, Advantages and Disadvantages of Welded Joints, Design of Fillet and Butt Welds, Design of Eccentric Connections, Gusset Plate and Bracket Connection

Module III (20 hours)

- a) Tension Members: Net Sectional Area, Permissible Stress, Design of Axially Loaded Tension Member, Design of Member Subjected to Axial Tension and Bending, Splicing of Tension Members
- b) Compression Members: Modes of Failure of a Column, Buckling Failure: Euler's Theory, Effective Length, Slenderness Ratio, Design Formula: I.S. Code Formula, Design of Compression Members, Simple Struts, Design of Concentrically and Eccentrically Loaded Built-Up Compression Members, Laced and Battened Columns, Secondary Design Consideration, Column Splicing

Module IV (20 hours)

- a) Beams: Design Procedure, Simple and Built-Up Beams, Laterally Restrained and Unrestrained Beams, Plate Girder: Plate Thickness, Web Crippling, Web Buckling, Connections and Curtailment of Flange Plates
- b) Beam Column: Eccentricity of Load, Interaction Formulae, Design Procedure
- c) Column Base: Centrally and Eccentrically Loaded Base Plate Design, Flat Slab Base, Gusseted Base, Grillage Foundation

COURSE /LEARNING OUTCOMES

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

- CO1:** Recall the design approaches using steel sections of various types, difference between design of concrete structures and design of steel structures and the advantages of steel structures over concrete structures. (Remembering)
- CO2:** Classify different types of steel sections and connections that are used in the design of steel structures. (Understanding)
- CO3:** Apply the theories learnt to design tension members and compression members and the various connections using bolts and welds, beams, beam-columns and column-bases. (Applying)
- CO4:** Analyse designed connections and members and point out the deficiencies in the connections in case the connections turn out to be unsafe and provide remedial measures in case of failure prediction. (Analysing)
- CO5:** Evaluate the performance of a designed member. The students are able to examine a steel structure for any faults and defects. The students are able to judge whether a particular design are sufficient for a given situation. (Evaluating)
- CO6:** Solve various problems in design of steel structures, various criticalities that are encountered while designing steel structures, to take up projects involving design of steel structures and to pursue research in the field of design of steel structures. (Creating)

Suggested Readings

1. IS 800:2007-Code of practice for Steel Design
2. N. Subramanian, Design of Steel Structures, Oxford University Press.
3. S.S. Bhavikatti, Design of Steel Structures, I.K. International Publishing House Pvt. Ltd.
4. L.S. Negi, Design of Steel Structures, Tata McGraw Hill Education
5. S. Ramamrutham, Design of Steel Structures, Dhanpat Rai Publications
6. Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Design of Steel Structures, Laxmi Publications

CVGE0029: GEOTECHNICAL ENGINEERING II**(4 credits — 60 hours)**

Objectives: *This course is in continuation with the course of Geotechnical Engineering I and deals with different types of foundation system and retaining structures, their analysis and geotechnical design, bearing and settlement behaviour under vertical stresses as well as various techniques of soil improvement. Students are expected to earn capability of making appropriate decision as regards type of foundation based on prevailing ground condition.*

Module I (20 hours)

- a) Vertical Stresses: Introduction, Boussinesque and Westergaard's formula and Newmark's chart, vertical stress distribution beneath loaded areas and stress distribution diagrams.
- b) Earth Pressures and Retaining Walls: Introduction, Earth pressure at rest, Rankine and Coulomb's theories for active and passive states, influence of surcharge, water table, wall friction and deformation on earth pressure, Culmann's graphical method, point of application, Design considerations for Retaining walls.

Module II (25 hours)

- a) Introduction: Classification of foundation types and principles of selection.
- b) Shallow Foundations: General Requirements for satisfactory action of footings.
- c) Bearing Capacity: Terzaghi's theory, factors affecting bearing capacity, influence of eccentric and inclined loads, determination of allowable bearing pressure and proportioning of footing on clay and sand Settlement: Immediate and consolidation settlements, compression characteristics of clays and settlement analysis of clays and sands, limits of settlement, correction for rigidity and three dimensional consolidation effects, settlement of foundation in sand and clay.
- d) Deep Foundations: Uses and types of piles; Bearing capacity of single pile in clay and sand, Engineering News and Hiley's formula, Indian standard pile load test, group action, negative skin friction, Settlement of pile groups
- e) Piers and caisson foundations, elements of well foundation, depth of well foundation, list of forces acting on well, remedial measures for shifts and tilts of well, permissible values

Module III (7 hours)

Machine Foundations: Types of machine foundations, modes of vibration of a block foundation, degrees of freedom of a block foundation, design criteria of a reciprocating machine foundation.

Module IV (8 hours)

- a) Soil Exploration: Purpose, methods of soil exploration, methods of boring, soil samples and samplers, penetration and sounding tests, plate load test, geophysical methods, site investigation Reports.

- b) Introduction to ground improvement techniques including use of geosynthetics and geotextiles

COURSE /LEARNING OUTCOMES

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

- CO1:** Define vertical stress, earth pressure in retaining wall, understand bearing capacity of shallow and deep foundation, settlement calculation and criteria of consolidated soil, Piers and caisson foundation, machine foundation, Soil exploration techniques. (Remembering)
- CO2:** Classify foundation types, machine foundations. (Understanding)
- CO3:** Apply the knowledge acquired in designing of foundations for structures, embankments, landslide, slope stability, storage systems for hazardous materials, and lessening of soil erosion. (Applying)
- CO4:** Analyse shallow and deep foundations and verify of the results obtained from the various analysis based on the soil exploration, boring and geophysical site method. (Analysing)
- CO5:** Evaluate the earth pressures on foundations and retaining structures and the bearing capacity of soils and foundation settlements. (Evaluating)
- CO6:** Design different types of foundation system and retaining structures.(creating)

Suggested Readings

1. Gopal Ranjan, A.S.R Rao, Basic and Applied Soil Mechanics, New Age International Publishers
2. V. N. S. Murthy, Geotechnical Engineering, Marcel Dekker, Inc.
3. Dr. B.C. Punmia, Ashok Kr Jain and Arun Kr Jain, Soil Mechanics and Foundations, Laxmi Publications
4. P. Purushothama Raj, Soil Mechanics and Foundation Engineering, Pearson

CVEE0030: ENVIRONMENTAL ENGINEERING II

(3 credits — 45 hours)

Objectives: *This course is in continuation with the course of Environmental Engineering I dealt with in previous semester and aimed at familiarizing the students with collection and characterization of wastewater samples, their treatment and disposal, wastewater treatment processes-chemical and biological and their applications in order to make them competent to understand and handle problems caused by sewage, sewerage and other types of water pollution.*

Module I (8 hours)

- a) Introduction: Wastewater Generation and sources, Sanitation, sewage, sewer, sewerage, method of water collection conservancy and water carriage system, sewerage system types, selection of a system.
- b) Waste water flow : Quantity of sanitary sewage, infiltration of water, variation in flow and its impact on wastewater system, quantity of stormwater, rational method, time of concentration, rainfall intensity duration relationship, Empirical formula.

Module II (5 hours)

Sewage Characteristics: Effluent Standards, Important parameters and their significance BOD, COD, DO nitrogen, test -physical, chemical and biological

Module III (12 hours)

Wastewater Collection: Sewerage system, Hydraulic flow of sewers, principle of lay out and planning shapes of sewers design of sewers, self-cleansing velocity and slopes, construction and testing of sewers line, sewers materials, joints and appurtenances, maintenance of sewerage system.

Module IV (12 hours)

Wastewater Treatment: Objectives, methods and their sequence and efficiencies, primary treatment- screening, grit removal, scum removal, primary treatment, sedimentation, secondary biological treatment- trickling filter, circulation, activated sludge process: sludge digestion and disposal.

Module V (8 hours)

Waste Water Disposal and Reclamation and Reuse of Sewage: Disposal by dilution, Self- purification of surface water bodies, Oxygen sag curve, disposal by irrigation, sewage farming, sewage sickness, septic tank and its general features, working principle and design consideration: Inhoff tank, oxidation pond, aerated lagoon etc.

COURSE /LEARNING OUTCOMES

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

- CO1:** Define the importance of sanitation, need of a planned wastewater treatment and disposal system, appropriate treatment methods for municipal and certain industrial effluents, Operation of wastewater treatment plants. (Remembering)
- CO2:** Classify the chemical and biological principles behind unit processes used in water and wastewater treatment unit processes, explain unit operation and a unit process, the fundamental scientific processes underlying the design and operation of wastewater treatment plant self purification of streams. (Understanding)
- CO3:** Make use of the relevant equations to compute the storm water flow and the sewage flow for planning the sewerage system, gradient required for the sewers to maintain the self cleansing velocity and non scouring velocity pollution level of a system. (Applying)
- CO4:** Analyse the effluents from different sectors to conclude the type and level of treatment required for a system. (Analzing)
- CO5:** Assess the level of pollution in a system, and classify the pollutants. (Analzing)
- CO6:** Estimate the efficiency of treatment plants to discuss the requirement of modifications. (Evaluating)
- CO7:** Design unit operations and processes and pumping stations.(Creating)

Suggested Readings

1. BC Punmia, Wastewater Engineering, Laxmi Publications Pvt. Ltd.
2. Howard S. Peavy, Environmental Engineering , McGraw Hill
3. K. N Duggal, Elements of Environmental Engineering, S Chand And Company Ltd.
4. G.S Birdie, Water supply and Sanitary Engineering , Dhanpat Rai Publishing company

CVHW0031: HYDROLOGY AND WATERSHED MANAGEMENT

(4 credits — 60 hours)

Objectives: *This course deals with key features of hydrological science including precipitation data analysis, rainfall – runoff analysis, ground water hydrology, introduction to hydrographs and flood routing, hydrological design, risk analysis and uncertainty. It also familiarizes the students with important aspects of river engineering and flood management.*

Module I (12 Hours)

- a) Introduction: Hydrology- definition and scope, hydrologic cycle and its components.
- b) Precipitation: Forms, type and formation of precipitation, measurement of rainfall, analysis of rainfall data, correction of deficiencies in rainfall data, double mass curve, average rainfall over area, DAD analysis
- c) Evaporation: Definition, factors affecting, measurement (Class A pan). Estimation using empirical methods (Meyer's and Rohwer's equation), Evaporation control. Evapo-transpiration- Definition, factors affecting, measurement, estimation (Blaney Criddle method) Infiltration - Definition, factors affecting, measurement (double ring infiltrometer), infiltration indices, Horton's equation of Infiltration

Module II (22 Hours)

- a) Stream gauging, measurement of stream stage, estimation and measurement of stream discharge, rating curve.
- b) Runoff, Hydrograph and Flood routing: Runoff components, factors affecting runoff, hydrograph and its components, base flow separation, Use of rational method, hydrograph method, unit hydrograph– concept, derivation, limitations and use, S- hydrograph and its uses.
- c) Definition of Flood Routing, storage equation, reservoir routing and channel routing, Hydrologic models, Frequency Analysis and Frequency Distribution Models, Rainfall Intensity-Duration and Frequency (Return Period) Relationships. Time Series analysis, determination of trend component, periodic component and stochastic component

Module III (7 Hours)

Ground Water hydrology: Occurrence of groundwater, soil-water relationship, Aquifers, movement of groundwater, Darcy's law, yield from wells for confined and unconfined aquifers, yield of an open well.

Module IV (12 Hours)

- a) Flood Management and River Engineering: Basics of river engineering, river survey, protection by embankment, dyke, bank protection, types of bank protection and channel improvement works.
- b) Flood control methods: Structural and nonstructural measures, flood plain Zoning, flood disaster monitoring and mitigation procedure, methods of forecasting, engineering methods for flood fighting.

Module V (7 Hours)

Soil erosion process, types of erosion, factors affecting erosion, assessment of erosion, modelling erosion using USLE, RUSLE Methods of controlling soil erosion by vegetative practice, mechanical practice, erosion control in torrents and gullies, soil conservation practices

COURSE /LEARNING OUTCOMES

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

- CO1:** Define various stages of hydrologic cycle, hydrograph, unit hydrograph, routing etc; list various river training works; show Darcy's law; name different types of soil erosion. (Remembering)
- CO2:** Explain various aspects of precipitation, evaporation and evapotranspiration; illustrate the methods for separating base flow from flood hydrograph; interpret the different applications of unit hydrograph theory; explain the theory of flood routing and compare between reservoir routing channel routing. (Understanding)
- CO3:** Analyse problems related to precipitation, infiltration and other abstractions, hydrographs, groundwater hydrology, routing etc; compare different techniques of flood routing; identify different models of soil erosion. (Applying)
- CO4:** Determine average precipitation depth for a catchment, infiltration capacity from Horton's equation etc; solve problems related to flood hydrographs and unit hydrographs; predict the flood hydrograph for a reservoir or a river reach by routing techniques; find out various parameters related to groundwater flow. (Analysing)
- CO5:** Decide which method to select for a particular hydrologic analysis and examine their suitability. (Evaluating)
- CO6:** Combine the concepts of surface hydrology with groundwater hydrology and conclude that for proper management of watersheds hydrologic analysis is critical. (Creating)

Suggested Readings

1. K Subramanya, "Engineering Hydrology", Tata McGraw-Hill
2. S. K. Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers
3. S.N. Ghosh, "Flood Control and Drainage Engineering"
4. G. Das, "Hydrology and soil Conservation Engineering".

CVCE0032: ESTIMATION AND COSTING

(4 credits — 60 hours)

Objectives: This subject will introduce the students to the basics of estimation of quantity and cost of civil engineering projects including the methods of tendering and contracting. It also deals with the valuation of properties.

Module I (8 hours)

- a) Introduction: Purpose and types of estimates, standard methods of estimating
- b) Specification: Aims of specification, types, open specification, general specification of different class buildings, detail specification of various items of works

Module II (24 hours)

- a) Building estimate: Methods of building estimate, items of work, estimate of earthwork, P.C.C., R.C.C. brickwork, opening, flooring, finishing, roofing, plumbing
- b) Road estimate: Estimate of earthwork for different roads, estimate of new road, railway track, culverts, bridges

Module III (6 hours)

- a) Rate analysis: Purpose, factors affecting rate analysis, overhead costs, rate analysis of material, rate analysis of labour for different items

- b) Schedule of rates: Assam schedule of rates, CPWD schedule of rates, schedule of rates for different items, carriage, bill of quantities

Module IV (16 hours)

- a) Introduction to valuation: Purpose, income, outgoings, scrap value, salvage value, market value, book value, capitalized value, sinking fund, year's purchase, depreciation, obsolescence, annuity
- b) Valuation process: Present day cost, different methods of valuation, valuation according to purpose
- c) Lease and rent: Mortgage lease, types of lease, valuation of leasehold properties, types of rent, security, rate statement, rate fixation for government buildings

Module V (6 hours)

Tendering and contract: Tendering - purpose and methods, types of tenders, specifications, notice inviting tender, prequalification, pretender conference, tender documents, acceptance and selection criteria, elements of contract as per India contract Act 1872, types of contracting systems, sub-contract, contract law, disputes and arbitrations

COURSE /LEARNING OUTCOMES

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

- CO1:** Define, Choose and Estimate the quantities of civil engineering materials required in a particular project and the cost of the project and conduct property valuation and tendering process. (Remembering, Understanding)
- CO2:** Demonstrate and outline managerial functions like planning, organizing, staffing, leading & controlling a construction project. (Applying)
- CO3:** Comprehend detailed report on estimation and valuation process. (Applying)
- CO4:** Examine logical thoughts and prepare the rate analysis and bills. (Analysing)
- CO5:** Assess various cost effective approaches for civil engineering projects and Analyse the rate of materials and labour required in the work and hence estimation of the cost involved. (Evaluating)
- CO6:** Estimate and evaluate the cost of expenditure and prepare a detailed rate analysis report. (Creating)

Suggested Readings

1. Prof. B.N.Dutta, Estimation and Costing in Civil Engineering, UBS Publishers' Distribution (P) Ltd.
2. M. Chakraborti, Estimating, Costing, Specification and Valuation in Civil Engineering, Self-Published
3. Prof V.N. Vazirani and S.P. Chandola, Civil Engineering Estimating, Costing and Valuation, Khanna Publishers
4. G. S. Birdie, Textbook of Estimating and Costing, Dhanpat Rai Publications

CVIG0033: IRRIGATION ENGINEERING

(4 credits — 60 hours)

Objectives: This course emphasizes in providing a comprehensive knowledge of different irrigation practices needed by civil engineers. It provides information about different irrigation activities, their application and advantages. The course further deals with theory and design of different hydrological structures. Further it briefly discusses about important soil - water relationship.

Module I (14 Hours)

Introduction: Definition, necessity, benefits, ill effects of irrigation, types and different methods of irrigation and their application, major irrigation projects in India

Module II (20 Hours)

Soil water-plant relationship and water requirement of crops: Soil water classifications, field capacity, wilting point, available moisture, soil fertility manure and fertilizer, crop rotation, functions of soil water, crop seasons, consumptive use – evapotranspiration, measurements, command area, delta, duty, base period kor depth, kor period, irrigation requirements, depth and frequency of irrigation, factors affecting water requirements, principal crops of India, irrigation efficiencies

Module III (18 Hours)

- a) Canal design: Canal section and bed slope, design of lined and rigid boundary canal – Manning’s equation, design of alluvial canals – Kennedy’s and Lacey’s silt theories, their limitations
- b) Canal headworks: Basic of layout and components of storage and diversion head works, concept of weirs, barrage, spillways and head regulator, sill excluder
- c) Regulation works: Canal falls – necessity, location and various types
- d) Cross drainage works: Necessity, types – aqueducts, super passages, level crossing, selection of suitable types

Module IV (8 Hours)

Soil properties and fertility and land reclamation: Land reclamation, soil characteristics, characteristics and factors affecting fertility of soils, purposes, methods, description of land and reclamation processes

COURSE /LEARNING OUTCOMES

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

- CO1:** Define irrigation, various terminologies like field capacity, wilting point, crop rotation, command area, duty, delta etc; recognize the principal crops in India; classify different irrigation efficiencies. (Remembering)
- CO2:** Explain the consumptive use of water; illustrate different land reclamation processes; classify different methods for canal design and demonstrate the use and necessity of different irrigation/hydraulic structures. (Understanding)
- CO3:** Apply Kennedy’s and Lacey’s method for the design of irrigation canal; (Applying)
- CO4:** Analyse different numerical problems related to soil water-plant relationship and water requirements of crops; compare the different design methods for designing irrigation canals. (Analysing)
- CO5:** Evaluate the factors leading to the assessment of water power potential and layout of a hydel plant. (Evaluating)
- CO6:** Discuss the different concepts of irrigation engineering to get an overall idea related to the various challenges that need to be addressed for designing an efficient irrigation system. (Creating)

Suggested Readings

1. N. N Basak, Irrigation Engineering, Tata McGraw Hills Education
2. S. R Sahasrabudhe, Irrigation Engineering, Katson Books
3. S. K. Garg, Irrigation Engineering and Hydraulic Structures, Khanna Publishers

CVEG0034: EARTHQUAKE ENGINEERING

(4 credits — 60 hours)

Objectives: *The main objective of this course is to illustrate the fundamentals of structural and soil dynamics so as to foresee the potential consequences of strong earthquakes on urban areas and civil infrastructure. The course deals with the problems and solutions in attaining efficient earthquake-resistant structures and facilities. This course will be a stepping stone towards designing, constructing and maintaining structures to perform at earthquake exposure up to the expectations and in compliance with building codes.*

Module I (8 Hours)

Introduction: Earthquake - magnitude and intensity, ground motions, wave propagation parameters - peak ground acceleration, velocity and displacement, epicentre and hypocentre, focus of earthquake, recording of ground motions - sensors

Module II: Analysis and design for earthquake effects (14 Hours)

- a) Structural dynamics – SDOF systems, equation of motions, free and forced vibrations, damping, response spectrum, MDOF systems
- b) Earthquake analysis - idealization of structures, equivalent force concepts, equivalent seismic lateral loads using seismic coefficient method, response spectrum analysis, use of IS 1893-2002 for analysis and design of building structures
- c) Introduction to seismic design of bridges, dams, industrial structures and retaining walls

Module III: Earthquake resistant construction (22 Hours)

- a) Earthquake resistant design philosophy, concept of ductility in structures, ductile detailing requirements, codal provisions for ductile detailing (specific reference to IS: 13920-1993), specific reference to IS: 4326 for earthquake resistant construction of non-engineered buildings
- b) Earthquake behaviour of buildings, soft storey effect in RC multistoried buildings, earthquake behaviour of masonry structures, repair and rehabilitation of RC structures, earthquake protection of non-structural elements in buildings

Module IV: Soil dynamics and soil structure interaction (10 hours)

Introduction of soil structure interaction (SSI), its effects and modeling, theory of soil liquefaction, liquefaction potential, criteria for liquefaction, factors affecting liquefaction, evaluation of zone and resistance against liquefaction: Seed and Idriss (1971) method, examples, anti-liquefaction measures

Module V (6 hours)

Earthquake risk mitigation: Earthquake risk mitigation, earthquake policy and disaster mitigation - review of damage during past earthquake natural disaster mitigation, lessons from past disasters, social and economic aspects, preparedness, public policies and role of engineers, strategies for quality control, vulnerability assessment of structures, retrofitting and strengthening of buildings and bridges, seismic micro- zonation

COURSE /LEARNING OUTCOMES

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

- CO1:** Define the basics of engineering Seismology and concepts of theory of vibrations. (Remembering)

- CO2:** Explain the earthquake behaviour of buildings; illustrate the detailing requirements of buildings for earthquake resistant construction; classify the methods of dynamic analysis and translate the analytical outputs into risk mitigation strategies. (Understanding)
- CO3:** Solve the equations of dynamic motions to compute the magnitude of ground vibrations; predict the liquefaction potential of soil; apply earthquake analysis methods as per Indian Standard Codes to find out the response spectrum of structures viz. buildings, bridges, dams, retaining walls, industrial structures. (Applying)
- CO4:** Identify the codal provisions for ductile detailing of structures; compare the earthquake policies and strategies for quality control. (Applying, Analysing)
- CO5:** Evaluate the seismic behaviour of engineered and non-engineered structures; combine and summarize the concepts of retrofitting and strengthening the existing structures. (Evaluating)
- CO6:** Estimate the seismic performance of building with respect to damage pattern. (Creating)

Suggested Readings

1. Manish Shrikhande and Pankaj, Earthquake Resistant Design of Structures, Phi Learning, 2006
2. Vinod Hosur, Earthquake-Resistant Design of Building Structures, Wiley and Sons
3. Anil K. Chopra, Dynamics of Structures Theory and Application to Earthquake Engineering, Pearson Education Singapore Pte Ltd.
4. Sekaran Rajasekaran, Structural Dynamics of Earthquake Engineering: Theory and Application, Woodhead Publishing Limited

CVTE0035: TRANSPORTATION ENGINEERING II

(4 credits — 60 hours)

Objectives: This course is in continuation with the course of Transportation Engineering I with prime focus on various aspects of different modes of transportation like railways, airways and waterways. On completion a student should be competent enough in the planning and design of railways, airport and harbour engineering.

Module I: Introduction to railways, its component parts and its function (16 hours)

Introduction with various aspects of railway engineering, permanent way component parts and its functions, various types of rails, functions, creep in rails, creep measurement, coning of wheels, rail fixations, sleepers - various types, merits and demerits, ballast – various types and subgrade preparation

Module II: Railway alignment and geometric design (14 hours)

Alignment, superelevation, negative superelevation, cant deficiency, example problems, points and crossings, layout of left hand and right hand turnouts, construction and maintenance of permanent way, appurtenant works, containerization

Module III: Airport engineering (12 hours)

Introduction to air transportation, history and international organizations role in development of airports, aircraft types and its characteristics, general layout of an airport and its component parts, site selection of airports as per ICAO, orientation of runway by wind rose diagrams, basic runway length determination, corrections to basic runway length, geometric design, types of airports as per landing and take-off and dimensions

Module IV: Water transportation (12 hours)

Introduction: inland water and ocean water transportation, purpose, classification and salient features of harbours, ports and docks, layout of a harbour, requirements of a good port, typical construction of a dock, break waters – necessity, vertical wall and mound breakwaters

Module V: Introduction to tunneling (6 hours)

Necessity of tunnels, classification, alignment and surveys, various methods of tunneling, tunnel lining, ventilation and drainage in tunnels

COURSE /LEARNING OUTCOMES

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

- CO1:** State the various components of railway engineering, airport engineering, water transportation as well as tunneling methods. (Remembering)
- CO2:** Illustrate the various elements of geometric design of railways. (Understanding)
- CO3:** Perform orientation of runways of an airport using the wind rose diagram. (Applying)
- CO4:** Analyse the layout of a port, dock and a harbor and differentiate between vertical wall and mound breakwaters. (Analysing)
- CO5:** Assess the role of various modes of transportation, their utilities and the importance of each type. (Evaluating)
- CO6:** Assemble the various methods of tunneling and classify the different types of tunnels. (Creating)

Suggested Readings

1. S. P. Arora, S. C. Saxena, A Textbook of Railway Engineering, Dhanpat Rai Publications
2. S. Chandra and M. M. Agarwal, Railway Engineering, University Press, New Delhi
3. S. C. Rangwala, Principles of Railway Engineering, Charotar Publishing House Pvt. Ltd.
4. S. K. Khanna, M. G. Arora and S. S. Jain, Airport Planning and Design, Nem Chand and Bros. Roorkee
5. R. Horonjeff and F. X. McKelvey, Planning and Design of Airports, McGraw-Hill
6. H. P. Oza and G. H. Oza, Dock and Harbour Engineering, Charotar Publishing House Pvt. Ltd

CVGO0036: ELEMENTS OF GEOINFORMATICS

(3 credits — 45 hours)

Objectives: *This elective course is designed to familiarize the students with the modern tools of Geoinformatics viz., remote sensing (RS) and geographical information system (GIS) which are useful for analysis and interpretation of occurrences on the earth's surface. Satellite remote sensing in optical bands has been introduced in more detail. Foundation of GIS will help the students to go ahead for using this tool in decision making and Bio-physical modelling.*

Module I: Basics of Geoinformatics (8 hours)

- a) Map basics: definition of map and fundamental characteristics, types of map, scale of a map and its representations, map projection – meaning, types and characteristics of each
- b) Coordinates system: geoid and reference ellipsoid, geographic coordinate system - projected coordinate, DEM - meaning and use, geo-referencing of map and image - its meaning and necessity, global positioning system (GPS) - important features and use

Module II: Foundation of remote sensing (10 hours)

- a) Basics - definition, remote sensing system, passive and active remote sensing, electromagnetic spectrum, atmospheric window, relevant radiation principles, Stefan – Boltzmann law, Wien's displacement law, interaction of EMR with atmosphere and earth surface features, spectral signature, atmospheric and geometric influence of spectral response patterns
- b) Data acquisition and visual interpretation: types of satellites, characteristic differences of optical and microwave data, multi-spectral and hyper-spectral data, data acquisition in optical bands - along track and across track scanning, examples of LANDSAT, SPOT and IRS, data acquisition in microwave bands, advantages and limitations - salient features of few satellites with microwave sensors such as RISAT, ERS etc., types of multi- spectral data products, hard copy and digital image (panchromatic, true colour and FCC etc.) visual interpretation of image - important keys, ground truth verification

Module III: Digital analysis and interpretation of satellite image (17 hours)

- a) Introduction to the broad types of computer assisted operators
- b) Image rectification and restoration - geometric correction, resampling using nearest neighbour, bilinear interpolation and cubic convolution, radiometric correction due to sun elevation and earth-sun distance, noise removal
- c) Image enhancements – level slicing, contrast stretching, spatial filtering, convolution, edge enhancements, and spectral ratios, vegetation indices
- d) Image classification - supervised, unsupervised and hybrid
 - i) Supervised classification: Minimum distance, parallelepiped and maximum likelihood classification
 - ii) Unsupervised: K means classifier, fuzzy classification of mixed pixels, classification using A.N.N.
 - iii) Classification accuracy assessment - error matrix, producer's accuracy, user's accuracy, KHAT index
 - iv) Data merging - multi-temporal merging, multi-sensor data merging, change detection procedures, biophysical modelling

Module IV: Introduction to geographic information system (GIS) (10 hours)

Definition of GIS, comparison of GIS with CAD, GIS architecture, components of a GIS –hardware, software, data, people, methods, GIS data type – spatial and attribute, spatial data types – point, line and polygon, raster and vector representation of data GIS workflow diagram with explanation, fundamental operation of GIS, application of GIS – few examples

COURSE /LEARNING OUTCOMES

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

- CO1:** Define the different types of maps, coordinate systems and recognize the importance and ease of surveying using remote sensing. (Remembering)
- CO2:** Classify different types of remote sensing. Students are able to illustrate the principles and different laws involved in the study of electromagnetic radiations. (Understanding)
- CO3:** Identify the hardware and software requirements for GIS analysis. (Applying)
- CO4:** Compare the various methods of digital analysis and interpret the satellite image. (Analysing)

- CO5:** Evaluate the utilities of surveying using information technology compared to the traditional methods. (Evaluating)
- CO6:** Modify the data obtained from various remote sensing sources to *formulate* the map of an area and utilize the same for various planning and other related works. (Creating)

Suggested Readings

1. T.M. Lillisand and R.W. Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, New York
2. Satheesh Gopi, R. Sathikumar, N. Madhu, Advanced Surveying – Total Station, GIS and Remote Sensing, Pearson Education
3. Paul Longely, M.F. Goodchild, et al., Geographical Information System, Volume I and II, John Wiley and Sons, Inc. 1999
4. J. B. Cambell, Introduction to Remote Sensing, Taylor and Francis, London, 1996
5. F.F. Sabins, Remote Sensing: Principles and Interpretation, W.H. Freeman and Company, New York, 1997
6. Jensen, J.R., Remote Sensing of the Environment – An Earth Resources Perspective, Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi, 2000
7. George Joseph, Fundamentals of Remote Sensing, Universities press (India) Pte Ltd., Hyderabad, 2003

CVOF0037: OPEN CHANNEL FLOW

(Credits — 45 hours)

Objectives: *This course provides a basic understanding of the flow of water in open channels which is highly essential in planning, design and operation of water resource systems such as single and multi-purpose river valley development projects for irrigation, flood control, power generation etc.*

Module I (20 Hours)

- a) Basic principles : Open channel, types and section elements, classification of flow, basic equations, velocity co efficient, pressure distribution and specific force
- b) Uniform flow in rigid boundary channels : Boundary shear, flow over scattered roughness elements, Chezy's equation, Manning's equation, other resistance formulae, equivalent roughness, channel conveyance, section factor – curves for rectangular and trapezoidal channels, flow in a circular channel, relation between conveyance and depth

Module II (8 Hours)

Energy depth relationship : Specific energy, critical depth, specific energy curve, critical depth computation, control section, application of specific energy and critical depth concepts, channel transitions

Module III (10 Hours)

Gradually varied flow : Governing equation and its limitations, water surface profiles – classification and characteristics, flow profiles on mild, steep, critical, horizontal and adverse slopes, computation of G.V.F. in prismatic and non-prismatic channels by direct step method and by numerical method, delivery of channels

Module IV (7 Hours)

Rapidly varied flow-hydraulic jump : Types of jump, hydraulic jump in horizontal and sloping rectangular channels, location and length of jump on horizontal floor, forced hydraulic jump, jump in expanding rectangular channels, energy loss and application of hydraulic jump

COURSE /LEARNING OUTCOMES

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

- CO1:** Recall the various open channel flow equations, velocity coefficients, pressure distribution. (Remembering)
- CO2:** Explain the principles of mechanics of open surface flow of fluids, and be able to express these in terms of mathematics. (Understanding)
- CO3:** Solve problems in uniform, gradually and rapidly varied flows in steady state. (Applying)
- CO4:** Analyse problems associated with flow of water in streams and canals. (Analysing)
- CO5:** Evaluate different situations involving free-surface flows with regard to flow conditions, water depth, water velocity, forces etc. (Evaluating)
- CO6:** Design canals and associated structures, and adapt research in the field. (Creating)

Suggested Readings

1. K. Subramanya, Flow In Open Channels 3rd Edition, Tata McGraw Hill Education Private Limited
2. M. M. Das, Open Channel Flow, PHI Learning Private Limited
3. Rajesh Srivastava, Flow through Open Channels, Oxford University Press

CVDS0038: DESIGN OF STRUCTURES III

(5 credits - 75 hours)

Objectives: *This is the third course of design of structures which deals with the concepts of analysis and design of some advanced R.C.C and steel structures viz. bridges, prestressed concrete, overhead water tanks, girders, industrial buildings and tubular structures.*

Module I (30 hours)

- a) General consideration of bridges: Types of bridges, economic spans, selection of suitable types of bridges
- b) Loads and their distribution: IRC loads, Railway loads, military loading classes, analysis of deck slab for wheel loads, load distribution among various longitudinal beams of a bridge
- c) Design of super-structure: R.C.C. Tee Beam Bridge, balanced cantilever bridge, Pratt truss steel bridge
- d) Design of sub-structure: Various types of bearing and design, different types of foundation design

Module II (20 hours)

- a) Prestressed concrete: Concept of Prestressing materials for Prestressed concrete, I.S. specifications; Analysis of Prestressed-resultant stress at section, Thrust line, load balancing concept, stress in tendons, Design of simple section
- b) Deflection of prestressed concrete Beams: Factors influencing deflection, Deflection of uncracked and cracked members, Long time deflection, codal practices
- c) Design of prestressed concrete sections: Design for flexure, shear, axial force, bond and bearing. Design of pre-tensioned members
- d) Transfer of prestress: Transfer by bond, transmission length, code provision for bond and Transmission length

Module III (13 hours)

Water Tank: Circular and rectangular tanks, Intze type tank, column-brace type staging; Elevated steel water tank: Rectangular pressed steel tank, staging and footing

Module IV (12 hours)

Plate girder and gantry girder; Industrial Building: Elements of an industrial building, structural framing, Bracing; Tubular structures: Behaviour of tubular sections, combined stresses and connections

COURSE /LEARNING OUTCOMES

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

- CO1:** Define and classify the different types of bridges, water tanks, pre-stressed concrete structures, industrial buildings and tubular structures; state their suitability and define the various classes of loading acting on these structures. (Remembering)
- CO2:** Classify and compare between pre-tensioned and post-tensioned concrete; explain the suitability of different types of bridges, tubular structures, RCC tanks and steel tanks; illustrate the different elements of bridges and industrial buildings (Understanding)
- CO3:** Apply the standard methodologies as per IS Codes to predict the response of pre-stressed concrete, bridge girders, water tanks under different classes of loads; compute the bending moments and shear forces at different sections of these structures. (Applying)
- CO4:** Analyse the super-structure and sub-structure of RCC bridges and pre-stressed concrete beams under various loadings; identify their deflection patterns; and point out the factors influencing their design. (Analysing)
- CO5:** Evaluate the structural design of these structures to determine the reinforcement required for an economic design; assess the performance of these structures by examining the serviceability of these structures. (Evaluating)
- CO6:** Estimate the analytical results and combine those outputs to carry out an organized structural design of those structures; conclude the structural design with necessary diagrams of bending, shear and axial forces. (Creating)

Suggested Readings

1. N. Krishna Raju, Design of Bridges, 4th Edition, Oxford and Ibh Publishing Co. Pvt. Ltd
2. Jagadeesh and Jayram, Design of Bridge Structures, PHI Learning Private Ltd
3. Johnson Victor, Essentials of Bridge Engineering, 6th Edition, Oxford and Ibh Publishing Co. Pvt. Ltd
4. G. S. Pandit, Prestressed Concrete 1st Edition, CBS Publisher
5. N. Rajagopalan, Prestressed Concrete, Narosa Book Distributors Pvt. Ltd
6. Naaman A. E., Prestressed Concrete Analysis and Design Fundamentals, McGraw Hill
7. S. Ramamrutham, Prestressed Concrete, Dhanpat Rai Publishing Company
8. Ram Chandra, Design of Steel Structures (Volume I and 2), Standard Book House-Delhi
9. S. Ramamrutham, Design of Steel Structures, Dhanpat Rai Publishing Company
10. S. Ramamrutham, Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company

CVWE0039: WATER RESOURCES ENGINEERING**(4 credits — 60 hours)**

Objectives: *This course comprehensively offers a broad coverage of pertinent topics concerning water resource engineering and combines the fundamentals of hydrology and hydraulic structures, river engineering and river training works together with a basic insight into water power engineering.*

Module I (20 hours)

- a) Introduction: Fields of water resources engineering; problems of water resources engineering, economics in water resources engineering, Social aspects of water resources engineering, planning of water resources projects, the future of water resources engineering.
- b) Reservoirs: Purpose, physical characteristics of reservoir, storage capacity determination from the site, reservoir site selection, life storage capacity by mass curve method, reservoir sedimentation, trap efficiency, distribution of sediment in a reservoir, useful life of reservoir, reservoir operation, reservoir sedimentation control, reservoir yield, economic height of a dam, reservoir working table
- c) Dams and embankments: Elements of gravity, arch and earth dams, selection of sites, stability analysis, embankments – materials of construction, typical sections, effectiveness and side effects.

Module II (20 hours)

- a) Introduction to River Engineering: Types of rivers-Perennial, flushy and virgin rivers; incised, boulder, flood plain, delta and tidal rivers; aggrading, degrading, meandering and braided rivers.
- b) Sediment transport: Sediments – bed load, suspended load and wash load; riverbank erosion, incipient motion, mode of sediment transport – rolling, sliding, saltation and suspension; introduction to theories of sediment transport including Shield's Theory.
- c) Regimes of flow: Definition, description of regimes of flow: plane bed, ripples, dunes, transition and anti-dunes; prediction of regimes of flow
- d) River training: Definition, objectives, classification – high water, low water and mean water river training; river training works – marginal embankment, spurs, guide bank, porcupines, bank pitching and revetment, cut off, pitched island, sills and bottom paneling, bandalling

Module III (20 hours)

- a) Introduction to Water Power Engineering: Energy, work and power; water energy, hydropower and other powers, their relative merits, comparison of hydro, thermal and nuclear power
- b) Estimation of available power: Flow and power duration curves, firm power, secondary power, dump power, load distribution – base load, peak load factor, capacity factor, pondage, storage, mass curve – determination of reservoir yield and capacity.
- c) Types of hydropower plants: High, medium and low head plants; runoff river plants, storage plants, diversion canal plants, pumped storage plants, tidal power plants; base load and peak load plants; concentrated fall and divided fall developments, components of hydropower schemes, general layout of hydropower plan with all its components
- d) Water Conveyance: Intakes – types, trash rack, control gates; canals, fore bay, tunnels, pipes
- e) Penstock: Design criteria, economic diameter, anchor, blocks, water hammer analysis – Allievi's equation, resonance

- f) Surge Tanks: Functions, types, design criteria, stability analysis
- g) Power House: Components, general layout – surface and underground power houses

COURSE /LEARNING OUTCOMES

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

- CO1:** Relate the basic fundamental concepts of water resources engineering with respect to a wide range of interdisciplinary subjects like hydrology, river engineering and hydraulic structures. (Remembering)
- CO2:** Illustrate the different forces, moments and stresses acting on hydraulic structures, determine the reservoir storage and yields as well as find the stresses that mobilize sediment transport. (Understanding)
- CO3:** Apply the standard design methodologies to design the hydraulic structures, apply the analytical and graphical concepts of mass curve for reservoir storage and yields as well as apply the established theories that mobilize sediment transport. (Applying)
- CO4:** Analyse the different stability criteria of hydraulic structures. (Analysing)
- CO5:** Evaluate the safe and economical design of various water resources projects, compute electrical power in reservoirs from storage and yield criteria. (Evaluating)
- CO6:** Compose the theoretical results from detailed design of hydraulic structures and combine those outputs to carry out an organized design of such structures and apply the theory of flow and power duration curves for hydroelectric power generation as well as preliminary application of benefit cost theories with respect to water resources projects. (Creating)

Suggested Readings

1. Larry W. Mays, Water Resources Engineering, Wiley India Pvt Ltd
2. P.N. Modi, Irrigation Water Resources and Water Power Engineering 7th Edition, Standard Publishers Distributors
3. K R Arora, Irrigation Water Power And Water Resource Engineering, Standard Publishers Distributors
4. B. C. Punmia, Irrigation and Water Power Engineering, Laxmi Publications
5. S. K. Garg, Hydrology and Water Resources Engineering, Khanna Publishers

CVCM0040: CONSTRUCTION MANAGEMENT

(2 credits — 30 hours)

Objectives: *The main aim of this paper is to give the students basic knowledge about management related to execution of civil engineering projects, contracts, work networks, equipment, etc. which are very essential from a practical point of view.*

Module I (5 hours)

Introduction to construction management: Construction industry and its practices. Civil Engineering and management as business management, construction management and sustainability, methodology of system design and techniques in construction

Module II (15 hours)

Construction Planning and Management: Introduction to bar charts and its limitations, Time, Cost and research management of projects for planning, Scheduling, Control and forecasting using networks with CPM/PERT, Probabilistic assessment of project completion time, introduction to risk management and safety engineering in construction

Module III (10 hours)

Role of equipment in modern construction industries: Selection, Planning and Cost of equipment, Earthmoving, Excavating, Hauling, Compacting, Drilling and Blasting, Grouting, Conveying and Dewatering equipment, intensive constructions, typical and special equipment for civil engineering structures such as-roads, bridge, multistoried buildings and towers

COURSE /LEARNING OUTCOMES

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

- CO1:** Recognize the different construction projects and its practices , define different stages and functions in a construction project , importance of managing and organizing different categories of employees working together, their safety, cost and time management in completion of a construction project. (Remembering)
- CO2:** Illustrate how to manage a company by following different procedures such as planning, scheduling, organizing, controlling etc., and explain the different stages through which a project should pass such as conception, design, and realization, and *Analyse* the Importance of safety and the different equipment used such as crawlers, cranes, draglines etc. (Understanding, Analysing)
- CO3:** Examine and Organize manpower at various levels as per their expertise. (Applying)
- CO4:** Make use of different network techniques which are effective tools for the execution of a civil engineering project such as CPM (Critical Path Method), PERT (Program Evaluation and Review Technique) and implement the bar chart and their limitations. (Applying)
- CO5:** Determine the best possible approach and technique to carry out the project, how to manage the work and the importance of supervising the work regularly, handle situations of disputes which may arise for smooth working and completion of the project within the specified time and the stipulated cost. (Evaluating)
- CO6:** Give an overview of the whole construction process and How to *maximize* the resource efficiently through procurement of labor, material and equipment and *develop* an understanding of effective leadership skills and management of employees, areas of technical expertise and interest. (Creating)

Suggested Readings

1. B. M. Dhir and P.S. Gahlot, Construction Planning and Management, P. S. New Age International Publisher
2. Prof. Harbhajan Singh, Construction Project Management, ISBN: 978818247386; Jain Book Agency
3. Dr. B.C. Punmia, Project Planning And Control With PERT And CPM; Laxmi Publications
4. M. R. Sharma, Fundamentals of Construction Planning and Management; S.K. Kataria and Sons
5. D. Lal, Construction Management and P.W.D. Accounts; S.K. Kataria and Sons

CVDM0041: DISASTER MANAGEMENT

(3 credits-45 hours)

Objective: *This course provides the students with a broad understanding of various disasters which they will come across throughout their engineering career and to familiarize them with the role of Civil Engineers in tackling the disasters for avoiding catastrophe.*

Module I (12 hours)

- a) Definition and description of disaster, hazard, emergency, vulnerability, risk and disaster management; Identification and description of the types of natural and manmade disasters, important phases of Disaster Management Cycle
- b) Natural Hazards: causes, distribution pattern, consequences and mitigation measures for earthquake, tsunami, cyclone, flood, landslide, drought
- c) Man-made hazards: causes, consequences, mitigation measures for various industrial hazards/disasters
- d) Inter-relationship between Disasters and Development: Factors affecting vulnerabilities, Impacts (including social, economic, political, environmental, health, psychosocial); Differential impacts - in terms of caste, class, gender, age, location, disability; impact of development projects such as dams, embankments, changes in land-use, etc.

Module II (24 hours)

Construction of infrastructure with high natural disaster resistance

- a) Flooding resistance: Water tight building construction, building elevation, dry flood proofing, wet flood proofing and use of flood walls
- b) Earth quake resistance: Use of energy dissipating devices, Braced structure frames, Moment resisting frames, Base Isolation
- c) Hurricane and Typhoon resistance: Use of hurricane straps to strengthen connections, Impact resistant doors and windows, Braced roof trusses and cables
- d) Land-slide resistance: Soil reinforcement using geosynthetic materials, construction channels, drainage systems, deflection systems, deflection walls
- e) Retrofitting of structures in post disaster situation: Retrofit of non-engineered building, historic buildings, bridges and buildings

Module III (4 hours)

Case Studies: Lessons and experiences from various important disasters with specific reference to Civil Engineering

Module IV (5 hours)

Preparedness for natural disasters in urban areas, Disaster planning in public health

COURSE /LEARNING OUTCOMES

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

- CO1:** Develop an understanding of the key concepts, definitions and key perspectives of all disaster management.
- CO2:** Understanding foundations of hazards, disasters and associated natural/social phenomena.
- CO3:** Develop a basic understanding of Prevention, Mitigation, Preparedness, Response and Recovery.
- CO4:** Distinguish between the different approaches needed to manage pre- during and post- disaster periods.
- CO5:** Affirm the usefulness of integrating management principles in disaster mitigation work.
- CO6:** Experience conducting independent Disaster Management study including data search, analysis and presentation of disaster case study.

Suggested Readings

1. Dr. Indu Prakash, 1994, Disaster Management, Rastriya Prahari Prakashan, Sahibabad, Ghaziabad.
2. Dr. Jagbir Singh, Disaster Management Future Challenges and Opportunities, I.K. International
3. Arvind Kumar, Disaster Management-Recent Approaches, Anmol Publications
4. V. K. Sharma (Editor), 1995, Disaster Management, Indian Institute of Public Administration, New Delhi.
5. U.R. Rao, Space Technology for Sustainable Development, Tata McGraw Hill.
6. S.B. Verma, Risk Management, Jain Book Depot
7. Mohiuddin Ali Khan, Earthquake-Resistant Structures: Design, Build, and Retrofit. Butterworth-Heinemann.

CVAF0042: ADVANCED FOUNDATION ENGINEERING

(3 credits - 45 hours)

***Objective:** This subject is in continuation with the courses of geotechnical engineering offered in the previous semester and mainly deals with the geotechnical proportioning as well as structural design of various deep and shallow foundation structures as per the Indian Standard Codal provisions.*

Module I Foundation Design-General Principles (5 Hours)

Types of foundations and selection of type of foundation, basic requirements of a foundation, computation of loads, design steps

Module II Shallow Foundation (20 Hours)

- a) Determination of allowable bearing pressure of footings in clay and sand soil, Proportioning of single isolated footing, considerations for proportioning of groups of footings for equal settlements, Structural design of strip footings, isolated footings, combined footings: rectangular and trapezoidal
- b) Raft in clay and sand, Suitability for raft, determination of safe bearing capacity and allowable bearing pressure, Structural design of raft by conventional (rigid) method as per IS: code of practice

Module III Pile Foundation (12 Hours)

Determination of allowable load on single pile and pile groups in clay and sand, pile group proportioning, Structural design of pile, pile groups and pile cap, Introduction to micro piles and laterally loaded piles

Module IV Elements of Bridge Substructure (8 Hours)

Forces on bridge substructure (IRC and IRS specification), well foundation with components only, design considerations for different components of a well foundation

COURSE/LEARNING OUTCOMES

On completion of the course the students will be able to:

- CO1:** Define the geotechnical proportioning and the structural design of various foundation structures. (Remembering)
- CO2:** Explain the different types of foundations that are used in design of structures like shallow foundations and deep foundations, and the elements of bridge substructures like well foundations. (Understanding)
- CO3:** Demonstrate various types of shallow foundations, various types of deep foundations and well foundations which are required in bridge design. (Applying)

- CO4:** Analyse the various foundations, check whether they are safe by pointing out the deficiencies in the foundations in case the foundation turns out to be unsafe and to provide remedial measures and redesign procedures if the foundation fails after analysis. (Analysing)
- CO5:** Evaluate if a design is adequate, examine a foundation for any faults and defects and to judge whether a particular foundation design are sufficient for a given situation. (Evaluating)
- CO6:** Formulate solutions for the various problems and criticalities that are encountered while designing foundations, take up projects and pursue research involving design of foundations. (Creating)

Suggested Readings

1. S. Saran, Analysis and Design of Foundations, IK International Pvt. Ltd. New Delhi
2. P. C. Varghese, Design of Reinforced Concrete Foundations, Phi Learning Private Ltd.
3. Satyendra Mittal, Pile Foundations Design and Construction 1st Edition, CBS Publisher
4. Joseph E. Bowles, Foundation Analysis and Design, McGraw-Hill education India Pvt. Ltd- New Delhi

CVBC0043: BASICS OF COMPUTATIONAL HYDRAULICS

(3 Credits – 45 hours)

Objectives: *This course introduces the governing equations describing the flow and transport in surface and subsurface water systems, the application of finite difference methods for the solution of these governing equations and introduction to other numerical methods.*

Module I: Introduction to the governing equations of fluid flow (15 hours)

Concept of control volume and control mass/ system; Reynold's Transport Theorem; Derivation of continuity equation, momentum equation (Navier-Stokes equations) and energy equation for finite control volume and infinitesimally small fluid element fixed in space; Derivation of one-dimensional St. Venant equation to model open-channel flow; Derivation of flow equation in groundwater; Derivation of generalized contaminant transport equation in groundwater for both reactive and non-reactive transport.

Module II: Introduction to finite difference, finite volume and finite element methods (16 hours)

Classification of partial differential equations- hyperbolic, parabolic and elliptic differential equations; General behavior of different classes of partial differential equation; Finite difference methods: difference equations, explicit and implicit approaches, error and stability analysis of explicit and implicit techniques; Finite Volume Methods: Philosophy, discretization procedure; Finite element method: Rayleigh-Ritz, Collocation and Galerkin methods.

Module III: Application of Finite difference methods in CFD and fundamentals of modeling (14 hours)

- a) Application of Crank Nicholson technique, The Lax-Wendorff Technique and McCormack's Technique for the solution of Navier-Stokes equations and contaminant transport equation in groundwater and surface water
- b) Introduction to model calibration, validation and concept of coupled model, Introduction to numerical computation software.

COURSE /LEARNING OUTCOMES

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

- CO1:** Explain the one, two and three-dimensional flow equations and know when to use their approximations.

- CO2:** Classify partial differential equations (PDEs) and determine the nature of a given PDE.
- CO3:** Implement finite difference, finite volume and finite element methods to solve partial differential equations.
- CO4:** Analyse a numerical scheme for numerical diffusion, dispersion, stability and convergence.
- CO5:** Implement different numerical schemes for hydraulics related problems appearing in civil engineering.

Suggested Readings

1. J. D. Anderson, (1995), "Computational Fluid Dynamics - the Basics with applications", McGraw-Hill, Inc., New York.
2. J. D. Hoffman (2001), "Numerical methods for engineers and scientists", Marcel Dekker, Inc., New York.
3. F. M. White (2008) "Fluid Mechanics", Tata McGraw Hill.

CVTM0044: TRAFFIC ENGINEERING AND MANAGEMENT

(3 credits – 45 hours)

Objective: *This elective course is designed to familiarize the students with the concepts of traffic engineering by providing general concepts of planning, functional design, traffic operation and management of road transportation. Forecasting of traffic, probabilistic approach towards traffic flow theory, highway capacity and study of road accidents has been introduced in detail.*

Module I: Traffic Forecast and Transportation Demand Management (12 hours)

Traffic Forecast: General travel forecasting principles, Different methods of traffic forecast - Mechanical and Analytical methods, Demand relationships, Methods for future projection; Design Hourly Volume for Varying Demand Conditions: Concept of Design vehicle units and Determination of PCU under mixed traffic conditions, Price- volume relationships, Demand functions. Determination of design hourly volume; Critical Hour concept

Module II: Highway Capacity and Level of Service (7 hours)

Highway Capacity: Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalised intersections. Problems in Mixed Traffic flow; Case studies

Module III: Accident Studies (8 hours)

Accident Analysis: Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors influencing traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions.

Module IV: Traffic Flow Theory and Simulation (18 hours)

Traffic Flow Theory: Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications; Probabilistic Aspects of Traffic Flow: Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications; Simulation: Fundamental principle, application of simulation techniques in traffic engineering - formulation of simulation models, Case studies.

COURSE /LEARNING OUTCOMES

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

- CO1:** State the different methods of traffic forecasting.

- CO2:** Classify the various types of levels of service and their importance.
- CO3:** Compute the parameters of traffic flow as well as use them to simulate the traffic flow models.
- CO4:** Compare the various factors influencing traffic accidents.
- CO5:** Assemble the probabilistic and deterministic approach of traffic flow.
- CO6:** Evaluate and design hourly traffic volume to use for the geometric design of roads.

Suggested Readings

1. L.R. Kadiyali, "Traffic Engineering and Transport Planning", Khanna Publication.
2. C.J. Khisty and B.K. Lall, "Transportation Engineering: An Introduction" Prentice Hall Publication
3. G.V. Rao, "Transportation Engineering", Tata McGraw Hill.
4. S.K. Khanna and C.E.G. Justo, "Highway Engineering", Nem Chand and Bros, Roorkee.

CVES0046: ENERGY SCIENCE AND ENGINEERING

(2 credits -30 Hours) (L-T-P: 1-1-0)

Objective: The objective of this Course is to provide *an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternatives, renewable energy sources such as solar, biomass (conversions), wind power, waves and tidal, geothermal, ocean thermal, hydro and nuclear. Energy conservation methods will be emphasized* from Civil Engineering perspective. The knowledge acquired lays a good foundation for design of various civil engineering systems/ projects dealing with these energy generation paradigms in an efficient manner.

Module I (4 hours)

Introduction to Energy Science: Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the Environment.

Module II (6 Hours)

Energy Sources: Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) -past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries)

Module III (6 Hours)

Energy & Environment: Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy.

Module IV (7 Hours)

Civil Engineering Projects connected with the Energy Sources: Coal mining technologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations

above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems

Module V (7 Hours)

Engineering for Energy conservation: Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated);

LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

COURSE /LEARNING OUTCOMES

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

- CO1:** List and generally explain the main sources of energy and their primary applications nationally and internationally
- CO2:** Explain the energy sources and scientific concepts/principles behind them
- CO3:** Identify effect of using these sources on the environment and climate
- CO4:** Analyse the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.
- CO5:** Estimate the energy demands and make comparisons among energy uses, resources, and technologies.
- CO6:** Organize information on renewable energy technologies as a basis for further analysis and evaluation.
- CO7:** Understand the Engineering involved in projects utilizing these sources

Suggested Readings

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press
3. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaia
4. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waub, XVIII,
5. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. (2006) Energy and the Environment, 2nd Edition, John Wiley
6. UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment
7. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company Related papers published in international journals

CVGE0047: ENGINEERING GEOLOGY

(1 credit-15 Hours) (L-T-P: 1-0-0)

Objectives: The objective of this Course is to focus on the core activities of engineering geologists – site characterization and geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil

work projects and the quantification of processes such as rock slides, soil-slope stability, settlement, and liquefaction.

Module I (2 Hours)

Introduction-Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work-GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondary minerals.

Module II (4 Hours)

Petrology-Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology-Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone

Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.

Module III (1 Hour)

Physical Geology- Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits.

Module VI (2 Hours)

Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

Module V (2 Hours)

Geological Hazards- Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. . Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table

and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India.

Module VI (2 Hours)

Rock masses as construction material: Definition of Rock masses. Main features constituting rock mass. Main features that affects the quality of rock engineering and design. Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging .Rock Quality Designation. Rock mass description.

Module VII (1 Hour)

Geology of dam and reservoir site- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

Module VIII (1 Hour)

Rock Mechanics- Sub surface investigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and shear strength of rocks, Bearing capacity of rocks.

COURSE /LEARNING OUTCOMES

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

- CO1:** Study of physical properties and identification of minerals referred under theory. (Knowledge)
- CO2:** Categorize rocks and minerals by their origin and engineering properties. (Comprehension)
- CO3:** Identify the various rocks, minerals depending on geological classifications. (Comprehension/Evaluation)
- CO4:** Apply geological principles to rock masses and discontinuities for use in engineering design e.g. rock slopes, foundation. (Application)
- CO5:** Interpret geological maps showing tilted beds, faults, uniformities etc.(Analysis)
- CO6:** Measure strike and dip of the bedding planes.Application/Evaluation)

Suggested Readings

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).

CVDP0048: DISASTER PREPAREDNESS & PLANNING MANAGEMENT

2 Credits -30 Hours (L-T-P: 1-1-0)

Objectives: *The objectives of the course are to understand basic concepts in Disaster Management, definitions and terminologies used in Disaster Management, types and Categories of Disasters, the Challenges posed by Disasters and the Impacts of Disasters Key Skills*

Module I (2 Hours)

Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation).

Module II (8 Hours)

Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Module III (6 Hours)

Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Module IV (8 Hours)

Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post- disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Module V (6 Hours)

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land- use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

LEARNING/COURSE OUTCOMES

Upon successful completion of the course, the students will be able to:

- CO1:** Define the application of Disaster Concepts to Management. (Remembering)
- CO2:** Explain the Relationship between Development and Disasters. (Understanding)
- CO3:** Develop realization that they have responsibilities to society (applying)
- CO4:** Categorize the different types of Disasters. (Analysing)
- CO5:** Assess the disaster impacts and vulnerability to formulate the risk reduction (evaluating)
- CO6:** Formulate the and conduct disaster risk reduction and awareness programmes. (creating)

Suggested Readings

1. <http://ndma.gov.in/> (Home page of National Disaster Management Authority)
2. <http://www.ndmindia.nic.in/> (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003

7. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

CVFM0049: INTRODUCTION TO FLUID MECHANICS

(2 credits-30 Hours) (L-T-P:2-0-0)

Objectives: *The objective of this course is to introduce the concepts of fluid mechanics useful in Civil Engineering applications. The course provides a first level exposure to the students to fluid statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems. A training to analyse engineering problems involving fluids – such as those dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective is essential for the civil engineering students. The topics included in this course are aimed to prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics, hydraulic machinery and hydrology in later semesters.*

Module I (6 Hours)

Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Module II (8 Hours)

Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro manometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Module III (8 Hours)

Fluid Kinematics- Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three

dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

Module IV (8 Hours)

Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation : venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by

fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π -Theorem.

LEARNING/COURSE OUTCOMES

At the end of the course, the student will be able to:

- CO1:** Know the broad principles of fluid statics, kinematics and dynamics
- CO2:** Define the basic terms used in fluid mechanics
- CO3:** Classify the fluid flow

- CO4:** Apply the continuity, momentum and energy principles
- CO5:** Apply dimensional analysis
- CO6:** Decide under which situation to use which equation; examine different cases of laminar and turbulent flow in pipes; determine the practical applications of various fluid mechanics principles.(Evaluation)
- CO7:** Combine the various principles of fluid mechanics and organize them to solve different types of problems related to pipe flow, pressure measurement, hydrostatic forces etc.

Suggested Readings

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

CVSM0050: INTRODUCTION TO SOLID MECHANICS

2 credits-30 Hours (L-T-P:2-0-0)

The objective of this Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design.

Module I (4 Hours)

Simple Stresses and Strains- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain.

Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications.

Module II (4 Hours)

Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

Module III (4 Hours)

Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams. BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contraflexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Module IV (6 Hours)

Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and

Channel sections – Design of simple beam sections.

Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

Module V (4 Hours)

Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.

Module VI (4 Hours)

Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

Module VII (4 Hours)

Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

COURSE/LEARNING OUTCOMES

On completion of the course, the student will be able to:

- CO1:** Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components;
- CO2:** Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; Analyse solid mechanics problems using classical methods and energy methods;
- CO3:** Analyse various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thin wall beams;
- CO4:** Calculate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading; apply various failure criteria for general stress states at points; solve torsion problems in bars and thin walled members;

Suggested Readings

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
5. Laboratory Manual of Testing Materials - William Kendrick Hall
6. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf– TMH 2002.
7. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

CVSG0051: SURVEYING AND GEOMATICS

(2 credits – 30 HOURS) (L-T-P: 1-1-0)

Objective: Objective of this course is to introduce the students the various types of surveying and to prepare them to work with survey observations and perform calculations.

Module I Introduction to Surveying (4 hours)

Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes.

Module II Triangulation and Trilateration (6 Hours)

Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation – network- Signals. Baseline - choices - instruments and accessories - extension of base lines – corrections - Satellite station - reduction to centre - Intervisibility of height and distances – Trigonometric leveling - Axis single corrections.

Module III Curves (5 hours)

Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves

Module IV Modern Field Survey Systems (6 Hours)

Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.

Module V Photogrammetry Surveying (6 Hours)

Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.

Module VI Remote Sensing (3 Hours)

Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

COURSE/LEARNING OUTCOMES:

On completion of the course, the student will be able to:

- CO1:** Recall the function of surveying in civil engineering construction,
- CO2:** Explain the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements,
- CO3:** Demonstrate different types of surveying and applicability of each.
- CO4:** Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities
- CO5:** Measure horizontal, vertical, and zenith angles with a transit, theodolite, total station or survey grade GNSS instruments,
- CO6:** Perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse. Use appropriate software for calculations and mapping,
- CO7:** Compile the knowledge gained for the implementation of civil infrastructure facilities

Suggested Readings

- 1 Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
- 2 Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011
- 3 Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010
- 4 Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
- 5 Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.
- 6 Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

CVMT0052: MATERIALS, TESTING AND EVALUATION**(2 Credits- 30 hours) (L-T-P: 1-1-0)**

Objective: *The objective of this Course is to deal with an experimental determination and evaluation of mechanical characteristics and advanced behavior of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behavior of structural materials. The main goal of this course is to provide students with all information concerning principle, way of measurement, as well as practical application of mechanical characteristics.*

- *Make measurements of behavior of various materials used in Civil Engineering.*
- *Provide physical observations to complement concepts learnt*
- *Introduce experimental procedures and common measurement instruments, equipment, devices.*
- *Exposure to a variety of established material testing procedures and techniques*
- *Different methods of evaluation and inferences drawn from observations.*

Module I (5 hours)

Introduction to Engineering Materials covering, Cements, M-Sand, Concrete (plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses of these

Module II (5 hours)

Introduction to Material Testing covering, What is the “Material Engineering”?; Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundamentals and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics

Module III (5 hours)

Standard Testing & Evaluation Procedures covering, Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue of material; Creep.

Tutorials (15 hours)

From the above modules covering, understanding i) Tests & testing of bricks, ii) Tests & testing of sand, iii) Tests & testing of concrete, iv) Tests & testing of soils, v) Tests & testing of bitumen & bituminous mixes, vi) Tests & testing of polymers and polymer based materials, vii) Tests & testing of metals & viii) Tests & testing of other special materials, composites and cementitious materials. Explanation of mechanical behavior of these materials.

COURSE/LEARNING OUTCOMES

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

- CO1:** List the different materials used in civil engineering applications
- CO2:** Execute planning an experimental program, selecting the test configuration, selecting the test specimens and collecting raw data
- CO3:** Demonstrate the experimental program including the test procedures, collected data, method of interpretation and final results
- CO4:** Make use of the laboratory equipment including the electronic instrumentation, the test apparatus and the data collection system
- CO5:** Analyse physical properties of common structural and geotechnical construction materials
- CO6:** Interpret the laboratory data including conversion of the measurements into engineering values and derivation of material properties (strength and stiffness) from the engineering values
- CO7:** Compare and explain various modes of failure in compression, tension, and shear

Suggested Readings

1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.), R. Butterworth-Heinemann
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Materials and Pavement Testing', Nem Chand & Bros, Fifth Edition
3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications
4. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
5. E.N. Dowling (1993), Mechanical Behaviour of Materials, Prentice Hall International Edition
6. American Society for Testing and Materials (ASTM), *Annual Book of ASTM Standards* (post 2000)
7. Related papers published in international journals

CVIS0053: INSTRUMENTATION & SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS

(2 credits- 30 hours) (L-T-P:1-1-0)

Module I

Fundamentals of Measurement, Sensing and Instrumentation: definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations;

Module II

Sensor Installation and Operation: i) Prediction of the response of sensors to various inputs; ii) Construction of a conceptual instrumentation and monitoring program; iii) order and methodology for sensor installation; and iv) Differentiate between types of sensors and their modes of operation and measurement and v) Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty

Module III

Data Analysis and Interpretation covering a) Fundamental statistical concepts, b) Data reduction and interpretation, c) Piezometer, Inclinator, Strain gauge, etc. d) Time domain signal processing, e) Discrete signals, Signals and noise and f) a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range)

Module IV

Frequency Domain Signal Processing and Analysis covering Explain the need for frequency domain analysis and its principles; Draw conclusions about physical processes based on analysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution

Tutorials from the above modules demonstrating clearly the understanding and use for the sensors and instruments used for the problems posed and inferences drawn from the measurement and observations made along with evaluation report

COURSE/LEARNING OUTCOMES:

After completing the course students will be able to:

- CO1:** Explain the noise added during measurements and transmission, the measurement of electrical variables and the requirements during the transmission of measured signals.
- CO2:** Identify the requirements in the calibration of sensors and instruments.
- CO3:** Analyse the errors during measurements
- CO4:** Decide proper sensor technologies for specific applications
- CO5:** Construct Instrumentation/Computer Networks
- CO6:** Design and set up measurement systems and do the studies

Suggested Readings

1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann
2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press
3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis
4. Ilya Gertsbakh (2010), Measurement Theory for Engineers, Springer

CVIC0054: INTRODUCTION TO CIVIL ENGINEERING

(2 Credits -30 Hours)(L-T-P : 2-0-0)

Objective: *The Objective of this course is to give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering, to motivate the students to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness and to expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.*

Modules I (5 Hours)

Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career.

History of Civil engineering: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers.

Overview of National Planning for Construction and Infrastructure Development; Position of construction industry vis-à-vis other industries, five year plan outlays for construction; current budgets for infrastructure works;

Fundamentals of Architecture & Town Planning: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities.

Module II (5 Hours)

Fundamentals of Building Materials: Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes.

Basics of Construction Management & Contracts Management: Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management

Module III (8 Hours)

Environmental Engineering & Sustainability: Water treatment systems; Effluent treatment systems; Solid waste management; Sustainability in Construction; Geotechnical Engineering: Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunneling; Hydraulics, Hydrology & Water Resources Engineering: Fundamentals of fluid flow, basics of water supply systems; Underground Structures; Underground Structures Multipurpose reservoir projects Ocean Engineering: Basics of Wave and Current Systems; Sediment transport systems; Ports & Harbours and other marine structures Power Plant Structures: Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects; Structural Engineering: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies; Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR; Traffic & Transportation Engineering: Investments in transport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public

and Freight Transportation; Road Safety under heterogeneous traffic; Sustainable and resilient pavement materials, design, construction and management; Case studies and examples.

Module IV (4 Hours)

Repairs & Rehabilitation of Structures: Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; Non- Destructive testing systems; Use of carbon fibre wrapping and carbon composites in repairs. Industrial lectures: Case studies of large civil engineering projects by industry professionals, covering comprehensive planning to commissioning;

Module V (5 Hours)

Computational Methods, IT, IoT in Civil Engineering: Typical software used in Civil Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA, AUTOCAD,...GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, ...)

Module VI (3 Hours)

Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Civil Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in Construction.

COURSE /LEARNING OUTCOMES

After finishing this course students will be able to:

- CO1:** Know what constitutes Civil Engineering and explore various possibilities of a career in this field
- CO2:** Identify the various areas available to pursue and specialize within the overall field of Civil Engineering
- CO3:** Infer the depth of engagement possible within each of these areas
- CO4:** Identify the vast interfaces this field has with the society at large
- CO5:** identify the possibilities for taking up entrepreneurial activities in this field
- CO6:** Design creative and innovative work and showcase monuments, heritage structures, nationally important infrastructure, and impressive projects to serve as sources of inspiration

Suggested Readings

1. Patil, B.S.(1974), Legal Aspects of Building and Engineering Contract
2. The National Building Code, BIS, (2017)
3. RERA Act, (2017)
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. Chandiramani, Neelima (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
6. Avtarsingh (2002), Law of Contract, Eastern Book Co.
7. Dutt (1994), Indian Contract Act, Eastern Law House
8. Anson W.R.(1979), Law of Contract, Oxford University Press
9. Kwatra G.K.(2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration
10. Avtarsingh (2005), Law of Arbitration and Conciliation, Eastern Book Co.
11. Wadhwa (2004), Intellectual Property Rights, Universal Law Publishing Co.

12. P. S. Narayan (2000), Intellectual Property Rights, Gogia Law Agency
13. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
14. Bare text (2005), Right to Information Act
15. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
16. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act
17. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House
18. Vee, Charles & Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss. 2, pp 117-127, MCB UP Ltd
19. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
20. Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill
21. Engineering Ethics, National Institute for Engineering Ethics, USA
23. Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
24. Resisting Bureaucratic Corruption: Alacrity Housing Chennai (Teaching Case Study) -S. Ramakrishna Velamuri CEIBS
25. CONSTRUCTION CONTRACTS, <http://www.jnormanstark.com/contract.htm>
26. Internet and Business Handbook, Chap 4, CONTRACTS LAW, <http://www.laderapress.com/laderapress/contractslaw1.html>
27. Contract & Agreements , <http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm>
28. Contracts, <http://206.127.69.152/jgretch/crj/211/ch7.ppt>
29. Business & Personal Law. Chapter 7. “How Contracts Arise”, <http://yucaipahigh.com/schristensen/lawweb/lawch7.ppt>
30. Types of Contracts, <http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt>
31. IV. TYPES OF CONTRACTS AND IMPORTANT PROVISIONS, <http://www.worldbank.org/html/opr/consult/guidetxt/types.html>
32. Contract Types/Pricing Arrangements Guideline- 1.4.G (11/04/02), <http://www.sandia.gov/policy/14g.pdf>

CVSG0055: CIVIL ENGINEERING – SOCIETAL & GLOBAL IMPACT

(2 Credits -30 Hours)(L-T-P :2-0-0)

Objective: *Objective of this course is to provide a better understanding of the impact which Civil Engineering has on the Society at large and on the global arena. Civil Engineering projects have an impact on the Infrastructure, Energy consumption and generation, Sustainability of the Environment, Aesthetics of the environment, Employment creation, Contribution to the GDP, and on a more perceptible level, the Quality of Life. It is important for the civil engineers to realise the impact which this field has and take appropriate precautions to ensure that the impact is not adverse but beneficial.*

Module I (6 Hours)

Introduction to Course and Overview; Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis;

Module II (4 Hours)

Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering

Module III (5 Hours)

Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability;

Module IV (5 Hours)

Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and nonstationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.

Module V (5 Hours)

Built environment – Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability

Module VI (5 Hours)

Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment (projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development.

COURSE/LEARNING OUTCOMES

After Finishing the course, students will be able to:

- CO1:** Know the impact which Civil Engineering projects have on the Society at large and on the global arena and using resources efficiently and effectively.
- CO2:** Define the Sustainability of the Environment, including its Aesthetics, Identify the potentials of Civil Engineering for Employment creation and its Contribution to the GDP
- CO3:** Explain the extent of Infrastructure, its requirements for energy and how they are met: past, present and future
- CO4:** Explain the Built Environment , factors impacting the Quality of Life and the precautions to be taken to ensure that the above-mentioned impacts are not adverse but beneficial.
- CO5:** Apply professional and responsible judgement and take a leadership role;

Suggested Readings

1. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.
5. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options
6. <http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx>
7. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
8. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. P 129-130
9. Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability with application to urban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May.
10. Bogle D. (2010) UK's engineering Council guidance on sustainability. Proc ICE Engineering Sustainability 163. June Issue ES2 p61-63
11. Brown R R., Ashley R M., Farrelly M. (2011). Political and Professional Agency Entrapment: An Agenda for Urban Water Research. Water Resources Management. Vol. 23, No.4. European Water Resources Association (EWRA) ISSN 0920-4741.
12. Brugnach M., Dewulf A., Pahl-Wostl C., Taillieu T. (2008) Toward a relational concept of uncertainty: about knowing too little, knowing too differently and accepting not to know. Ecology and Society 13 (2): 30
13. Butler D., Davies J. (2011). Urban Drainage. Spon. 3rd Ed.
14. Cavill S., Sohail M. (2003) Accountability in the provision of urban services. Proc. ICE. Municipal Engineer 156. Issue ME4 paper 13445, p235-244.
15. Centre for Water Sensitive Cities (2012) Blueprint for a water sensitive city. Monash University.
16. Charles J A. (2009) Robert Rawlinson and the UK public health revolution. Proc ICE Eng History and Heritage. 162 Nov. Issue EH4. p 199-206

LABORATORY COURSES

CVGE6013: GEOTECHNICAL ENGINEERING LAB

(2 credits)

1. Liquid Limit test of soil by Cone Penetrometer Apparatus and Casagrande Apparatus.
2. Plastic limit of soil
3. Sieve analysis of soil
4. Moisture content of soil by oven dry method.
5. Dry Density of soil by sand replacement method.
6. Dry Density of soil by core cutter method.
7. Direct shear test of soil.

8. Unconfined compression test of soil.
9. Proctor's Compaction test of soil.
10. Permeability test of soil.
11. Consolidation test of soil.
12. Triaxial test of soil.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall the basic knowledge to carry out field investigations and to identify soils in geotechnical engineering practice. (Remembering)
- CO2:** Classify soil based on standard geotechnical engineering practice. Develop laboratory compaction and in-place density tests for fill quality control. (Understanding)
- CO3:** Develop and interpret laboratory tests for evaluating subgrade performance and for pavement design. (Applying)
- CO4:** Design and conduct experiments as well as Analyse and interpret data. (Creating)
- CO5:** Examine various criticalities that are encountered while testing of soil in the laboratory. (Analysing)
- CO6:** Conduct laboratory tests needed to determine soil design parameters. Develop and formulate laboratory procedures to test geotechnical engineering concepts. (Creating)

CVES6014: ENGINEERING SURVEY LAB II

(2 credits)

1. Measurement of angle by method of repetition and reiteration using theodolite
2. Traversing with theodolite – open and closed traverse
3. Setting out of circular curve using chain and tape
4. Setting out of circular curve using theodolite – one theodolite and two theodolite method
5. Trigonometric levelling
6. Route alignment of an open traverse
7. Introduction to total station

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Define advanced surveying equipment like total station, theodolite etc.; name the different types of levelling, traversing, setting out works, and state the methods applicable for these works. (Remembering)
- CO2:** Differentiate between open and closed traverse; explain the measurement of horizontal and vertical angles using theodolite, and illustrate the setting out of circular curves for highway/railway projects. (Understanding)
- CO3:** Apply advanced methods of surveying using total station; construct traverse maps and levelling charts, and find out RLs and heights of different stations/objects. (Applying)
- CO4:** Identify the methods of repetition and reiteration for calculation of angles between points/objects using theodolite and compare the results with conventional methods. (Analysing)

- CO5:** Assemble the field observations and combine those results to summarize the final charts and maps. (Creating)
- CO6:** Examine the field book data and determine the adjustments required for correcting the observational and instrumental errors. (Evaluating)

CVMI6015: MINI PROJECT

(2 credits)

***Objectives:** Mini Projects are assigned to students individually or in groups by the department under the supervision of designated faculty members. The primary objective of the Mini Project is to enable students to have a thorough understanding of the theoretical principles learnt in earlier four semesters through a prolonged practical experience. Collectively the students will get to know about multiple areas of Civil Engineering analysis and design procedures and the methods of reporting in standard format.*

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Relate the practical knowledge within the chosen area of Civil Engineering for project development. (Remembering, Understanding)
- CO2:** Develop effective communication skills for presentation of project related activities. (Applying)
- CO3:** Apply theoretical knowledge in practical through experiments. (Applying)
- CO4:** Evaluate the experimental data to identify critical parameters influencing the characteristics of different building materials. (Evaluating)
- CO5:** Analyse and formulate projects with a comprehensive and systematic approach. (Analysing and Creating)

CVTE6016: TRANSPORTATION ENGINEERING LAB

(2 Credits)

1. To determine the IMPACT VALUE of coarse aggregates by use of IMPACT MACHINE.
2. To determine the ABRASION VALUE of coarse aggregates by use of LOS ANGELES MACHINE.
3. To determine the Flakiness Index and Elongation Index of coarse aggregates.
4. To determine the MARSHALL STABILITY of Bitumen mix.
5. To determine the SOFTENING POINT of Bitumen.
6. To determine the DUCTILITY of Bitumen.
7. To determine the Specific Gravity of Bitumen.
8. To determine the Penetration of Bitumen.
9. To determine the CALIFORNIA BEARING RATIO of soil.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Relate the theoretical knowledge with the practical scenario. (Remembering)
- CO2:** Classify and characterize the pavement materials. (Understanding)
- CO2:** Plan and perform quality control tests on pavements and pavement materials. (Applying)

- CO3:** Assess the quality and grade of bitumen. (Analysing)
CO5: Compare the quality of various pavement materials and discuss their suitability in highway construction. (Evaluating)
CO6: Elaborate the properties and testing procedures of pavement materials. (Creating)

CVEE6017: ENVIRONMENTAL ENGINEERING LAB

(2 Credits)

1. To determine the pH of a water sample
2. To determine the turbidity of a water sample
3. To determine the hardness of a water sample
4. To determine the chloride of a water sample
5. To determine the alkalinity of a water sample
6. To determine the total solids of a water sample
7. Jar test for coagulation studies
8. To determine the DO and BOD of a water sample
9. To determine the COD of a water sample

Suggested Readings

1. Clair N. Sawyer, Chemistry for Environmental Engineering and Science, Tata McGraw Hill Education Private Limited.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall which tests are appropriate for a given environmental problem. (Remembering)
CO2: Explain the impact of water and wastewater treatment on people and the environment. (Understanding)
CO3: Apply ethical issues associated with decision making and professional conduct in the laboratorial and field environment. (Applying)
CO4: Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions. (Applying)
CO5: Statistically Analyse and interpret laboratory results. (Analysing)
CO6: Evaluate common environmental experiments relating to water and wastewater quality.(Evaluating)
CO6: Demonstrate the ability to write clear technical laboratorial reports and work in groups. (Creating)

CVCS6018: COMPREHENSIVE SURVEYING CAMP

COURSE/LEARNING OUTCOMES

At the end of this Minor Project students will be able to:

- CO1:** List different types of surveying instruments and accessories to conduct a survey of an area or locality. (Remembering)
CO2: Illustrate different techniques, skills and conventional surveying instruments necessary for engineering practice.(Understanding)

- CO3:** Apply the basic principles of engineering surveying and for linear and angular measurements. (Applying)
- CO4:** Analyse effectively the field procedures required for a professional surveyor. (Analysing)
- CO5:** Estimate the quantity of earthwork required to maintain the specified ground level for a project. (Evaluating)
- CO6:** Compile the observation gathered in the field to replicate the features of the area under study. (Creating)

CVMN6019: MINOR PROJECT

(2 credits)

Objectives: *This is in continuation with the minor project in last semester where students will be given some field related analysis and design work to give them exposure towards real use of their acquired knowledge. Collectively the students will get to know about multiple areas of Civil Engineering analysis and design procedures and the methods of reporting in standard format.*

CVCA6020: COMPUTER APPLICATIONS IN CIVIL ENGINEERING

(2 credits)

Objectives: *This laboratory course is introduced to familiarize the students with a number of Civil Engineering software packages so as to equip them with necessary know-how for their use in actual field. Students will also be able to use this knowledge in carrying out their minor and major projects.*

In this course the students will be exposed to different tools to acquire hands-on experience for:

- 3D model generation, analysis and multi-material design of any type of structure including buildings, water tanks, culverts, petrochemical plants, tunnels, bridges, foundations, airport hangers and much more. All the steps involved in structural analysis and design of concrete and steel will be covered.
- Elementary features of solving slope stability and related geotechnical and geo- environmental analyses.
- Geospatial raster data processing to prepare, display and enhance digital images for mapping use in geographic information system (GIS) or in computer-aided design (CAD) software and to perform numerous operations on an image and generate an answer to specific geographical questions.

COURSE/LEARNING OUTCOMES

At the end of this Minor Project students will be able to:

- CO1:** Demonstrate computer literacy skills in both standard applications and discipline specific applications.
- CO2:** Recognize and apply basic modeling principles to the analysis, design, and evaluation of civil engineering problems.
- CO3:** Analyse the limitations, constraints, and applicability of various field and laboratory data collection methods.
- CO4:** Apply spreadsheets to solution of engineering problems.
- CO5:** Demonstrate Design, construction, and load test of a reinforced concrete beam.
- CO6:** Evaluate and compare the model results with the calculated values.

CVTS6021: TRAINING SEMINAR**(2 credits)**

Objectives: During the semester break at the end of the third year, the students are required to undergo an industrial training. The purpose of the industrial training is to expose students to real-life industry situations, so that they may be able to apply the engineering knowledge and skills that they have gained through classroom teaching and lab activities, in an on-the-job situation. After the period of training, students are required to present their experience in the form of reports and seminar presentations. Students will be evaluated on the seminar, viva-voce examination and written reports.

COURSE/LEARNING OUTCOMES

At the end of Training Seminar students will be able to:

- CO1:** Relate the lessons learned in a class room in to real world experience set in a professional practice oriented environment. (Remembering)
- CO2:** Summarize the activities required for a complete project. (Understanding)
- CO3:** Develop professional skills such as team work, effective communication and social interaction. (Applying)
- CO4:** Make use of latest software to Analyse problems related to Civil Engineering. (Applying, Analysing)
- CO5:** Adapt to software and equipment as per the industrial requirements. (Creating)
- CO6:** Identify, formulate and model problems and find engineering solution based on a system. (Applying, creating)

CVMP6022: MAJOR PROJECT (PHASE I)**(4 credits)**

Objectives: To develop the capacity of the students to convert theoretical knowledge base to practical systems for performing creative tasks and analysis and hence suggest solutions to problems pertaining to civil engineering. Each student group consisting of not more than 5 members is expected to plan, analyse and design a multi-storeyed building and verify the work with a design and analysis software package.

During the first phase of the Major Project students will identify and plan a multi-storeyed building, prepare the drawings and perform gravity analysis followed by seismic analysis. There will be two progress seminars - after the planning and after the seismic analysis, which will be evaluated by a panel of internal examiners.

COURSE/LEARNING OUTCOMES

At the end of Major Project I students will be able to:

- CO1:** List different types of buildings and components, their analyses and design methods. (Remembering)
- CO2:** Demonstrate a sound technical knowledge on planning and civil Engineering project. (Understanding)
- CO3:** Identify the support conditions and types of members in a building frame. (Applying)
- CO4:** Analyse the structural members to arrive at the design values. (Analysing)
- CO5:** Estimate the load carrying capacity of structural members. (Evaluating)
- CO6:** Design the structural members of a project optimizing the cost and materials. (Creating)

CVMP6023: MAJOR PROJECT (PHASE II)

(8 credits)

Objectives: During the second phase of the Major Project, students will compile the analyses performed in the first phase. They will work out the design details, and design the load carrying members of the frame with detailing. This will be followed by verification of the analysis and design using a software package. The project work will be concluded with quantity estimation and preparation of report. The internal assessment shall be evaluated by the DPEC and the external assessment shall be done by the external examiner(s) assisted by the DPEC and the supervisor. The modality and components of the internal assessment and their weightages shall be notified at the beginning of each semester.

Project implementation and documentation: 70

Viva voce examination: 20

Seminar presentation: 10

COURSE/LEARNING OUTCOMES

At the end of Major Project II students will be able to:

- CO1:** Identify the design philosophy to be applied to a particular project. (Remembering)
- CO2:** Demonstrate the use of domain knowledge in in real life engineering practices. (Understanding)
- CO3:** Carry out design of different members in an optimized manner. (Applying)
- CO4:** Use design software for *Analysing* different types of structures. (Analysing)
- CO5:** Evaluate the strength or load carrying capacity of a structure. (Evaluating)
- CO6:** Compile all the analysis results for the design of different members. (Creating)

CVED6024: ENGINEERING GRAPHICS AND DESIGN

(3 credits) (L-T-P:1-0-4)

Objective: This course is designed to teach the basics of engineering drawing and drafting utilizing free hand sketching as well as computer aided modeling. The fundamental principles of projections and dimensioning as well as the overview of computer graphics, customizations, annotations, layering and other functions of computer aided designs viz. geometric and topological designs of engineered components are taught.

Module I: Introduction to Engineering Drawing (5 hours)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only), Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales

Module II: Orthographic Projections (5 hours)

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes

Module III: Projection of Solids (5 hours)

- a) Projections of Regular Solids: Solids inclined to both the Planes- Auxiliary Views, simple annotation, dimensioning and scale
- b) Sections and Sectional Views of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views, development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, sectional orthographic views of geometrical solids

Module IV: Floor Plan Drawings (5 hours)

Floor plans that include windows, doors, and fixtures such as WC, bath, sink, shower, etc., objects from industry and dwellings (foundation to slab only)

Module V: Isometric Projections (5 hours)

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions, Isometric Views of lines, Planes, Simple and compound Solids, Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions

Module VI: Overview of Computer Graphics (5 hours)

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]

Module VII: Customisation and CAD Drawing (5 hours)

Consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically, producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles

Module VIII: Annotations, layering and other functions (5 hours)

Application of dimensions to objects, application of annotations to drawings; Setting up and use of layers, layers to create drawings, create, edit and use customized layers; changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface, Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views, Spatial visualization exercises, dimensioning guidelines, tolerancing techniques; dimensioning and scale multiviews of dwelling

Module IX: Team design project demonstrating geometry and topology of engineered components (5 hours)

Creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids, meshed topologies for engineering analysis and tool-path generation for component manufacture, geometric dimensioning and tolerancing, Use of solid-modeling software for creating associative models at the component and assembly levels, floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling, Introduction to Building Information Modelling (BIM).

COURSE/LEARNING OUTCOMES

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

- CO1:** Demonstrate drawing methodology of lettering with ISO specifications, concept of representative factors for drawing various types of scales the theory and methodology for different types of conic and cycloidal curves, the concept of orthographic projection for drawing projection of points, lines, planes and the concept of dimensioning, drawing complex solids, concept of isometric scale, projection and views, perspective projection of simple 1,2and 3D figures. (Remembering)
- CO2:** Explain the application and functionalities of computer aided drafting software like QCAD and AUTOCAD. (Understanding)
- CO3:** Apply the theoretical knowledge of engineering drawing to draw precise, accurate, neat and unambiguous drawings following the proper dimensioning specifications and drawing methodology that would be required in design pertaining to civil and mechanical engineering. (Applying)
- CO4:** Analyse the first angle projection of points, lines and planes, the various drawing methodology for conic and cycloidal curves ' engineer's and graphical scales. (Analysing)
- CO5:** Judiciously evaluate the concept of drawing 1, 2 and 3 D figures in orthographic, isometric and perspective projections in line with BIS design and drawing specifications. (Evaluating)
- CO6:** Interpret the manual drawings to **construct** workable schematic drawings using CAD softwares such as QCAD and AUTOCAD. (Creating)

Suggested Readings

1. N. D. Bhatt, V. M. Panchal, P. R. Ingle (2014), Engineering Drawing, Charotar Publishing House
2. M. B. Shah and B. C. Rana (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. B. Agrawal and C. M. Agrawal (2012), Engineering Graphics, TMH Publication
4. K. L. Narayana and P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. Corresponding set of CAD Software Theory and User Manuals

CVCA0045: COMPUTER-AIDED CIVIL ENGINEERING DRAWING

(1 Credit -15 Hours)(L-T-P : 1-0-0)

Module I (2 hours)

Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, coordinate systems, and reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

Module II (2 hours)

Symbols and sign conventions: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

Module III (1 hour)

Masonry Bonds: English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

Module IV (7 Hours)

Building Drawing: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

Module V (3 Hours)

Pictorial View: Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM). It may be advisable to conduct Theory sessions along with Lab demonstrations.

Suggested Readings

1. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers
2. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 2001", Tata- Mc Graw-Hill Company Limited, New Delhi
3. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd.,
5. Balagopal and Prabhu (1987), "Building Drawing and Detailing", Spades publishing KDR building, Calicut,
6. (Corresponding set of) CAD Software Theory and User Manuals.
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
8. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria& Sons,

CVCA6025: COMPUTER-AIDED CIVIL ENGINEERING DRAWING LAB**(2 Credits)(L-T-P : 1-0-2)****Module I (2 hours)**

Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, coordinate systems, and reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

Module II (2 hours)

Symbols and sign conventions: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

Module III (1 hour)

Masonry Bonds: English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

Module IV (7 Hours)

Building Drawing: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

Module V (3 Hours)

Pictorial View: Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM). It may be advisable to conduct Theory sessions along with Lab demonstrations.

List of Drawing Experiments:

1. Buildings with load bearing walls including details of doors and windows. 09
2. Taking standard drawings of a typical two storeyed building including all MEP, joinery, rebars, finishing and other details and writing out a description of the Facility in about 500 -700 words. 06
3. RCC framed structures 09
4. Reinforcement drawings for typical slabs, beams, columns and spread footings. 09
5. Industrial buildings - North light roof structures - Trusses 06
6. Perspective view of one and two storey buildings 06

COURSE/LEARNING OUTCOMES

At the end of **Drawing Experiments** students will be able to:

- CO1:** Do a detailed study of an engineering artefact
- CO2:** Illustrate a design idea/concept graphically/ visually
- CO3:** Develop parametric design and the conventions of formal engineering drawing
- CO4:** Construct and interpret 2D & 3D drawings and produce designs using a combination of 2D and 3D software.
- CO5:** Analyse a design critically and with understanding of CAD

Suggested Readings

1. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers
2. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 2001", Tata- Mc Graw-Hill Company Limited, New Delhi
3. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd.,
5. Balagopal and Prabhu (1987), "Building Drawing and Detailing", Spades publishing KDR building, Calicut,
6. (Corresponding set of) CAD Software Theory and User Manuals.
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
8. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria& Sons,

CVEG6026: ENGINEERING GEOLOGY LAB

(1 Credit)(L-T-P : 0-0-2)

List of Experiments

1. Study of physical properties of minerals.
2. Study of different group of minerals.
3. Study of Crystal and Crystal system.
4. Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite; Pyroxene group: Talc; Mica group: Muscovite; Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum.

5. Identification of rocks (Igneous Petrology): Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite, Basalt and its varieties, Trachyte.
6. Identification of rocks (Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties, Laterite, Limestone and its varieties, Shales and its varieties.
7. Identification of rocks (Metamorphic Petrology): Marble, slate, Gneiss and its varieties, Schist and its varieties. Quartzite, Phyllite.
8. Study of topographical features from Geological maps. Identification of symbols in maps.

COURSE/LEARNING OUTCOMES

- CO1:** Define the physical properties and identification of minerals referred under theory.
- CO2:** Categorize rocks and minerals by their origin and engineering properties.
- CO3:** Identify the various rocks, minerals depending on geological classifications.
- CO4:** Apply geological principles to rock masses and discontinuities for use in engineering design e.g. rock slopes, foundation.
- CO5:** Interpret geological maps showing tilted beds, faults, uniformities etc.

CVFM6027: INTRODUCTION TO FLUID MECHANICS LAB

(1 Credit)(L-T-P : 0-0-2)

List of Experiments:

1. Measurement of viscosity
2. Study of Pressure Measuring Devices
3. Stability of Floating Body
4. Hydrostatics Force on Flat Surfaces/Curved Surfaces
5. Verification of Bernoulli's Theorem
6. Venturimeter
7. Orifice meter
8. Impacts of jets
9. Flow Visualisation -Ideal Flow
10. Length of establishment of flow
11. Velocity distribution in pipes
12. Laminar Flow

COURSE/LEARNING OUTCOMES

On completion of the course students will be able to:

- CO1:** Perform experiments in different pipe-flow and open-channel flow related apparatus.
- CO2:** Analyse different fluid-flow instruments and utilize concepts of fluid mechanics in design.
- CO3:** Solve practical problems related to fluid mechanics in industries.

CVSM6028: INTRODUCTION TO SOLID MECHANICS LAB

(1 Credit)(L-T-P : 0-0-2)

List of Experiments

1. Tension test
2. Bending tests on simply supported beam and Cantilever beam.
3. Compression test on concrete

4. Impact test
5. Shear test
6. Investigation of Hook's law that is the proportional relation between force and stretching in elastic deformation,
7. Determination of torsion and deflection,
8. Measurement of forces on supports in statically determinate beam,
9. Determination of shear forces in beams,
10. Determination of bending moments in beams,
11. Measurement of deflections in statically determinate beam,
12. Measurement of strain in a bar
13. Bend test steel bar;
14. Yield/tensile strength of steel bar.

COURSE/LEARNING OUTCOMES

- CO1:** Study the stress-strain curves of different materials used in the field under different loading conditions.
- CO2:** Compare the properties of materials affect strength under various conditions.
- CO3:** Calculate simple tensile and shear stress using the appropriate guidelines and formats.
- CO4:** Analyse the bending stress on different types of sections.
- CO5:** Understand deflection of different sections at different loading conditions.

CVSG6029: SURVEYING AND GEOMATICS LAB

(1 Credit)(L-T-P : 0-0-2)

List of experiments:

1. Ranging- direct and indirect
2. Chain triangulation
3. Compass traversing- open and closed traverse
4. Levelling- Profile, Cross section and Fly leveling
5. Plane table traversing
6. Contouring- direct and indirect
7. Theodolite surveying- open and closed traverse
8. Curve setting – circular and combined curve
9. Trigonometric leveling- accessible and inaccessible objects
10. Total station surveying

COURSE/LEARNING OUTCOMES

After completing the practical classes students will be able to:

- CO1:** Able to Prepare the survey sheet according to the method used.
- CO2:** Able to apply theoretical considerations in field and other engineering projects
- CO3:** Able to survey the area using different methods of plane tabling and compass survey and to adjust the compass traverse graphically.
- CO4:** Able to record the reduced levels using various methods of levelling and measurement of horizontal & vertical angles by Theodolite.

CO5: Able to determine the location of any point horizontally and vertically using Tachometry.

CVMT6030: MATERIALS, TESTING AND EVALUATION LAB

(1 Credit)(L-T-P : 0-0-2)

List of Experiments :

1. Gradation of coarse and fine aggregates
2. Different corresponding tests and need/application of these tests in design and quality control
3. Tensile Strength of materials & concrete composites
4. Compressive strength test on aggregates
5. Tension I - Elastic Behaviour of metals & materials
6. Tension II - Failure of Common Materials
7. Direct Shear - Frictional Behaviour
8. Concrete I - Early Age Properties
9. Concrete II - Compression and Indirect Tension
10. Compression – Directionality
11. Soil Classification
12. Consolidation and Strength Tests
13. Tension III - Heat Treatment
14. Torsion test
15. Hardness tests (Brinell's and Rockwell)
16. Tests on closely coiled and open coiled springs
17. Theories of Failure and Corroboration with Experiments
18. Tests on unmodified bitumen and modified binders with polymers
19. Bituminous Mix Design and Tests on bituminous mixes - Marshall method
20. Concrete Mix Design as per BIS

COURSE/LEARNING OUTCOMES

- CO1:** Explain Experimental procedures and common measurement instruments, equipment and devices.
- CO2:** Test various types of material behavior under similar loading conditions.
- CO3:** Analyse various modes of failure in compression, tension and shear.
- CO4:** Interpret the experimental results to assess the quality of building materials.
- CO5:** Compare various types of material behavior under similar loading conditions.

CVIS6031: INSTRUMENTATION & SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS LAB

(1 Credit)(L-T-P:0-0-2)

1. Instrumentation of typical civil engineering members/structures/structural elements
2. Use of different sensors, strain gauges, inclinometers,

3. Performance characteristics
4. Errors during the measurement process
5. Calibration of measuring sensors and instruments
6. Measurement, noise and signal processing
7. Analog Signal processing
8. Digital Signal Processing
9. Demonstration & use of sensor technologies

CVIS6031: INSTRUMENTATION & SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS LAB

(2 credits)

a) Programs to be created and executed on the following areas

1. Use of SQL Syntax: Insertion, Deletion Join), Updating using SQL.
2. Program segments in embedded SQL using C as host language to find average grade point of a student, etc.
3. Program for Log based data recovery technique.
4. Program on data recovery using check point technique.
5. Concurrency control problem using lock operations.
6. Use of package (ORACLE) for programming approaches.
7. Programs on JDBC/ODBC.

b) PL/SQL Programming Language fundamentals

1. PL/SQL block structure, character set, identifiers, literals, delimiters, comments, data types in PL/SQL
2. Program structure- Conditional constructs, iterative constructs, exception handling
3. SQL in PL/SQL - DML and Transaction Management (Commit and Rollback), Data Retrieval, Cursors (Explicit and Implicit), Error handling with cursors, Procedures, Function, Triggers-creating and managing functions, procedures.

c) PHP, MYSQL

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** familiarize with database design using the ER Model and its mapping to a relational database representation. (Understanding/Applying)
- CO2:** Illustrate and manipulate SQL queries and relational algebra. (Understanding/Analysing)
- CO5:** Evaluate and Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database. (Evaluating/Applying)
- CO3:** Formulate, using relational algebra, solutions to a broad range of query problems. (Creating)
- CO4:** Formulate, using SQL, solutions to a broad range of query and data update problems. (Creating)

DEPARTMENT OF MECHANICAL ENGINEERING

Vision

To establish the department as a hub of quality technical education and research for aiding the industry and to strive for the upliftment of the North East Region and nation as a whole.

Mission

1. To train the youth to be intellectually competent with strong fundamentals in Mechanical engineering.
2. To create an environment for carrying out fundamentals and interdisciplinary research to address the future needs and challenges of a society and the industry.
3. To cultivate strong moral values and professional ethics to build them as responsible and environmentally conscious citizens.
4. To motivate, nourish and mould the students to be dynamic leader and entrepreneurs.

Program educational objectives (PEOs)

1. To develop the ability to design a system, component or process to meet the social and industrial requirements within realistic constraints.
2. To achieve high level of technical expertise through extensive project work, experiments, industrial visits and regular symposiums.
3. To inculcate professional ethics, leadership qualities and inherent creative instincts in students.
4. To encourage lifelong learning and to foster the ability to function on multi-disciplinary teams.

DETAILED SYLLABUS

MNHM0010: HYDRAULICS MACHINERY

(3 credits – 45 hours)

Objective: *The course familiarises students with basic facts relating to working principles of hydraulic machines and equipment used in all industrial fields. It deals with pumps, hydraulic motors, water turbines and fluid mechanisms such as hydraulic elements, hydraulic transmissions and couplings.*

Module I: Impact of free jets (10 hours)

Force exerted on stationary flat plate held normal to jet and inclined to jet, force exerted on curved plate, force exerted on moving flat plate normal to jet and moving inclined to the direction of the jet, jet propulsion of jet

Module II: Hydraulic Turbines (10 hours)

Classification of hydraulic turbines, Impulse and reaction turbines, Pelton wheel, work done and efficiency of Pelton wheel, Francis turbine, propeller turbine and Kaplan turbine, draft tube , specific speed, performance characteristics of hydraulic turbines, cavitation

Module III: Centrifugal pumps (10 hours)

Classification of centrifugal pumps, working principles and head of centrifugal pumps, losses and efficiencies of centrifugal pumps, effect of variation of discharge on efficiency, multi stage centrifugal pumps, characteristics of centrifugal pumps, Net Positive Suction Head, cavitation and priming of centrifugal pumps.

Module IV: Reciprocating pumps (10 hours)

Classification of reciprocating pumps, working principles of reciprocating pumps, discharge, work done, power for reciprocating pumps, single acting and double acting reciprocating pumps, slip, indicator diagram, air vessels.

Module V: Miscellaneous hydraulic machines (5 hours)

Hydraulic accumulator, hydraulic intensifier, hydraulic press, hydraulic crane, hydraulic lift, hydraulic ram, hydraulic coupling, hydraulic torque converter, jet pump, submergeable pump.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to:

- CO1:** Define governing principle of impulse momentum, various hydraulic turbines and pumps. (Remembering)
- CO2:** Classify the various types of pumps and turbines, their performance characteristics, blade triangles and various efficiency studies. (Understanding)
- CO3:** Solve various numerical problems based on the application of impulse momentum theory in impact of jet problems and performance characteristics of turbines and pumps based on velocity triangle approach. (Applying)
- CO4:** Analyse various results to estimate the performance of turbines and pumps. (Analysing)
- CO5:** Interpret the results obtained through numerical approach and comment with suitable conclusion and future study if any. (Evaluating)

CO6: Elaborate study that can be made with proper references from E Learning resources available. (Creating)

Suggested Readings

1. R.K Rajput, Text book on hydraulic machines, S.Chand.
2. Dr.R.K. Bansal, Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi publication.
3. Jagadish Lal, Fluid machines Including Fluid mechanics, Metropolitan Book Co.
4. P.N Modi and S.M Seth, Hydraulics and Fluid Mechanics, Standard Book House.

MNDM0011: DYNAMICS OF MACHINES

(4 credits - 60 hours)

Objective: To understand the fundamentals of the theory of kinematics and dynamics of machines as well as to understand techniques for studying motion of machines and their components.

Module I: Cams (12 Hours)

Types of followers, Nomenclature of followers, Motion of follower, Simple harmonic motion of follower, Uniform acceleration and retardation, Cycloidal motion, cam profile construction, cam profile for roller followers.

Module II: Balancing of Rotating Masses (12 Hours)

Static and dynamic balancing. Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.

Module III: Balancing of Reciprocating Masses (12 Hours)

Balancing of reciprocating engine, Partial balancing of primary force, Partial balancing of locomotives, Variation of tractive force, swaying couple, hammer blow, coupled locomotive, primary balance of multi-cylinder inline engine, Secondary balance of multi-cylinder inline engines, Method of direct and reverse cranks.

Module IV: Governors (12 Hours)

Types of Governor, Watt Governor, Porter governor, Proell Governor, Hartnell Governor, Wilson-Hartnell governor, Sensitivity, Stability, Isochronism, Hunting, Governor Effort and Power, controlling force.

Module V: Flywheel (12 Hours)

Fluctuations of energy, Co-efficient of fluctuation of energy and speed, function of flywheel.

COURSE/LEARNING OUTCOMES

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

- CO1:** List different types of cam, follower and governors. (Remembering)
- CO2:** Explain the concept and need of balancing, its necessity and different effects on a system. (Understanding)
- CO3:** Identify various types of motions exhibited by a cam and follower mechanism. (Applying)
- CO4:** Compare between static and dynamic balancing of rotational parts. (Analysing)
- CO5:** Perceive the working of governor and flywheel. (Evaluating)
- CO6:** Evaluate a designed system in terms of balancing; judge on the suitability of selection of a particular flywheel, governor for a specific application. (Evaluating)

- CO7:** Construct cam profile design for simple applications with standard motions. (Creating)
CO8: Synthesize a balanced system in case of systems with rotational mass and reciprocating mass. (Creating)

Suggested Readings

1. Rattan S.S., Theory of Machines, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2009.
2. Amitabha Ghosh and Ashok kumar Mallik , Theory of Mechanisms and Machines, Third Edition Affiliated East-West Press.
3. J. Lal, Theory of Machines, Metropolitan Books Ltd.
4. Joseph Edward Shigley and John Joseph Uicker, Theory of Machines and Mechanisms, Jr. Second Edition, MGH, New York

MNMT0012: MANUFACTURING TECHNOLOGY II

(4 credits - 60 hours)

Objective: *There are various processes in manufacturing for conversion of raw material into final products. The basic knowledge of these processes is essential for engineering students. This course provides students with a further treatment of the analysis of the manufacturing processes.*

Module I: Mechanics of metal cutting (14 hours)

Reference to ASA and ORS, Mechanism of chip formation, Type of chips. Orthogonal and oblique machining, Chip thickness ratio - velocity relationship, Stress, Strain and Strain rate, Merchant Circle Diagram, Measurement of cutting forces, Cutting variables and factors affecting them. Cutting Tool Materials. Tool wears and Tool life, Basic causes, Progressive tool wears, Tool life, Variables affecting the tool life, Taylor's tool life equation. Machinability, Definition, Techniques for improving Machinability. Tool nomenclature

Module II: Heat Generation and Cutting Temperature in Machining (10 hours)

Heat generation in machining - Location, causes, effects of cutting temperature on job and tool, variation of machining parameters and control of cutting temperature, cutting fluids – Types and applications.

Module III: CNC Machines (12 hours)

Introduction – working principle, coordinate system in CNC Machine Tools, path control, point to point, continuous, machining centers, part programming- manual, Computer Assisted Part Programming (CAPP), G codes and M codes, CNC program for operations, turning, drilling, threading, canned cycle operations.

Module IV: Non-conventional Machining (12 hours)

Need for non-conventional Machining, principles of operation - machine setups, applications, merits and demerits of (a) Abrasive Jet Machining, (b) Ultrasonic Machining, (c) Electrochemical Machining, (d) Electro-discharge Machining, (e) Laser Beam Machining, (f) Electron Beam Machining. Comparative study of the above processes.

Module V: Jigs and Fixtures (12 hours)

Introduction, elements of jigs and fixtures, principle of location, locating methods and devices, design principle for location; Clamping, principles for clamping, clamping devices; Indexing jigs and fixtures, indexing devices, fool-proofing.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** Define machining and classify the associated nomenclatures. (Remembering)
- CO2:** Explain the various non-traditional machining operations and understand their advantages and limitations. (Understanding)
- CO3:** Develop various machining operations through the use of CNC programming. (Applying)
- CO4:** Classify the different causes of heat generation and explain the role of cutting fluids. (Analysing)
- CO5:** Evaluate the various forces developed during machining with single point cutting tool. (Evaluating)
- CO6:** Discuss the various causes of tool wear and the various ways of preventing it. (Creating)

Suggested Readings

1. A.B.Chattopadhyay, Machining and Machine Tools, Wiley India Pvt Ltd
2. P.N. Rao, Manufacturing Technology, Tata McGraw Hill
3. G.K. Lal, Introduction to Machining Science, New Age International Limited
4. P.H. Joshi, Jigs and Fixtures, Tata McGraw Hill
5. Amitabha Ghosh and Ashok Kumar M allick, Manufacturing Science, East West Press
6. P.K. Mishra, Non-Conventional Machining, Narosa Publishing House.

MNAT0013: APPLIED THERMODYNAMICS

(3 credits - 45 hours)

Objective: This course is designed to introduce basic application of thermodynamic systems such as turbine, compressor refrigerator and air condition and their application in real life situations. The course will help students to understand the dynamics of energy through the air, gas or other media; calibration of measuring instruments and build students' ability to solve thermodynamic problems.

Module I: Steam Turbine and Steam Condenser (11 hours)

Classification, Flow of steam through impulse and reaction turbines, Velocity diagrams, Compounding of steam turbines, Losses in steam turbine. Steam condenser- introduction and classification, Function of steam condenser, Elements of a condenser plant, sources of air in condenser, effects of air leakage in condenser, vacuum and condenser efficiency.

Module II: Air Compressor (12 hours)

Introduction; Reciprocating type – Single stage and multi-stage, Compression ratio and volumetric efficiency, effect of clearance, compressor efficiencies. Methods for improving thermal efficiencies. Compressor work and power. Intercooler and after- cooler. Rotary compressors: Classification, Centrifugal compressors: theory of operations, impeller and diffuser, impeller work; efficiency. Rotary Vs Reciprocating compressor.

Module III: Gas Turbine and Jet Propulsion (12 hours)

- a) Gas turbine: introduction and classification, constant pressure combustion gas turbine , thermal and compressor efficiency, method of improving thermal efficiency of open cycle gas turbine, constant volume combustion gas turbine.

- b) Jet propulsion: introduction and classification, thrust, thrust power, propulsive efficiency and thermal efficiency.

Module IV: Refrigeration and Air Conditioning (10 hours)

Fundamentals of refrigeration, C.O.P, reversed Carnot cycle, reversed Brayton cycle, simple vapour compression cycle, actual vapour compression cycle, volumetric efficiency, simple vapour absorption system. Introduction to psychrometry and its properties, psychrometric relation, psychrometric chart and processes.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** list the basic concepts and definitions used in engineering thermodynamics. (Remembering)
- CO2:** illustrate the mathematical skills to solve thermodynamics problems. (Understanding)
- CO3:** model the performance and characteristics of mechanical components and energy systems. (Applying)
- CO4:** solve the various psychrometric problems using psychrometric chart. (Applying)
- CO5:** inspect and categorize available renewable energy sources, energy conversion and application. (Analysing)
- CO6:** conclude solution to thermodynamic problems in HVAC systems, power plant, engines or renewable energy devices. (Evaluating)
- CO7:** evaluate the relevant parameters of various energy systems and conclude the most efficient one in terms of it. (Evaluating)
- CO8:** estimate the most environmental friendly energy system in terms of emission parameters. (Creating)

Suggested Readings

1. R. K Rajput, Thermal Engineering, Laxmi publication
2. Domkundwar, A course in Thermal Engineering, Dhanpat Rai and Co (P) Ltd.
3. K. K. Ramalingam, Steam Tables, Scitech
4. Onkar Singh, Applied Thermodynamics, New Age.

MNMD0014: MACHINE DESIGN I

(4 credits - 60 hours)

***Objective:** To make students learn about various design considerations and accordingly their applications into the design field. Afterwards, students will be able to have proper conceptualization of designing the essential machine components like screws, shafts, couplings, gears, joints, springs etc., under different safety limitations.*

Module I: Introduction to design (10 hours)

Overview and need of design, Design procedures, Engineering materials and their properties, Material selections and design considerations, BIS standards, Tolerances and Fits.

Module II: Design against static load (10 hours)

Modes of failure, Factor of safety, Stress-strain, Design of cotter and knuckle joints, Theories of failure: Maximum normal-stress theory, Maximum shear-stress theory and Distortion-energy theory.

Module III: Design against fluctuating load (10 hours)

Stress concentration, Modes of failure, Fluctuating stresses, Fatigue failure and S-N diagram, Notch sensitivity, Soderberg, Goodman and Gerber diagrams, modified Goodman diagrams, Fatigue design under combined stresses.

Module IV: Shafts, keys, Joints and couplings, Springs (20 hours)

- Power Screw: Forms of threads, self locking screw, efficiency of screw. Threaded fasteners: I.S.O. Metric screw thread, Bolted joint in tension, Torque required for bolt tightening.
- Permanent Joints: Design of Riveted joints and welded joints and their strength.
- Shafts, keys and couplings: Design of shaft subjected to bending, torsion, axial and combined loading, keys, cotter and Knuckle joint.
- Springs: Helical springs, Leaf springs, Spring materials, Design against static and fluctuating load.

Module V: Brakes and clutches (10 hours)

- Brakes: Types of brakes, Energy absorbed by the brakes, Design of Block, band and disc brakes.
- Clutches: Classification, application and design of friction clutches, Disc or Plate clutches, Cone clutches, Centrifugal clutches.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** Define basic design concepts and procedures. (Remembering)
- CO2:** Interpret different types of failure criterion of mechanical parts. (Understanding)
- CO3:** Make use of design data available for different machine elements. (Applying)
- CO4:** Solve and determine safe dimensions of mechanical components under static and dynamic loading conditions. (Applying)
- CO5:** Analyse design problems considering environmental effect with incorporation of factor of safety. (Analysing)
- CO6:** Perceive the system of tolerance defined by BIS and the use of failure theories. (Evaluating)
- CO7:** Modify the design of mechanical elements based of safety standards. (Creating)

Suggested Readings

- V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publications.
- J.E. Shigley et al., Mechanical Engineering Design, Tata McGraw-Hill Publications
- P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learning Pvt. Ltd.
- U. C. Jindal, Machine Design, Pearson Education.
- K Mahadevan et. al., Design Data Handbook, CBS Publishers and Distributors Pvt. Ltd.
- V. B. Bhandari, Machine Design: Data book, Tata McGraw Hill Publications.
- Design Data: Data book of Engineers, PSG College Kalaikathir Achchagam, Coimbatore.

MNOR0015: OPERATIONS RESEARCH**(4 credits - 60 hours)**

Objective: Operations Research can be described as a scientific approach to the solution of problems in the management of complex systems. In a rapidly changing environment an understanding is sought which will facilitate the choice and the implementation of more effective solutions which, typically, may involve complex interactions among people, materials and money.

Module I: Introduction to Linear Programming (15 hours)

Introduction to linear programming - formulation, graphical method, Simplex method and its applications, initial basic feasible solution, optimality test, Big M method and Two Phase method.

Module II: Special topics in Linear Programming (15 hours)

Duality in linear programming, the dual simplex method, the revised simplex method, sensitivity analysis of linear programming, Goal programming, and Integer programming.

Module III: The Transportation Model and The Assignment Model (15 hours)

- a) Formulation and solution of Transportation Model, North-west Corner method, Vogel's approximation method, stepping stone method, modified distribution method, degeneracy in Transportation problem, least time transportation problems,
- b) Mathematical representation and solution of assignment model, Hungarian method.

Module IV: Sequencing Problem, Replacement Analysis and Queueing Model (15 hours)

Assumptions in sequencing problem, processing of n jobs through one machine, two machines and three machines, processing of two jobs through m machines. Replacement of items whose maintenance and repairing cost increase with time, i) ignoring changes in the value of money, ii) value of money changes with time; replacement of items that fail suddenly. Introduction to Queueing Model.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO 1:** Recall the basics of how to plot graphs in the coordinate axes. (Remembering)
- CO 2:** explain the various concepts like linear programming, transportation, assignment, sequencing etc. used in operations research framework. (Understanding)
- CO 3:** apply various methods and techniques for problem solving in industry with operations research framework. (Applying)
- CO 4:** analyse various techniques for operations research. (Analysing)
- CO 5:** evaluate the best possible way to organize and maintain operations in industrial work scenario with better productivity. (Evaluating)
- CO 6:** Construct mathematical models to obtain optimised feasible solution for operations problems. (Creating)
- CO 7:** Adapt to the use of operation research method in actual environment. (Creating)

Suggested Readings

- 1. C. Mohan, "Optimization Techniques" New Age
- 2. D. S. Hira and P.K. Gupta, "Operations Research" S. Chand
- 3. J.K. Sarma "Operations Research "Macmillan
- 4. Taha " Operation Research an introduction" Pearson
- 5. Billey Gillet "Operations Research" PHI
- 6. N.G Nair "Operations Research" Dhanpat Rai Publication
- 7. Pablo Pedvegal " Introduction to Optimization" New Age.

MNMM0016: MECHANICAL MEASUREMENT**(3 credits - 45 hours)**

Objective: This course provides an introduction to the fundamentals of mechanical measurement devices and their use in mechanical field.

Module I: Principles and characteristics of Measurement systems (7 Hours)

Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in measurement, classification of errors.

Module II: Transducer (5 Hours)

Transducer, LVDT transfer efficiency, Primary and secondary transducers, electrical, mechanical, electronic transducer, advantages of each type of transducers.

Module III : Measurement of pressure and flow (10 Hours)

Introduction to pressure measurement, Manometer, types of manometer, Mechanical gauges pressure, electrical pressure transducers, measurement of high pressure. Measurement of low pressure - Mcleod gauge, ionization gauges pirani gauges. Introduction to flow measurement, rotameter, elbow meter, electromagnetic flow meter, hot wire anemometer, ultrasonic flow meter, Hydrometer.

Module IV: Measurement of force, torque velocity and acceleration (10 Hours)

Principle, analytical balance, platform balance, proving ring. Torque measurement – Rope brake, Prony brake, hydraulic dynamometer, eddy current dynamometer, mechanical tachometer, piezoelectric accelerometer and dynamometer.

Module V: Temperature and strain measurement (13 Hours)

Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer, Strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** define basic concepts related to measurements. (Remembering)
- CO2:** classify different types of errors and compute the same while taking measurements. (Understanding)
- CO3:** classify the various types of transducers as well as understand the importance and functioning of LVDTs. (Understanding)
- CO4:** identify the different ways of measuring pressure and flow and criticize each method for its advantages and limitations. (Applying)
- CO5:** Analyse the different ways of force, torque and acceleration and criticize each method for its advantages and limitations. (Analysing)
- CO6:** choose the different ways of measuring temperature and criticize each method for its advantages and limitations. (Evaluating)
- CO7:** Compile the different ways of measuring strain and discuss their advantages and limitations. (Creating)

Suggested Readings

1. R.K.Rajput, Mechanical measurements and Instrumentation, S.K.Kataria and Sons publishers, New Delhi
2. A.K. Sawhney, A Course in Mechanical Measurement & Instrumentation, Dhanpat Rai Publication, New Delhi
3. R. S. Sirohi, Mechanical Measurement, New Age Publications, New Delhi
4. D. S. Kumar, Mechanical Measurement and Control, Metropolitan Books Co. Pvt. Ltd.

MNMD0018: MACHINE DESIGN II

(4 credits - 60 hours)

Objective: This course is a further extension of Machine Design I. The objective is to make students able to perform modifications in design which could meet the requirement standards for safe machine elements. The applications of empirical as well as standard equations with available design data will help students understand practical design engineering.

Module I: Bearings (15 hours)

Types of bearings, Ball and roller bearings, Journal bearings, Static and dynamic load carrying capacity, Load life relationship, Taper roller bearings, Bearing lubrication and mounting.

Module II: Belt and chain drive (10 hours)

- a) Design of belt drive: geometrical relationships, analysis, condition for maximum power, V belts.
- b) Design of chain drive: geometrical relationships, sprocket wheels, design of chain drive.

Module III: Gears (20 hours)

- a) Design of Spur gears: classification, selection of material, force analysis, gear tooth failures, beam strength of spur gear tooth, wear strength.
- b) Design of Helical gears: virtual teeth and tooth proportions, force analysis, beam strength of helical gear tooth, effective load, wear strength.
- c) Design of Bevel gears: force analysis, beam strength, wear strength, effective load.
- d) Design of Worm gears: proportions of worm gears, force analysis, friction in worm gears, strength rating and wear rating of worm gears.

Module IV: Flywheels and IC engine components (15 hours)

- a) Design of Flywheels: Turning moment diagram, solid disk flywheel, rimmed flywheel.
- b) Design of IC engine components: cylinder, piston, connecting rod, crankshaft, valves.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** Recall the basic concepts related to design process. (Remembering)
- CO2:** Classify type of bearings and select suitable bearings for different applications. (Understanding)
- CO3:** Develop the idea of different types of gear tooth strength determination based on failure criterion. (Applying)
- CO4:** Analyse the use of suitable belt drive depending upon requirements. (Analysing)
- CO5:** Compare bearings and belts based on their ratings and cross section. (Evaluating)

- CO6:** Evaluate failure load in connecting rod and piston and decide suitable dimensions. (Evaluating)
- CO7:** Discuss and elaborate the relationship of tooth profile parameters of helical gear, bevel gear and worm gear with spur gear. (Creating)

Suggested Readings

1. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publications.
2. J.E. Shigley et al., Mechanical Engineering Design, Tata McGraw-Hill Publications.
3. P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learning Pvt. Ltd.
4. U. C. Jindal, Machine Design, Pearson Education.
5. K Mahadevan et. al., Design Data Handbook, CBS Publishers and Distributors Pvt. Ltd.
6. V. B. Bhandari, Machine Design: Data book, Tata McGraw Hill Publications.
7. Design Data: Data book of Engineers, PSG college kalaikathir achchagam, coimbatore
8. BIS standards on Limits & Fits (IS 919), Surface Finish (IS 2073), Machine Tool Alignment, 1993

MNMT0019: ENGINEERING METROLOGY

(3 credits - 45 hours)

Objective: The science of precision measurement is called Metrology. The aim of this course is to develop knowledge and skills regarding various measuring instruments among the students. The subject imparts knowledge about process control and quality control by making measurements and inspection of various parameters.

Module I: Standards of Measurements (10 Hours)

Definition and objectives of metrology, Standards of length - International prototype meter, Imperial standard yard, Wavelength standard, sub division of standard, line and end standard, calibration of end bars (Numerical), Slip gauges, wringing phenomena.

Module II: System of Limits, Fits and Tolerance and Gauging (12 Hours)

- a) Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, Indian standards (IS 919-1963) - Concept of Limits of size and tolerances, compound tolerance, accumulation of tolerances, Natural tolerance and process capability, geometrical tolerance, positional tolerances; definition of fits, types of fits and their designation. Hole basis system, shaft basis system.
- b) Classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowances on gauges, Types of gauges - Plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.

Module III: Comparators and Angular measurement (10 Hours)

- a) Introduction to comparators, characteristics, classification of comparators, mechanical comparators - Johnson Mikrokator, sigma comparators, dial indicator; optical comparator - principles, Zeiss ultra optimeter; pneumatic comparators - back pressure gauges, solex comparators.
- b) Angular measurements, bevel protractor, sine principle and use of sine bars, sine centre, use of angle gauges, clinometers, profile projector.

Module IV: Interferometer and screw thread, gear measurement and surface texture (13 Hours)

- a) Interferometer, principle of interference, gauge interferometer, Laser interferometer, Optical flats, use of optical flat, autocollimator.

- b) Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, best size wire. Tool maker's microscope.
- c) Gear tooth terminology, use of gear tooth Vernier caliper and micrometer.
- d) Meaning of surface texture, order of geometrical irregularities, estimation of surface roughness, measurement of roughness by Stylus equipment.

COURSE/LEARNING OUTCOMES

After completing the course successfully, the students will be able to-

- CO1:** define and differentiate the basic measurement standards. (Remembering)
- CO2:** classify limits, fits and tolerances. (Understanding)
- CO3:** Apply the principles of measuring instruments, gauges and their uses. (Applying)
- CO4:** Inspect spur gear and thread elements. (Analysing)
- CO5:** Compare the different methods for linear and angular measurement. (Evaluating)
- CO6:** Compare the screw, gear and surface measurement techniques. (Creating)

Suggested Readings

- 1. R. K Jain, Engineering Metrology, Khanna publishers, New Delhi
- 2. M.Mahajan, A Text book of Metrology, Dhanpat Rai and Co Ltd, New Delhi
- 3. N.V. Raghavendra, Engineering Metrology and Measurement, Oxford University Press, New Delhi
- 4. Anand Kr. Beroor, Metrology and Measurement, Tata McGraw-Hill Publications, New Delhi

MNMS0020: MANUFACTURING METHODS

(4 credits - 60 hours)

Objective: *The objective of this subject is to make the reader familiarize with different manufacturing processes and their underlying principles and make them understand the importance of manufacturing for humankind. This course provides the knowledge of different non-subtractive manufacturing methods with special emphasize on metal casting, metal forming and powder metallurgy and their associated processes. After successfully completing the course, the reader will be able to distinguish between various manufacturing processes and select the best suited method for manufacturing as per their special need & availability.*

Module I: Metal casting and allied processes (10 hours)

Introduction: Solidification behaviour in casting, Centreline shrinkage, Comparative study of different melting furnaces. Special casting methods, Permanent mould casting , Pressure Die casting, Hot chamber, Cold chamber, Air blown methods, Low pressure Die casting, Continuous casting. Non-metallic mould casting, Centrifugal casting, Investment casting. Casting defects, their causes and remedies, Inspection.

Module II: Metal forming and press work (14 hours)

- a) Introduction: Classification, Hot, Cold and Warm working, Variables affecting mechanical working process.
- b) Rolling: Principle, Condition for continuous rolling, Forces acting on metal during rolling, Types of rolling mills, Roll pass design, Roll Piercing.
- c) Forging: Forgeability, Forgeable materials, Metallurgy of Forging, Classification, Hand forging operations, Forging hammers, Drop forging, Press forging, machine forging, Forging Defects, Die design considerations.

- d) Extrusion: Classification, Principle of operations, Variation of ram pressure with ram travel, Principle of operations of Hydrostatic extrusion, side extrusion, impact and Hooker's extrusion. Wire, Rod and Tube drawing, Principle and Operation.
- e) Press Work: Introduction, Different types of Press and Selection of Presses, Press Operations –Main parts of power press, Feeding mechanism, Press working dies, Principles and Operations of Cutting/Shearing and Deep drawing operations, Cutting and drawing dies, Design considerations.

Module III: High Energy Rate Forming (HERF) (6 hours)

Introduction, Reasons that prompted transition to HERF, Classification , Principles and operations of Explosive Forming, Electro-hydraulic Forming, Electro-magnetic forming.

Module IV: Thread and Gear Manufacturing (16 hours)

- a) Production of Screw Threads:- Possible Methods and Their Characteristics: Casting, Forming (Rolling), Machining, Grinding, Near net shape production by investment casting and injection moulding, Non-conventional processes.
- b) Production of gears: Casting, Rolling, Blanking, Injection moulding, Extrusion, Wire EDM; Machining:- (Form cutter methods such as Shaping, planing and slotting, milling , gear shaping by machining, broaching), and Generation methods such as Rack cutter, gear shaping by generation, gear hobbing). Gear finishing (Gear shaving, rolling, burnishing, grinding, and lapping).

Module V: Powder Metallurgy (7 hours)

Introduction, Applications of P/M, Powder Characteristics, Powder production methods, Mixing and Blending, Briquetting techniques, Sintering, Infiltration and Impregnation. Cemented carbides. Advantages and Disadvantages of P/M.

Module VI: Surface Finishing Operations (7 hours)

Introduction, Classification, Principle and Operations of Lapping, Honing, Super finishing, Polishing, Buffing, Tumbling and Burnishing, Introduction to some advanced (Nano) finishing operations like AFF, MRAFF etc.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO 1:** define and characterize the various conventional and non-conventional manufacturing methods. (Remembering)
- CO 2:** classify various manufacturing methods for its useful and suitable applications in industries. (Understanding)
- CO 3:** solve manufacturing related problems for various products and processes relate to production. (Applying)
- CO4:** Analyse the use of a particular method for production of specific products in industry environment. (Analysing)
- CO 5:** Judge the application of a manufacturing method and its effectiveness on various production processes. (Evaluating)
- CO 6:** Elaborate the effectiveness of various processes and examine the outcome of the methods for its productive implementation in industries. (Creating)

Suggested Readings

1. P N Rao, "Manufacturing Technology," Vol 1-, McGraw Hill Education
2. Amitabha Ghosh and Asok Kumar Mallick, "Manufacturing Science," East West Press
3. P.C. Sharma, "Production Engineering," S. Chand & Company Ltd.
4. Dr. R. Narayanasamy, "Metal Forming Technology," Ahuja Book Co. Pvt. Ltd.
5. G.E. Dieter, "Mechanical Metallurgy," McGraw Hill Publication.
6. Production Techology P.C. Sharma
7. Rajput R. K., A textbook of manufacturing technology, Laxmi Publications (P) Ltd., New Delhi, 2007.
8. Production Technology – HMT handbook
9. Manufacturing Processes by B.H. Amsteeal, Philip F. Ostwald & Myron L. Begeman, John Wiley & Sons.

MNVC0022: VIBRATION OF MECHANICAL SYSTEMS AND CONTROL

(4 credits - 60 hours)

Objective: This subject introduces the students to the various types of Mechanical vibrations and different types of machine component failures due to vibrations. Students will be familiarized with different types of vibration isolation and the mathematical modelling. Also the control systems engineering part aims at application of control theory to design systems with desired behaviours.

Module I: Introduction (10 hours)

Definition, types of vibration:- Free and Forced vibration, Damped (viscous) and Undamped vibration; degrees of freedom (DOF), beats, mathematical models, displacement, velocity and acceleration, Resonance, Whirling of shafts.

Module II: Free Vibrations (15 hours)

- a) Undamped free vibration: Derivation of differential equation by equilibrium method and energy method, Newton's 2nd law method, Solutions to differential equations of single degree and 2 degree of freedom system, mode shapes.
- b) Damped free vibration: Introduction, free vibration with viscous damping- overdamped, underdamped and critically damped system, logarithmic decrement, Coulomb damping.

Module III: Forced Vibrations (15 hours)

- a) Introduction, Response under a periodic force for first order and second order systems, resonance, vibration isolation and force transmissibility, vibration absorbers.
- b) Multi degree of freedom systems: equations of motion, matrix methods, eigenvalue problems.

Module IV: Control systems engineering (20 hours)

Introduction, transfer function, mathematical modelling of physical systems, feedback systems, Laplace transforms, block diagrams, signal flow graphs. Controllers: proportional, integral, PI, PD and PID controllers. Stability analysis: Routh-Hurwitz stability criteria, relative stability. Root locus technique, Hydraulic, pneumatic and electronic controllers. Vibration Isolation, Vibration Absorber and tuning.

COURSE/LEARNING OUTCOMES

- CO 1:** Recall the basic use of NSL and to apply it on FBD. (Remembering)
- CO 2:** Classify the various types of vibration. (Understanding)
- CO 3:** Explain linear mathematical models of real life engineering systems. (Understanding)

- CO 4:** Identify applications of differential equation of two degree and of higher orders. (Applying)
- CO 5:** Apply Newton's equation of motion and energy methods to model basic vibrating mechanical systems. (Applying)
- CO 6:** Analyse vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation. (Analysing)
- CO 7:** Evaluate the motion and the natural frequency for free and forced vibration of a single degree of freedom damped or undamped system. (Evaluating)
- CO 8:** Develop numerical solutions to vibration problems by simple algorithms, and display the findings in graphical form. (Creating)

Suggested Readings

1. V. P. Singh, "Mechanical Vibrations," Dhanpat Rai & Co. (P) Ltd.
2. G. K. Grover, "Mechanical Vibrations," Nem chand and Brothers.
3. S. S. Rao., "Mechanical Vibrations," Pearson Education.
4. S. Salivahan et. al., "Control Systems Engineering," Pearson Education.

MNNM0023: NUMERICAL METHODS IN MECHANICAL ENGINEERING

(3 Credits - 45 Hours)

Objective: To learn and understand the various numerical approximation methods used to solve different types of equations, which are used to model mechanical engineering phenomena. The subject gives an insight into how real life problems in the field of engineering are solved.

Module I (15 Hours)

Taylor's Series; Roots of equations: The Bisection Method, The False Position Method, Simple Fixed Point Iteration, Newton Raphson method, Secant method. Roots of polynomials: Muller's and Bairstow's Method. Sets of Linear algebraic equations: Gauss Elimination method, Gauss Jordan elimination method, LU Decomposition method, Matrix Inversion method, Gauss Siedel iteration method. Numerical Integration: Trapezoidal rule, Simpson's 1/3rd Rule, Simpson's 3/8th rule, Ordinary Differential Equations: Euler's method, Runge Kutta Methods.

Module II (15 Hours)

Numerical solutions to Partial Differential Equations using Finite Difference Method (FDM): Elliptic Equations, Parabolic equations. Curve Fitting: Least Squares Regression, Interpolation.

Module III (15 Hours)

Basic finite element concepts - Basic ideas in a finite element solution, General finite element solution procedure, Application of Finite element concepts to 1D and 2D problems. Finite volume method: Conceptual Basics and Illustrations through 1-D Steady State Problems.

COURSE/LEARNING OUTCOMES

- CO1:** Recall numerical methods to solve ordinary differential equations. (Remembering)
- CO2:** Classify the different approaches used to solve partial differential equations numerically. (Understanding)
- CO3:** Solve integrals numerically. (Applying)
- CO4:** Apply the numerical method which can optimize the solution for specific problems in terms of computation effort and accuracy. (Applying)

- CO5:** Analyse data sets through applications of curve fitting methods. (Analysing)
- CO6:** Choose the type of numerical approach that needs to be adopted while tackling engineering problems in general through their understanding of the pros and cons of each method. (Evaluating)
- CO7:** Develop Finite Element, Finite Difference and Finite Volume formulations of mechanical engineering problems. (Creating)

Suggested Readings

1. Steven C. Chapra et al, "Numerical Methods for Engineers", Tata McGraw Hills Publication.
2. Dr. B. S. Grewal, "Numerical Methods in Engineering and Science with Programs in C and C+ +", Khanna Publications.
3. Bhatti, M.A., "Fundamental Finite Element Analysis and Applications: with Mathematica and Matlab Computations", Wiley, 2005.

MNPP0024: POWER PLANT ENGINEERING

(3 credits - 45 hours)

Objective: *This course will enable students to study the preliminary design of the major systems of conventional fossil-fuel steam-cycle, nuclear, gas turbine, combined cycle, hydro, wind, geothermal, solar, and alternate power plants. It will also make the students aware regarding the economic, environmental, and regulatory issues related to power generation.*

Module I: Introduction and Economics of Power Plant Generation (5 hours)

Introduction to different power plants, Load duration curves, Location of power Plants, Power plant economics and Indian energy scenario.

Module II: Steam Power Plant (15 hours)

Introduction, Rankine cycle, Carnot cycle, Reheating of steam, Regeneration, Steam power plant appraisal, Deaeration, Typical layout of steam power plant, Efficiencies in steam power plant, Cogeneration of power and process heat, Combined cycle power generation, Different types of fuel used for steam generation, Draught system, Natural Draught, Mechanical Draught.

Module III: Gas Turbine Power Plant and Diesel Electric Power Plant (10 hours)

- a) Introduction, Classification of different gas turbine power plants, Analysis of closed cycle and open cycle constant pressure gas turbine plant, Reheat, Intercooling and regeneration cycle, components of gas turbine plants, Semi-closed gas turbine plant, gas turbine fuels and gas turbine materials.
- b) Introduction, Application of diesel engines in power field, Advantages and disadvantages of diesel engine power plant, General layout, Performance characteristics, Supercharging.

Module IV: Hydro-Electric Power Plant and Nuclear Power Plant (10 hours)

- a) Introduction, Classification of hydro-electric power plant, Site selection, Elements of hydro-electric power plant, Advantages of hydro-electric power plant, Classification of hydraulic turbines and its selection, Hydrographs, Flow duration curves.
- b) Introduction to nuclear engineering, Types of nuclear reactors, Pressurized water reactor, Boiling water reactor, CANDU reactor, Gas-cooled reactor, Liquid metal fast breeder reactor, India's nuclear power programme.

Module V: Non- Conventional Power plants (5 hours)

Prospect of renewable energy source, Types of non-conventional power plants, solar plants, Wind power plants, Bio-mass plants, Geo-thermal power plant, Tidal powerplant.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** recall the basic of power plant engineering terminologies. (Remembering)
- CO2:** explain the non-renewable energies and their current status. (Understanding)
- CO3:** select the design parameters of power plant. (Applying)
- CO4:** solve power plant engineering problem. (Applying)
- CO5:** classify various equipments of power plant engineering. (Analysing)
- CO6:** compare various power plant equipments and evaluate their design. (Evaluating)
- CO7:** estimate the various design parameters of power plant. (Creating)

Suggested Readings

1. P. K. Nag, "Power Plant Engineering" Tata McGraw-Hill.
2. S.C. Arora and S. Domkundar, "A course in Power Plant Engineering" Dhanpat Rai, Publication.
3. R.K.Rajput, "Power Plant Engineering", Laxmi Publishers.
4. Black and Veatch, " Powerplant Engineering" ,McGraw-Hill.

MNIE0025: INDUSTRIAL ENGINEERING

(5 credits - 75 hours)

Objective: *The objectives of the Industrial Engineering program are: to graduate well rounded Industrial Engineers who are prepared for employment , to graduate Industrial engineers who have a strong sense of professionalism, with respect for fellow workers and their profession; and to provide graduates with a set of skills that will allow them to grow professionally and provide service and leadership in their careers.*

Module I: Work Study and Ergonomics (15 hours)

- a) Introduction to work study, Scope of Work study (Motion/Method study and Work measurement).
- b) Method study: Meaning, Process charts and diagrams, ASME symbols, Check lists and examples for developing better methods from existing methods;
- c) Micro motion study: Meaning and scope, Therbligs, use of motion camera in micro motion study, SIMO chart.
- d) Motion economy: Meaning, Principles related to (i) Workplace layout (ii) Design of tools and equipments and (iii) Use of human body.
- e) Ergonomics (Human factors engineering): Meaning, Characteristics (Cognitive ergonomics and Physical ergonomics), Introduction ONLY to Anthropometry, Biomechanics and Musculoskeletal Disorders (MSD) such as CTS (Carpal Tunnel Syndrome) and RSI (Repetitive Stress Injury); Preventive measures by ergonomic designs.
- f) Work measurement: Meaning, Methods such as (i) Stopwatch time study (ii) Work sampling (iii) Normal time, Rating factor (RF), allowances and determination of Standard Time.

Module II: Plant Location and Facility Layout (15 hours)

- a) Meaning of plant location, factors affecting location decisions, location theory, Qualitative models and semi quantitative models: Brown and Gibbs model, Break-Even analysis model, single facility location problems and multi-facility location problems.

- b) Meaning of plant/facility layout, Need for layout study, factors influencing plant layout, objections of good facility layout, Types of plant layout; Systematic Layout Planning (SLP)
- c) Group Technology (GT), Flexible Manufacturing Systems (FMS) and flexible layout and Computer integrated manufacturing (CIM).
- d) Line balancing: objectives, solution of Assembly Line Balancing (ALB) problems by: Largest Candidate Rule and RPW methods.

Module III: Product development and Design (8 hours)

- a) Meaning of product, product life cycle (PLC) and product mix.
- b) Decision to be taken during product development and design. Procedure for product development and design.
- c) Value of a product: its meaning, Value analysis: its objectives, procedure: Simplification and Standardization.

Module IV: Production planning and Inventory Control (12 hours)

- a) Meaning and objectives of production planning and control. Function of production planning and control, various steps in production planning and control (PPC)
- b) Technological Forecasting – its meaning and scope, Qualitative and quantitative methods of forecasting and their scope in engineering industries.
- c) Introduction to MRP and MRP II, evolution from Materials Requirement Planning (MRP) to Manufacturing Resource Planning (MRP II). Enterprise resource planning (ERP).
- d) Inventory Management: Meaning of inventory, Necessity for maintaining inventory, Inventory classification, Meaning of inventory control, Costs associated with inventory system, Analysis of deterministic inventory model, Just in Time (JIT) and Kanban systems.

Module V: Quality Engineering (10 hours)

- a) Meaning of quality, Objectives of quality control
- b) Meaning of Total Quality and Total quality management (TQM)
- c) Statistical quality control: Meaning and tools;
- d) Reliability engineering: Meaning of reliability, series and parallel systems, design of for reliability.
- e) Introduction to “TRIZ”, the Russian acronym for the “Theory of Inventive Problem Solving.”

Module VI: Maintenance Engineering and Networks Analysis for project management (15 hours)

- a) Meaning and types of maintenance: Breakdown, Scheduled, Preventive and Predictivemaintenance and their suitability, standards of maintenance.
- b) (i) Meaning of project management and its objectives, Network development technique (Arrow diagram and AON diagram) for determination of critical path (CP), earliest and latest dates/times. (ii) PERT model: characteristics, probability density function used for PERT activities, probability density function used for the CP, Calculation of Expected length of CP and its standard deviation, calculation of probability of completion of aPERT project (iii) CPM model: characteristics, difference with PERT, direct and indirect costs, concept of crashing (cost time trade off).

COURSE/LEARNING OUTCOMES

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

- CO1:** relate the knowledge of professional and economical responsibility in the society. (Remembering)
- CO2:** summarize the impact of industrial engineering solutions in a global, economic, environmental and societal context. (Understanding)
- CO3:** apply knowledge in operations management to solve business processes. (Applying)
- CO4:** organize a system, component or process in a production unit to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. (Applying)
- CO5:** examine the techniques, skills and use modern engineering tools (PPC, TQM, MRP etc.) necessary for production system. (Analysing)
- CO6:** interpret engineering problems based on industrial engineering. (Evaluating)
- CO7:** justify various drawbacks by carrying out case study for manufacturing units. (Evaluating)
- CO8:** measure the expectations and requirements of internal and external customers. (Evaluating)
- CO9:** improve a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, health and safety, manufacturability, and sustainability. (Creating)

Suggested Readings

1. Barnes R. M, "Motion and Time Study- Design and Measurement of of Work" Wiley India Pvt. Ltd.
2. Bridger R.S, " Introduction to Ergonomics" McGraw Hill.
3. Telsang M, " Industrial Engineering" S. Chand.
4. Panneerselvam R. " Production and Operation management" Prentice Hall of India.
5. Billington P.J, Mc Leavey D. W and Narasimhan S. L. "Production Planning and InventoryControl" Prentice Hall of India.
6. Jhamb L.C, " Production Planning and Control" Everest Publishing House.
7. Eilon S, " Element of Production Planning and Control" Mc Millan.
8. Buffa E.S and Sarin R. K, "Modern Production and Operation Management" John Wiley.
9. Deb Tanmoy, " Maintenance Management and Engineering" Ane Books Pvt Ltd.
10. Ebeling C.E, " An Introduction To Reliability and Maintaibility Engineering" Mc Graw Hill.
11. Besterfiled D. H, "Total Quality Control" Pearson.
12. Sharma S.K, "Industrial Engineering and Organization Management" S. K. Kataria and Sons.

MNRA0026: REFRIGERATION AND AIR CONDITIONING

(4 credits-60 hours)

Objective: *The objective is to study the characteristics and engineering design of heating, ventilating, air conditioning and refrigeration (HVAC and R) systems. This course will enable students to design efficient and effective solutions.*

Module I: Introduction and Principles of Refrigeration (10 hours)

Concept of throttling, Joule-thomson effect, Concepts of Refrigeration and Air conditioning. Difference between engine, refrigerator and heat pump. COP, power consumption of a refrigerating machine, Heat pump vs electric resistance heater.

Module II: Gas Cycle Refrigeration and Vapour Compression Systems (15 hours)

- a) Simple cycles – Carnot and Bell-Coleman; Aircraft refrigerating system – simple, boot- strap, regeneration, reduced ambient; Actual cycles, DART.
- b) Analysis of simple cycles, representation of T-S, p-h charts; methods of improving COP; Deviations of actual cycles from theoretical cycles. Compound compression with liquid flash cooler, flash inter-cooler multiple systems – COP, power required.

Module III: Vapour Absorption System and Refrigerants (10 hours)

- a) Vapour Absorption Refrigeration System (VARs): Advantages of VARs over VCRS. Working principle of simple VARs, practical VARs. Limitations of VARs, maximum COP of a VARs, Lithium-bromide water System; Aqua-ammonia systems.
- b) Nomenclature, classification, desirable properties. Important refrigerants and their comparisons, selection of refrigerants.

Module IV: Psychrometry and psychrometric processes (10 hours)

Basic definitions and principles related to Psychrometric ; Psychrometric Charts and Their Uses; adiabatic saturation and enthalpy deviation. Adiabatic mixing of air stream. Constant sensible heat and latent heat processes, Total heat process, sensible heat factors, grand sensible heat ratio lines, apparatus dew points, Bypass factors, Air washer humidifying efficiency, Summer Air conditioning, Winter Air conditioning.

Module V: Load Analysis, Comfort air-conditioning and Duct Design (15 hours)

Cooling load estimate, heating load estimate, high latent cooling load application, Air temperature, human health, body temperature regulation, comfort indices, comfort charts and their limitations, Different methods of duct design such as velocity reduction, equal friction static regain, distribution of air in rooms.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** define the different types of refrigeration systems and air-conditioning devices. (Remembering)
- CO2:** illustrate the working principle of various types of refrigeration systems. (Understanding)
- CO3:** classify the refrigeration systems on the basis of important relevant parameters. (Understanding)
- CO4:** solve a variety of problems related to refrigeration and air-conditioning systems. (Applying)
- CO5:** analyse the characteristics and performance of basic and advanced HVAC systems. (Analysing)
- CO6:** deduct cooling load, sensible heat and latent heat in air conditioning systems using the property relations. (Evaluating)
- CO7:** discuss about the desirable properties of refrigerants with respect to ODP and GWP. (Creating)
- CO8:** estimate the factors affecting the evaporator capacity, condenser capacity and COP of refrigeration systems. (Creating)

Suggested Readings

1. C.P.Arora, "Refrigeration and Air Conditioning" Tata McGraw-Hill.
2. Manohar Prasad, "Refrigeration and Air Conditioning" New Age International Publishers.
3. R. K Rajput, "A textbook of Refrigeration and Air Conditioning," S K Kataria and Sons
4. Domkundwar, "A course in Thermal Engineering," Dhanpat Rai and Co (P) Ltd.
5. Onkar Singh, "Applied Thermodynamics," New Age.
6. Psychrometry chart

MNDM0027: COMPUTER AIDED DESIGN AND MANUFACTURING**(3 Credits - 45 Hours)**

Objective: To provide a holistic approach in learning through well designed course involving fundamental concepts and state-of-the-art techniques in the field of CAD/CAM. To equip students, with knowledge and skill to undertake, design, analysis, evaluation of system, processes and components of computer aided and manufacturing.

Module I: Introduction (9 hours)

Introduction to CAD/CAM, need, advantages, Fundamentals of design process, stages in design process and product development cycle, Computers in design applications, role of computers in industrial manufacturing, components of CAD/CAM/CAE systems, Computer configuration for CAD applications, CAD software, definition of system software and application software, CAD database and structure, coordinate systems in CAD: WCS, UCS, SCS, Typical Product Life Cycle

Module II: Geometric Transformations (10 hours)

Intro to Rigid body transformation, affine transformation and general transformations; Basic transformations: Translation, Rotation, Scaling, Reflection and Shear; Introduction to Homogeneous coordinate representation: 2D and 3D; Concatenated transformation.

Module III: Geometric modeling (10 hours)

- a) 3D wire frame modeling, wire frame entities- definitions interpolation and approximation curves, concept of parametric and nonparametric representation of curves, curve fitting techniques, definitions of cubic spline and Bezier, B-spline.
- b) Surface modeling: Algebraic and geometric form, parametric space of surface, blending functions, Reparametrization of a surface patch, subdividing, cylindrical surface, ruled surface, surface of revolution, spherical surface, Composite surface, Bezier surface, B- spline surface.
- c) Solid modeling: Definition of cell composition and spatial occupancy enumeration, sweep representation, constructive solid geometry, boundary representations.

Module IV: NC Part Programming and Robotics (9 hours)

- a) Introduction to NC, CNC, DNC; NC coordinate system; Introduction to NC part programming: manual part programming, computer assisted part programming (APT language), advantages and limitations of programming methods.
- b) Introduction to Robotics: Robot definition, origin and characteristics; History of robotics; Asimov's laws of robotics, types of robots, specifications and applications, advantages and limitations, Introduction to robot anatomy.

Module V: Group Technology and Flexible Manufacturing System (7 hours)

Group technology and flexible manufacturing system: Part families, parts classification and coding, production flow analysis, machine cell design, FMS workstations, Material handling and storage system, Computer control system, planning the FMS, analysis methods for flexible manufacturing system, Application of Group technology and FMS.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** Recall various hardware, software components and system requirements for implementing. CAD/CAM; state the different laws governing robotics (Remembering)
- CO2:** Illustrate the product design and manufacturing process. (Understanding)
- CO3:** Summarize the concepts of group technology, FMS and their applications. (Understanding)
- CO4:** Apply suitable modelling techniques satisfactorily in developing a model/product. (Applying)
- CO5:** Compare and Analyse the various types of modelling techniques, different geometric primitives, curves, surfaces. (Analysing)
- CO6:** Appraise the use of robotics and automation in different environment. (Analysing)
- CO7:** Evaluate various transformation operations to manipulate an object under consideration as per the need of the design/manufacturing process. (Evaluating)
- CO8:** Build a CNC manual or computer assisted part program to use it for machining of different parts by various manufacturing operations. (Creating)

Suggested Readings

1. Mickel P.Groover, "Automation, production systems and computer Integrated manufacturing", 3rd edition, PHI.
2. Ibrahim Zeid., "CAD/CAM Theory and practice" Tata Mcgraw Hill education private limited.
3. David D Bedworth, "Computer Integrated design and Manufacturing," McGraw Hill International
4. P. N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill
5. Dr.K.C.Jain, Sanjay Jain, "Principles of Automation and Advanced Manufacturing Systems,," Khanna Publishers.
5. K. Lalit Narayan et al. "Computer aided design and manufacturing." PHI

MNAE0028: AUTOMOBILE ENGINEERING

(3 credits - 45 hours)

Objective: *This course is an introduction to the description and working of various mechanical parts of an automotive vehicle. After learning the course students will be able to understand the usage of mechanical components and their assembly. As there is a growing demand for design and development of modern environment friendly vehicles, this course serves as an introduction to enable students to develop better technologies.*

Module I: Automobile components (9 hours)

- a) History and development of Automobiles, classification, layout of various components in an automobile, design considerations and materials.
- b) Various parts: chassis, frame and body, aerodynamic considerations,

- c) Various types of engines: Identification of petrol, diesel, gas and hybrid engines, Inline, Radial and V engines, Overhead Camshaft (OHC) engine, CRDI engine, Introduction to Single point injection or Throttle Body injection (TBI) engine and Multi point Injection (MPI) engine.
- d) Tyres (with tube and tubeless, radial) and spark plugs (heat range, hot and cold).

Module II: Transmission System (9 hours)

- a) Clutch: types and working.
- b) Gearbox: classification, sliding mesh, constant mesh and synchro-mesh gear boxes, Gear shifting mechanism.
- c) Manual transmission, Automatic transmission: torque converters, epicyclic gear train, freewheeling mechanism, propeller shaft and universal joint. Final drive: rear axle, mounting methods, differential mechanism.

Module III: Suspension system (9 hours)

- a) History, functions and requirements, elements of a suspension system, loads and characteristics.
- b) Springs: leaf, coil and torsion bar, air springs.
- c) Shock absorbers: dampers. Different types of suspension systems. Wheels and tyres.

Module IV: Automotive mechanisms and systems (14 hours)

- a) Steering mechanism: function and requirements, layout of steering system, front axle and stub axles, steering linkages, cornering force and self-righting torque, power steering.
- b) Braking mechanism: function and requirements, classification, mechanical and hydraulic brakes, air brake, brake efficiency. Antilock braking systems (ABS).
- c) Four wheel drive mechanism, variable valve timing (VVT) technology, d) Cooling and Lubrication systems, SAE grades for lubricant oils used.
- e) Exhaust system and Emission control system. f) Vehicle safety systems.

Module IV: Introduction to Eco-friendly Vehicles

- a) Electric and hybrid vehicles b) Fuel cell operated vehicles

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** Relate different aspects of mechanical design to automobile engineering. (Remembering)
- CO2:** Classify and interpret various assembly of an automobile. (Understanding)
- CO3:** Apply the knowledge of theories of mechanical engineering in manufacturing automotive parts. (Applying)
- CO4:** Distinguish between different terminologies of an automobile. (Analysing)
- CO6:** Examine the performance of transmission, suspension, steering and different linkages. (Analysing)
- CO7:** Determine various factors related to automobile aerodynamics. (Evaluating)
- CO5:** Predict the problems in a faulty automotive part. (Creating)

Suggested Readings

1. P. S. Gill, Automobile Engineering I and II, S. K. Kataria and sons.
2. D. S. Kumar, Automobile Engineering, S. K. Kataria and sons.
3. K. K. Jain, R. B. Asthana, Automobile Engineering, Tata McGraw Hill publishing co. Ltd.
4. R K. Rajput, A Textbook of Automobile Engineering, Laxmi Publications (P) Ltd.

MNHT0031: HEAT TRANSFER I

(4 credits-60 hours)

Objective: *The course objective of the following course is to understand the two main modes of heat transfer viz. conduction and convection. The understanding of conduction and convection mode of heat transfer will enable student to design and analyse different types of advanced heat transfer problems.*

Module I Introduction and Basic Concepts (5 hours)

Introduction, Application areas of heat transfer, Modes and Laws of heat transfer.

Module II Conduction (20 hours)

- a) Three dimensional heat conduction equation in Cartesian coordinates and its simplified equations, thermal conductivity, thermal diffusivity.
- b) One dimensional steady state heat conduction without heat generation: Heat conduction in plane wall, composite slab, composite cylinder, composite sphere, electrical analogy, concept of thermal resistance and conductance, three dimensional heat conduction equations in cylindrical and spherical coordinates and its reduction to one dimensional form, critical radius of insulation for cylinders and spheres.
- c) One dimensional steady state heat conduction with heat generation: Heat conduction with uniform heat generation in plane wall, cylinder and sphere with different boundary conditions.
- d) Transient heat conduction: Validity and criteria of lumped system analysis, Biot and Fourier number, Time constant and response of thermocouple.

Module III Boundary Conditions and Extended Surfaces (10 hours)

Boundary and initial conditions: Temperature boundary condition, heat flux boundary condition, convection boundary condition, radiation boundary condition. Heat transfer through extended surface: Types of fins, Governing Equation for constant cross sectional area fins, solution for infinitely long and adequately long (with insulated end) fins and short fins, efficiency and effectiveness of fins.

Module IV Convection (25 hours)

- a) Fundamentals of convection: Boundary layer concept, Basic governing equations, Mechanism of natural and forced convection, local and average heat transfer coefficient, Reynolds Number, Prandtl Number.
- b) Forced Convection: Introduction, laminar boundary layer equations on a flat plate and in a tube, laminar forced convection on a flat plate and in a tube, empirical correlation for forced convection.
- c) Natural Convection: Introduction, laminar boundary layer equations of free convection on a vertical flat-plate, concept of Grashoff Number, Empirical correlations for vertical plates, horizontal plates, inclined surface, vertical and horizontal cylinders, spheres.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** define different mode of heat transfer. (Remembering)
- CO2:** recall the basic laws of heat transfer. (Remembering)
- CO3:** illustrate various mode of heat transfer application. (Understanding)
- CO4:** interpret heat conduction equation for different geometrical shape. (Evaluating)

- CO5:** model forced and free convection governing equation. (Applying)
CO6: Analyse mechanism of free and forced convection. (Analysing)
CO7: compare differences between heat conduction and heat convection. (Analysing)
CO8: Analyse various factors effecting heat conduction and heat convection. (Analysing)
CO9: compare heat conduction equation for different geometrical shape under different boundary condition. (Evaluating)
CO10: assess various empirical correlation of forced convection and free convection. (Evaluating)
CO11: estimate the engineering appliances by knowledge of heat conduction and heat convection. (Creating)

Suggested Readings

1. R.C. Sachdeva "Fundamental of Engineering Heat & Mass Transfer" New Age
2. F. P. Incropera, D.P. Dewitt, "Fundamentals of Heat and Mass Transfer" John Wiley.
3. Y. A. Cengel and A.J. Ghajar, "Heat and Mass Transfer Fundamentals and Applications" Tata McGraw Hill Education Private Limited.
4. S.P. Sukhatme, "A Textbook on Heat Transfer" Universities Press.
5. A.F. Mills, "Basic Heat and Mass Transfer" Pearson.
6. M.N. Ozisik "Heat and Mass transfer A basic approach" Tata McGraw-Hill
7. P. S. Ghoshdastidar "Heat Transfer" Oxford

MNHT0032: HEAT TRANSFER II

(3 credits-45 hours)

Objective: This course is a further extension of Heat Transfer I. The objective is to make students able to understand the mode of radiation heat transfer and phase change heat transfer in depth. The outcome of the present course will help the students to model and analyse advanced heat exchangers and advanced energy systems.

Module I Radiation Heat Transfer (8 hours)

Nature and laws of thermal radiation, emissive power, Absorption, Reflection and Transmission, Concept of a black body, Intensity of Radiation, Laws of black body radiation, Radiation to and from surfaces.

Module II Radiation: Exchange between Surfaces (15 hours)

Radiation between two black bodies, Radiation shape factor (View factor) and its properties, Shape factors for different geometries, Radiation between two infinite parallel plates, Radiation between two infinitely long concentric cylinders, Radiation between two gray bodies, Electrical Network Analogy for thermal radiation, Radiation shields.

Module III Heat Exchanger analysis and design (12 hours)

Classification and applications, Overall heat transfer coefficient, Fouling factor, LMTD method of analysis for parallel and counter flow, Effectiveness-NTU Method for parallel and counterflow heat exchanger, Introduction to cross flow heat exchanger, Shell and Tube Heat exchanger, LMTD correction factor.

Module IV Phase Change Heat Transfer and Mass Transfer (10 hours)

- a) Boiling heat transfer, types of boiling, Pool boiling curve, Correlations of Boiling Heat Transfer, Condensation heat transfer, Dropwise condensation, Filmwise condensation, Laminar film condensation on a vertical plate- Nusselt's theory, Condensation on Horizontal tubes.

- b) Mass transfer by molecular diffusion: Fick's law of diffusion, Diffusion coefficient, Concentration boundary layer and mass transfer coefficient, Analogy between momentum, heat and mass transfer.

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** define black body and state laws of black body. (Remembering)
- CO2:** illustrate the concept of shape factors and its properties. (Understanding)
- CO3:** classify various heat exchanger and its applications. (Understanding)
- CO4:** apply thermal radiation laws to different geometrical elements. (Applying)
- CO5:** determine various parameters to design heat exchanger by using LMTD method and NTU method. (Applying)
- CO6:** Analyse effectiveness of parallel and counter flow heat exchanger. (Analysing)
- CO7:** assess the correlations of boiling and condensation of heat transfer. (Evaluating)
- CO8:** evaluate the design parameters of heat exchanger. (Evaluating)
- CO9:** estimate the electrical network analogy for radiation. (Creating)

Suggested Readings

1. R.C. Sachdeva "Fundamental of Engineering Heat & Mass Transfer" New Age
2. F. P. Incropera, D.P. Dewitt, "Fundamentals of Heat and Mass Transfer" John Wiley.
3. Y. A. Cengel and A.J. Ghajar, "Heat and Mass Transfer Fundamentals and Applications" Tata McGraw Hill Education Private Limited.
4. S.P. Sukhatme, "A Textbook on Heat Transfer" Universities Press.
5. A.F. Mills, "Basic Heat and Mass Transfer" Pearson.
6. W. Kays, "Convective Heat Transfer" Mc Graw Hills Publications.
7. P. S. Ghoshdastidar "Heat Transfer" Oxford.
8. Dr. D.S. Kumar, "Heat and Mass Transfer" S.K. Kataria and Sons.
9. P.K. Nag, "Heat and Mass Transfer" Mc Graw Hill Publications.

MNIC0033: INTERNAL COMBUSTION ENGINES

(3 credits-45 hours)

Objective: This course studies the fundamentals of how the design and operation of internal combustion engines affect their performance, operation, fuel requirements, and environmental impact. Topics include fluid flow, thermodynamics, combustion, heat transfer and friction phenomena, and fuel properties, with reference to engine power, efficiency, and emissions.

Module I: Air-standard cycle and performance of I C Engines (15 hours)

Basic types of engines, Engine components and Basic engine nomenclature, I.C. Engine Classification, 4-stroke and 2- stroke engines, Comparison of S.I. and C.I. engines, performance parameter, air standard cycle- Otto cycle, Diesel cycle and Dual Cycle, Comparison of Otto, Diesel and Dual Combustion Cycles, Atkinson Cycle, fuel air cycles, effect of variation of specific heats, fuel-air ratio, compression ratio and dissociation,. Actual cycles, losses in actual cycle, Performance parameter: BHP, IHP, Mechanical Efficiency, BSFC and Methods for their measurement.

Module II: Carburetor, Diesel Injection and Ignition Systems (12 hours)

- a) Elementary carburetor, complete carburetor, air fuel ratio, stoichiometric ratio, Spark plug, Magneto and battery ignition system, fuel pump, drawbacks of carburetor and introduction of multi-point fuel injection.

- b) Diesel injection system, fuel pump, injectors and nozzles. c) Firing order, Ignition timing, and valve timing diagram.

Module III: Combustion, Supercharging (12 hours)

- a) Combustion in S.I and C.I engines, Parameters influencing combustion, Detonation and knocking in S.I. and C.I. engines and their prevention, Combustion chamber types, Basic principles of combustion chamber in I.C. engines,
 b) Supercharging, Thermodynamic cycle with supercharging, supercharging power, Supercharging of I.C. engines, Effect of supercharging on performance of the engine, Turbocharging

Module IV: Lubrication system, Cooling system and Fuels of I.C. Engines (6 hours)

- a) Lubrication and cooling of I.C. engines, properties of lubricating oils
 b) Classification and desirable characteristics of I.C. engine fuels, Rating of S.I. and C.I. engine fuels: Octane number (RON and MON), Cetane number, CFR engine, Alternative fuels (liquid, gaseous, etc.)
 c) Greenhouse gases and Exhaust emissions from I. C. engines (Pollutants: CO, HC, NO_x, and PM)
 d) Environmental effects of I. C. engine exhaust pollutants, Introduction to Catalytic converters and other technological changes in I C engines for control.

COURSE/LEARNING OUTCOMES

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

- C01:** To introduce and define various basic cycles applicable to IC engines, advancement of engine technology and pollution from IC engines using visual aids of learning methodology. (*Knowledge*)
C02: To classify and identify the various differences of the engine cycles and technology in order to interpret them. (*Comprehension*)
C03: To find out various performance parameters through numerical problems. (*Application*)
C04: To critically Analyse various results of engine performance to understand the difference among various parameters. (*Analysis*)
C05: To generalize the results obtained through numerical approach and comment with suitable conclusion and future study if any. (*Synthesis*)
C06: A careful evaluation of the overall study can be made with proper references from E Learning resources available. (*Evaluation*)

Suggested Readings

1. M.L. Mathur and R. P. Sharma, "Internal Combustion Engine," Dhanpat Rai company Ltd.
2. R.K. Rajput, "Internal Combustion Engine", Laxmi publication.
3. S.K. Agrawal, "Internal combustion engine", New age
4. V. Ganesan, "Internal combustion engine", Tata McGraw Hill.

MNEM0034: ENGINEERING MECHANICS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objective: To develop the ability of the engineering students to Analyse physical engineering problems in a simple and logical manner; to apply the basic principles and concepts of mechanics to obtain a feasible solution and reach at a conclusion. To understand the kinetics and dynamics of motion and concept of vibration and its effect on a system.

Module I: Introduction (9 hours)

- a) Force Systems Basic concepts, Particle equilibrium in 2-D and 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.
- b) Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack and differential screw jack.

Module II: Basic Structural Analysis (8 hours)

Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams and types of beams; Frames and Machines;

Module III: Centroid and Moment of Inertia (8 hours)

Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Module IV: Virtual Work and Energy Method (8 hours)

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy(elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Module V: Kinetics and Dynamics (9 hours)

- a) Particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton’s 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).
- b) Introduction to Kinetics of Rigid Bodies- Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D’Alembert’s principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

Module VI: Introduction to Mechanical Vibration (8 hours)

Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums

COURSE/LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** Define various principles, definitions, theorem related to mechanics.
- CO2:** Compare and identify the various types of beams, frames and the effect of different loading on them
- CO3:** Apply the concept of virtual work for relevant problem solving

- CO4:** Analyse the different truss and frames for its suitability considering various given constraints.
- CO5:** Appreciate the importance of the knowledge of vibration and its effect on a system
- CO6:** Solve various simple day to day life problems within the applicable constraints and communicate the solution effectively.

Suggested Readings

1. Engineering Mechanics, Mariam and Craig, Wiley.
2. Engineering Mechanics by S. Timoshenko and D.H. Young, McGraw Hill Int
3. Engineering Mechanics by R.K. Banshal, Laxmi Publication (P) Ltd.
4. Engineering Mechanics by K.L. Kumar, McGraw Publishing Co.
5. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
6. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, Dynamics, 9th Ed, Tata McGraw Hill.
7. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
8. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education.
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand and Co.

MNBT0035: BASIC THERMODYNAMICS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objectives:

- To learn about work and heat interactions, and balance of energy between system and its surroundings.
- To learn about application of I law to various energy conversion devices.
- To evaluate the changes in properties of substances in various processes.
- To understand the working of petrol and diesel engines.

Module I: Fundamental and Basic Concepts (15 hours)

Fundamentals - System and Control volume; Property, State and Process; Exact and Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers. Definition of heat; examples of heat/work interaction in systems. First Law for Cyclic and Non-cyclic processes; Concept of total energy E; Demonstration that E is a property; various modes of energy, Internal energy and Enthalpy.

Module II: First and Second Law of Thermodynamics (15 hours)

- a) First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.
- b) Second law : Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Carnot's theorem, Corollary of Carnot theorem, Absolute thermodynamic temperature scale, Clausius theorem; Definition of entropy S ; Demonstration that entropy S is a property; Inequality of Clausius, Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines

and nozzles. Irreversibility and Availability, Availability functions for systems and Control volumes undergoing different processes, Lost work. Second law efficiency.

Module III: Properties of Pure Substance and Gas Mixtures (10 hours)

Definition of Pure substance, p-v diagram, p-T diagram, p-v-T diagram, T-s diagram for a Pure Substance, h-s diagram or Mollier diagram, Dryness Fraction, Charts of Thermodynamic Properties. Equation of State of a Gas, Ideal Gas, Specific Heats, Internal Energy, Enthalpy and Entropy of an Ideal Gas, Equations of State, Compressibility Charts, Properties of Mixtures of Gases-Dalton's law of Partial Pressures, Internal Energy, Enthalpy and Specific Heats of Gas Mixtures.

Module IV: Internal Combustion Engine (10 hours)

Definition of Engine, classification of IC Engines, Performance Parameters, Working principle of 4-stroke and 2-stroke engine, Petrol Engine, Diesel Engine, Comparison between Petrol and Diesel Engine.

COURSE /LEARNING OUTCOMES:

After completing the course successfully the students will be able to

- CO1:** recall the basic definitions and terminology of thermodynamic system. (Remembering)
- CO2:** relate the work done and heat transferred for various types of thermodynamic processes. (Understanding)
- CO3:** apply the Steady Flow Energy Equation (SFEE) for various devices. (Applying)
- CO4:** Distinguish between the first law and second law of thermodynamics. (Analysing)
- CO5:** Determine the first law efficiency of air standard cycles. (Evaluating)
- CO6:** Elaborate the importance of petrol and diesel engines. (Creating)

Suggested Readings

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India.
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

MNAP0036: APPLIED THERMODYNAMICS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objectives:

- *To learn about the operating parameters of vapour power cycles.*
- *To understand about the properties of dry and wet air and the principles of psychrometry.*
- *To learn about gas dynamics of air flow and steam through nozzles.*
- *To learn about reciprocating compressors with and without intercooling.*
- *To Analyse the performance of steam turbines.*

Module I: Vapour and Gas Power Cycles (10 hours)

- a) Simple Steam Power Cycle, Rankine Cycle, Actual Vapour Cycle Processes, Comparison of Rankine and Carnot Cycles, Mean Temperature of Heat Addition, Reheat Cycle, Regeneration-Open Feedwater Heater, Reheat-Regenerative Cycle, Characteristics of an Ideal Working Fluid, Binary Vapour Cycles.

- b) Gas power cycles, Air standard Cycles- Otto, Diesel and Dual cycles, Comparison of Otto, Diesel and Dual Cycles, Brayton cycle, effect of reheat, regeneration and intercooling.

Module II: Refrigeration and Psychrometry (10 hours)

Reversed Carnot Cycle, Unit of Refrigeration, Limitation of Reversed Carnot Cycle, Gas Refrigeration Cycle, Vapor compression refrigeration cycles, p-h diagram. Properties of Atmospheric Air, Psychrometric Properties of Air, Psychrometric Chart.

Module III: Compressible Flow (10 hours)

Velocity of Pressure Pulse in Fluid, Stagnation properties, Mach Number, Property Relations for Isentropic Flow through a Duct, One Dimensional Steady Isentropic Flow, Critical Properties-Choking in Isentropic Flow, Normal Shocks, use of ideal gas tables for isentropic flow and normal shock flow, Flow through Actual Nozzles and Diffusers, Effect of Irreversibilities on Nozzle Efficiency.

Module IV: Compressors and Steam Turbines (10 hours)

- a) Classification, Reciprocating Compressor Terminology, Work of Compression, Single stage Reciprocating Air Compressor, Volumetric Efficiency, Limitations of Single Stage Compression, Multistage Compression.
- b) Classification of Steam Turbines, Simple Impulse Turbine, Optimum Operating Conditions from Blade-Velocity Diagram, Effect of Blade Friction on Velocity Diagram, Compounding of Impulse Turbine, Reaction Turbine, Comparison between Impulse and Reaction Turbines, Losses in Steam Turbines.

Module V: Fuels and Combustion (10 hours)

Characteristics of an Ideal Fuel, Liquid Fuel, Gaseous Fuel, Combustion, Amount of Air Required for Combustion, Air-Fuel Ratio, Air-Fuel Ratio from Analysis of Flue Gases, Heat Generated by Combustion, Standard Reference State, Enthalpy of Formation, Enthalpy of Reaction, Calorific value of Fuel.

COURSE/ LEARNING OUTCOMES

After completing the course successfully the students will be able to-

- CO1:** Define the thermodynamic processes of a Rankine cycle. (Remembering)
- CO2:** Illustrate the mathematical equations to solve thermodynamics problems. (Understanding)
- CO4:** Identify the losses in a steam turbine. (Applying)
- CO3:** Compute and *Analyse* the performance and characteristics of reversible thermodynamic cycles. (Analysing)
- CO5:** Compare the different types of fluid flow based on Mach Number. (Evaluating)
- CO6:** Conclude solution to thermodynamic problems in steam power plant, gas turbine plant and refrigeration systems. (Creating)

Suggested Readings

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India.
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

MNFM0037: FLUID MECHANICS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objective: *This is an introduction in mechanics of fluid motion. It is designed to establish fundamental knowledge of basic fluids mechanics and hydraulic machines. It addresses specific topics relevant to simple applications in field of fluids as well hydraulics machines.*

Module I: Fluid statics (6 hours)

Definition of fluid, Units and dimensions-Properties of fluids, Pascal law, Pressure measurement manometer, types of manometer and its application, Newton's law of viscosity, Forces on submerged plane and curved surfaces, buoyant force, metacentre, centre of buoyancy, equilibrium of floating and submerged body.

Module II: Fluid kinematics and dynamics (11 hours)

Types of fluid flow: steady, unsteady, uniform, non uniform, laminar, turbulent, compressible, incompressible, rotational, irrotational, one, two, three dimensional flows, velocity, acceleration, Velocity potential function, Stream function. Control volume- application of continuity equation and momentum equation, flow net, Vortex flow Bernoulli's equation and its applications to Venturimeter, Orificemeter and Pitot tube and Notches.

Module III: Laminar and Turbulent flow (15 hours)

Exact flow solutions in channels and ducts, Laminar flow, Velocity distribution, mean velocity, velocity profile Kinetic energy factor and momentum Couette and Poiseuille flow, laminar flow through circular conduits and circular annuli. Turbulent flow: Reynold's experiment, laws of fluid friction, shear stress, types of boundary, Prandtl length concept, velocity distribution, mean velocity, velocity profile, resistance to flow in smooth and rough pipes, Darcy Weisbach equation, friction factor, Moody's diagram.

Module IV: Boundary layer theory (7 hours)

Concept of boundary layer, laminar boundary layer, turbulent boundary layer, Laminar sub layer, Boundary layer thickness, displacement thickness, momentum thickness, energy thickness. Flow around submerged bodies- Introduction to concept and expression of drag and lift, pressure drag and friction drag, Streamlined and Bluff bodies.

Module V: Dimensional and Model analysis(4 hours)

Need for dimensional analysis, Buckingham's pi theorem and its application. Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.

Module VI: Hydraulic Pumps (9 hours)

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle.

Module VII: Hydraulic Turbine (8 hours)

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the properties of fluids and characteristic of hydraulics machines .
(Remembering)

- CO2:** Recall basic fundamental law of fluid mechanics and governing equations of hydraulic system. (*Remembering*)
- CO3:** Classify different types of fluids, types of fluid flow and various hydraulics equipments (*Understanding*)
- CO4:** Apply fundamental concepts of fluid mechanics and hydraulic system to engineering application. (*Applying*)
- CO5:** Analyse fluid flow problems with the application of fluid mechanics laws, using dimensional and model analysis . (*Analysing*)
- CO6:** Evaluate various results to estimate the performance of fluid mechanics system and hydraulic (*Evaluating*)
- CO7:** Improve any fluid and hydraulic system. (*Creating*)

Suggested Readings:

1. Sukumar Pati, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill
2. Dr. R.K. Bansal, Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications
3. R.K Rajput, Text book on Fluid Mechanics and Hydraulic Machines, S. Chand
4. Y. A. Cengel, Fluid Mechanics Fundamentals and Applications, Tata McGraw Hill
5. P.N. Modi and S.M. Seth, Hydraulics and fluid Mechanics including hydraulics machines, Standard Book House.

MNSM0038: STRENGTH OF MATERIALS

(4 Credits-60 hours)(L-T-P: 3-1-0)

Objectives:

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
- To calculate the elastic deformation occurring in various simple geometries for different types of loading

Module I (8 Hours)

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.

Module II (8 Hours)

Beams and types transverse loading on beams- shear force and bend moment diagrams-Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Module III (8 Hours)

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Module IV (8 Hours)

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Module V (8 Hours)

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

COURSE/LEARNING OUTCOMES

- CO1:** Define and relate basic definitions of important terminologies used to characterize solid mechanics problems. (Remembering)
- CO2:** Explain various loading conditions and stress regimes prevalent under various loading and boundary conditions. ((Understanding)
- CO3:** Solve various problems related to stresses in beams, cylinders, columns and prismatic bodies subjected to combinations loading. (Applying)
- CO4:** Analyse various stress states using both analytical and graphical techniques. (Analysing)
- CO5:** Compare existing stressed mechanical systems with theoretical results to predict failure. (Evaluating)
- CO6:** Design and improve mechanical systems through exhaustive knowledge of stress and its effects on deformation behaviour. (Creating)

Suggested Readings

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Beer, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

MNSE0039: MATERIAL SCIENCE AND ENGINEERING

(3 Credits-45 hours)(L-T-P: 3-0-0)

Objectives:

- *Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.*
- *To provide a detailed interpretation of equilibrium phase diagrams*
- *Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.*

Module I (6 hours)

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Module II (6 hours)

Mechanical Property measurement: Tensile, Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Module III (8 hours)

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to

Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to nondestructive testing (NDT)

Module IV (6 hours)

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Module V (6 hours)

Heat treatment of Steel: Annealing, tempering, normalizing and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

Module VI (8 hours)

a) Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

COURSE/ LEARNING OUTCOMES

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

- CO1:** know *How* to quantify mechanical integrity and failure in materials. (Remembering)
- CO2:** Explain how to tailor material properties of ferrous and non-ferrous alloys. (Understanding)
- CO3:** Identify crystal structures for various materials and understand the defects in such structures. (Applying)
- CO4:** Analyse the hardness of different constituents of microstructure using different hardness testers also to list the prominent non-metallic materials available for engineering applications. (Analysing)
- CO5:** Evaluate the important steps in different types of phase transformations. (Evaluating)
- CO6:** Develop the ability to identify the concepts of alloy design, phase diagrams and strengthening mechanisms and apply them to materials systems. (Creating)

Suggested Readings

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering", Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011

MNIC0040: INSTRUMENTATION AND CONTROL

(3 Credits-45 hours)(L-T-P: 3-0-0)

Objectives:

- *To provide a basic knowledge about measurement systems and their components*
- *To learn about various sensors used for measurement of mechanical quantities*

3. To learn about system stability and control
4. To integrate the measurement systems with the process for process monitoring and control

Module I (10 hours)

Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements. Mechanical and Electromechanical sensor: Resistive (potentiometric type), Strain gauge, Inductive sensor, LVDT, Proximity sensor, Capacitive sensors, Stretched diaphragm type, Piezoelectric, Thermal sensors: Material expansion type: solid, liquid, gas and vapor, Resistance change type: RTD materials, tip sensitive and stem sensitive type, Thermister material, shape, ranges and accuracy specification. Thermoemf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison. Pyroelectric type, Magnetic sensors, Introduction to smart sensors.

Module II (12 hours)

Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric; Control systems – basic elements, open/closed loop, design of block diagram. Types of control system: Servomechanism and regulator, examples of feedback control system.

Module III (8 hours)

Control method – P, PI, PID, when to choose what, tuning of controllers; System models, transfer function and system response, frequency response; Nyquist diagrams and their use.

Module IV (6 hours)

Practical group based project utilizing above concepts.

COURSE/ LEARNING OUTCOMES

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

- CO1:** Define the basic terminologies related to instrumentation and control system. (Remembering)
- CO2:** Demonstrate the measurement of various quantities using instruments, their accuracy and range, and the techniques for controlling devices automatically. (Understanding)
- CO3:** Model and Analyse transducers. (Applying)
- CO4:** Apply advanced control theory to practical engineering problems. (Applying)
- CO5:** Analyse Instrumentation systems and their applications in various industries. (Analysing)
- CO6:** Evaluate, review, prepare and present technological developments. (Evaluating)
- CO7:** Develop or solve engineering hardware and problems. (Creating)

Suggested Readings

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200
2. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York, 1999.

MNME0041: ELEMENTS OF MECHANICAL ENGINEERING**Objectives:**

- *To learn about the 1st and 2nd law of thermodynamics.*
- *To understand the working of petrol and diesel engines.*
- *To interpret the different types of manufacturing processes and their applicability.*
- *To familiarize with the belt drive and gear drive.*

Module I Thermodynamics (10 Hours)

Thermodynamics system, surrounding and boundary, thermodynamic properties, path, processes and cycle, Macroscopic and Microscopic approach, Thermodynamic equilibrium, Pressure and Temperature, Zeroth Law of Thermodynamic. Displacement work, path function, point function, Work done for constant volume, constant pressure, isothermal, adiabatic and polytropic processes, Internal energy, enthalpy specific heat at constant pressure and volume. First Law of Thermodynamic and its application to non-steady flow systems, Steady flow energy equation, Limitation of First Law of Thermodynamic, Second Law of Thermodynamic, Clausius and Kelvin Planck Statements, concept of Entropy.

Module II Applications of Thermodynamics (10 Hours)

Engine, Classification, Definition of Brake power, indicated power, friction power, BTE, ITE, calorific value of fuel, Stoichiometric air-fuel ratio, Engine Terminology- bore, compression ratio, swept volume, clearance volume etc. Difference between 4-stroke and 2-stroke engine, comparison of petrol and diesel engine, simple problems related to performance parameters of IC engine, Classification of boilers, Fire Tube boiler- Cochran and Lancashire boiler, Watertube boiler- Babcock wilcox boiler, Advantages and disadvantages of firetube and water tube boilers.

Module III Manufacturing Technology (10 hours)

Types of materials: Ferrous metals, Non-Ferrous Metals, Alloys and Composites, Casting- Sand casting, Types of Pattern, Pattern Materials, Solidification time, Casting Defects. Metal Forming Techniques- Rolling, Forging, Extrusion, Deep Drawing. Simple Problems on Rolling, Welding- Classification, Arc Welding, Problems related to Open Circuit Voltage-Short Circuit Current characteristics, Welding speed, Gas Welding, Types of Flame, Flux, Slag, working of oxy-acetylene welding.

Module IV Theory of Machines (10 Hours)

Resistant Body, Link, Difference between machine and structure, types of link, Kinematic pair, constrained motions, kinematic chain, mechanism, degree of freedom, types of joints, simple problems.

Types of Belts and Gears, Transmission of Power by Belts and Gear Trains, Simple Belt Drive and Simple Gear Drive, Velocity Ratio, simple problems.

COURSE/ LEARNING OUTCOMES:

After the completion of the course the students will be able to:

- CO1:** define a thermodynamic system and surroundings.
- CO2:** relate the first and second law of thermodynamics in practical applications.
- CO3:** classify the internal combustion engines on the basis of working substance and stroke execution.
- CO4:** explain the application of alloys and composites in practical applications.

CO5: Analyse the manufacturing processes with respect to its applications.

CO6: compare the advantage and limitation of firetube and watertube boilers.

Suggested Readings:

- 1) Nag P. K., "Engineering Thermodynamics", 4th Edition, Tata McGraw Hill.
- 2) Chattopadhyay, P., "Engineering Thermodynamics", 2nd Edition, Oxford.
- 3) Domkundwar S., Kothandaraman C.P., "A Course in Thermal Engineering", 6th Edition, Dhanpat Rai & Co (p) Ltd.
- 4) Sharma P.C. "Production Technology" S. Chand.
- 5) Singh V.P. "Theory of Machines" Dhanpat Rai & Co.

MNEE0042: ENGINEERING MECHANICS FOR ELECTRONICS AND ELECTRICAL

(4 credits-60 hours)(L-T-P:3-1-0)

Objective:

Module I: Introduction to vectors and tensors, co-ordinate systems and Three-dimensional Rotation (9 hours)

- a) Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.
- b) Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

Module II: Kinematics and Kinetics of Rigid Body (11 hours)

- a) Kinematics of rigid bodies: Definition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.
- b) Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Definition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

Module III: Free Body Diagram and Bending Moment (6 hour)

- a) Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.
- b) Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

Module IV: General Motion and Torsional Motion (11 hours)

- a) Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.
- b) Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Module V: Friction (3 hours)

Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

COURSE/LEARNING OUTCOMES:

After completing the course successfully the students will be able to-

- CO1:** Define various principles, definitions, theorem related to mechanics; understand the different coordinate systems and their transformation. (Remembering)
- CO2:** Compare the various types of beams and the effect of different loading on them. (Understanding)
- CO3:** Apply the concept of virtual work for relevant problem solving. (Applying)
- CO4:** Appreciate the various types of motions and their effects on a body. (Evaluating)
- CO5:** Draw the FBD for various situations. (Creating)
- CO6:** Solve various simple day to day life problems within the applicable constraints and communicate the solution effectively. (Creating)

Suggested Reading:

1. J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
2. M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.

LAB COURSES

MNTM6008: THEORY OF MACHINES LAB

(2 credits)

List of Experiments for Theory of Machines Lab

1. Study of various types of Kinematic links, pairs, chains and Mechanisms.
2. Study of inversions of four bar Mechanisms, Single and double slider crank mechanisms.
3. Study of various types of cam and follower arrangement.
4. Study of gyroscope and gyroscopic effect/couple.
5. Study of various types of gears – Helical, cross helical, worm, bevel gear.
6. Study of various types of gear trains – simple, compound, reverted, epicyclic and differential.
7. Study of different types of brakes and dynamometers.
8. Determination of the sleeve lift for various speeds of a Hartnell governor.
9. To plot follower displacement vs Cam rotation for various cam follower systems.
10. Investigation of balancing of rotating mass.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Name various mechanisms, their inversions, relative motions and different constituting elements. (Remembering)
- CO2:** Interpret the working and use of various gears and gear train. (Understanding)
- CO3:** Experiment with governor; cam and follower mechanism. (Applying)
- CO4:** Inspect the similarity and difference between various governors, brakes and dynamometers. (Analysing)
- CO5:** Judge a mechanical systems for its suitability for a particular application based on

some constraints. (Evaluating)

CO6: Construct a cam profile for a particular application. (Creating)

CO7: Synthesize a rotational mass system which is statically and dynamically balanced. (Creating)

MNAT6009/ MNTD6021: APPLIED THERMODYNAMICS LAB/ THERMODYNAMICS LAB

(2 credits)

List of Experiments for Applied Thermodynamics Lab

1. Determination of dryness fraction of combined separating and throttling calorimeter
2. Study working model of steam turbine
3. To determine the coefficient of performance of refrigeration system
4. Study and performance test of single acting air compression
5. Study and performance test of rotary compression
6. Study and performance test of condenser unit
7. Study and performance test of air condition unit
8. To analyse the humidification heating, cooling and dehumidification process and plot them on psychrometric charts
9. To determine the bypass factor of cooling and heating coils of air conditioner

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: list the different types of mechanical devices related with the phenomenon of energy conversion technologies. (Remembering)

CO2: illustrate the basic working principle of various mechanical accessories and their purpose of incorporation in the testing unit. (Understanding)

CO 3: develop the practical utility of the experimental setup. (Applying)

CO4: Analyse the modelling and performance of various energy systems and their accessories. (Analysing)

CO 5: compare the COP of different refrigeration systems. (Analysing)

CO 6: assess the importance of relevant experimental set ups for their practical applicability in automotive industries. (Evaluating)

CO 7: estimate the factors affecting the performance of energy systems as well as underline the cause of variation in practical results with that of the theoretical one. (Creating)

MNHY6010: HYDRAULICS LAB

(2 credits)

1. Hydraulic ram testing rig
2. Submersible pump testing rig
3. Reciprocating pump testing rig
4. Centrifugal pump testing rig
5. Francis turbine testing rig
6. Pelton turbine testing rig

7. Demonstration of Kaplan turbine

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** recall working principle of various hydraulic equipments. (Remembering)
- CO2:** explain the basic operation of various hydraulic equipments. (Understanding)
- CO3:** apply the basic mathematical formulae to determine the characteristics of various hydraulic equipments. (Applying)
- CO4:** Analyse the characteristics parameter of various hydraulic equipments. (Analysing)
- CO5:** evaluate the characteristics parameter of various hydraulic equipments. (Evaluating)
- CO6:** elaborate the characteristics parameter of various hydraulic equipments. (Creating)

MNMI6011: MINI PROJECT I

(2 credits)

***Objective:** The mini project is the first step to prepare the students for the major project. It should enable the students to apply the subject knowledge they gained and to develop their ideas in the different areas such as fluid and thermal, Design and Manufacturing under the guidance of expert and dedicated faculty members.*

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Relate the knowledge of mechanical engineering outcome in practical scenario. (Remembering)
- CO2:** Extend the domain knowledge in the form of product, fabrication, research, extensive study or survey. (Understanding)
- CO3:** Make use of project to solve the problem. (Applying)
- CO4:** Analyse the performance of the project. (Analysing)
- CO5:** Criticize the model/project with its further development scope. (Evaluating)
- CO6:** Develop a model and demonstrate the performance of the fabricated model/project. (Creating)

MNMM6013: ENGINEERING METROLOGY AND MEASUREMENT LAB

(2 credits)

1. Use of Vernier caliper, micrometer, depth gauge and height gauge –source of error in Measurement ideas on range, precision and accuracy/Calibration of Vernier / Micrometer / Dial Gauge
2. Study of Slip gauges and their use in linear measurements
3. Ideas on tolerance allowance, limits, fits.
4. Dial gauges their use in the measurement of small linear displacements, parallelism and concentricity.
5. Measurement of Angle using Sine bar
6. Study of Measurement of surface roughness, surface roughness parameters, surface finish evaluation
7. Measurement of straightness and flatness

8. Optical Profile Projector

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO 1:** Label various engineering measurement devices with its characteristics. (Remembering)
- CO 2:** Relate the theoretical learning into applications with various engineering measurement devices and tools. (Understanding)
- CO 3:** Make use of various measuring devices for taking different measurements. (Applying)
- CO 4:** Distinguish the implementations and critical use of various devices for precise measurement. (Analysing)
- CO 5:** Justify theoretical and practical knowledge into actual working environment for various measurement. (Evaluating)
- CO 6:** Elaborate the processes related to measurement in engineering and determine the use of various tools. (Creating)

MNMD6014: MACHINE DESIGN AND DRAWING LAB

(2 credits)

To design and draw (At least 5) of the following components under different safety limitations.

1. Screws
2. Shafts
3. Couplings
4. Gears
5. Joints
6. Springs
7. I.C. Engine parts.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Relate the theories of failure to design problems. (Remembering)
- CO2:** Illustrate assembly of mechanical elements with the help of drawing. (Understanding)
- CO3:** Apply the knowledge of design to find the safe dimensions. (Applying)
- CO4:** Compare the uses of cotter joint, knuckle joint, rigid flange coupling, riveted joint. (Analysing)
- CO5:** Select preferred values of machine parts from design data book. (Evaluating)
- CO6:** Estimate the suitable values of design parameters. (Creating)

MNMP6015: MINOR PROJECT

(2 credits)

The minor project is a step to prepare the student for the major project. It enables the student to apply the subject knowledge that they have gained and to develop their ideas in the different areas of mechanical engineering fields such as Thermal, Design, Fluid machinery, Manufacturing and Mechanical systems under the guidance of faculty members.

COURSE/LEARNING OUTCOMES

After successful completion of the Minor Project, student will be able to:

- CO1:** Remember the mechanisms and various laws of physics in constructing project models. (Remembering)
- CO2:** Summarize various challenges for the well-being of mankind. (Understanding)
- CO3:** Construct the process of literature review, project presentation, concept generation. (Applying)
- CO4:** Critically Analyse various results from survey made from literatures and other allied studies for the project. (Analysing)
- CO5:** Evaluate the quality of work by implementing proper mechanisms and laws. (Evaluating)
- CO6:** Develop new ideas/models for the proper utilization to mankind. (Creating)

MNVC6016: VIBRATION OF MECHANICAL SYSTEMS AND CONTROL LAB

(2 credits)

Perform any 8 experiments from the following

1. To find the natural frequency of simple pendulum
2. To find the natural frequency of compound pendulum
3. To determine radius of Gyration “K” of given pendulum.
4. To study the free vibration and to determine the natural frequency of vibration of Two- Rotor system.
5. To study the torsional vibration and to determine the natural frequency vibration of single rotor system.
6. Study of longitudinal vibration and to determine the frequency of vibration.
7. To study the damped torsional vibration and determine the damping coefficient.
8. Determination of whirling speed of shafts
9. To determine the stiffness of spring mass damper system.
10. Determination of Natural Frequencies of Free Damped Oscillations.
11. Determination of the Amplitude of Forced Damped Oscillations.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO 1:** Recall the basic use of laws of motion and to apply it on FBD. (Remembering)
- CO 2:** Recognize application of differential equation of two degree and of higher orders. (Understanding)
- CO 3:** Construct models of free and forced vibration systems and Analyse damped mechanical systems. (Applying)
- CO 4:** Explain linear mathematical models of real life engineering systems. (Understanding)
- CO 5:** Apply Newton’s equation of motion and energy methods to model basic vibrating mechanical systems. (Applying)
- CO 6:** Analyse vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation. (Analysing)

- CO 7:** Evaluate the motion and the natural frequency for free and forced vibration of a single degree of freedom damped or un-damped system. (Evaluating)
- CO 8:** Develop linear mathematical models of real life engineering systems. (Creating)

MNIC6017: INTERNAL COMBUSTION ENGINE LAB

(2 credits)

Perform any 8 experiments from the following

1. Study of Carburetor
2. Study of Fuel pump and injector
3. Study of Ignition System
4. Test on single cylinder Petrol engine for determination of power.
5. To prepare heat balance sheet on multi-cylinder diesel engine / petrol engine.
6. Test on variable compression ratio engine.
7. To prepare variable speed performance test of a multi-cylinder /single cylinder petrol engine / diesel engine and prepare the curve (i) bhp, ihp, fhp Vs Speed (ii) Volumetric efficiency & indicated specific fuel consumption Vs Speed.
8. To study and draw the valve timing diagram four stroke, single – cylinder diesel engine.
9. Assignment on any one advanced technology related to I.C. Engine.
10. Assignment on alternative fuels used in I.C. Engine.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** define various performance characteristics of IC engines. (Remembering)
- CO2:** classify and identify the study of carburettor, fuel pump and injector, ignition system for indulging a practical understanding. (Understanding)
- CO3:** model test in the laboratory for studying variable speed performance test of multi cylinder engine and Morse test. (Applying)
- CO4:** Analyse various results of petrol and diesel engines performance study to understand the difference among various parameters. (Analysing)
- CO5:** assess the results obtained by preparing curves and comment with suitable conclusion. (Evaluating)
- CO6:** estimate the results by doing further studies in the laboratory under various conditions. (Creating)

MNTS6018: TRAINING SEMINAR

(2 credits)

Objective: During the semester break at the end of the third year, students are required to undergo an Industrial Training. The purpose of the Industrial Training is to expose students to real-life industry situations, so that they may be able to apply the engineering knowledge and skills that they have gained through classroom teaching and lab activities, in an on-the-job situation. After the period of training, students are to present their experience in the form of reports and seminar presentations. Students will be evaluated on the seminar, viva voce examination and written reports.

COURSE/LEARNING OUTCOMES

At the end of Training Seminar students will be able to

- CO1:** Relate the actual machine parts over images. (Remembering)
- CO2:** Extend classroom learning to working at organizations. (Understanding)
- CO3:** Apply industrial knowledge to project work. (Applying)
- CO4:** Discover the application and working of various machines. (Analysing)
- CO5:** Explain the organizational work structure. (Evaluate)
- CO6:** Maximize the individual skill level. (Creating)

MNMP6019: MAJOR PROJECT (PHASE I)

(4 credits)

The major project phase I requires an understanding of core concepts including mechanics, kinematics, thermodynamics, materials science, etc. students will learn to use these core principles along with tools like computer-aided design, ABAQUS, ANSYS to design and Analyse manufacturing plants, industrial equipment and machinery, refrigeration and air conditioning systems, transport systems, aircraft, watercraft, robotics, medical devices, and others under the guidance of faculty members.

COURSE/LEARNING OUTCOMES

At the end of Project Phase I students will be able to

- CO1:** Find potential gaps and needs related to mechanical engineering through study of existing literature. (Remembering)
- CO2:** Interpret the potential gaps in mechanical engineering through literature review. (Understanding)
- CO3:** Develop a feasibility study on the proposed topic. (Applying)
- CO4:** Discover the problem statement. (Analysing)
- CO5:** Assess the proposed topic by application of basic principles of mechanical engineering. (Evaluating)
- CO6:** Evaluate and validate their respective results and propose further scope for advancement in that particular domain. (Evaluating)
- CO7:** Compile their results using various engineering application tools. (Creating)
- CO8:** Construct the mechanical engineering component using resources available. (Wherever applicable). (Creating)
- CO9:** Build reports of the work. (Creating)

MNMP6020: MAJOR PROJECT (PHASE II) AND VIVA VOCE

(8 credits)

The major project phase II involves the students in realising their goal towards fulfilling the identified problem from the first phase of the major project. Accordingly students will design/fabricate/analyse whichever is/are needed. The complete report of the work in proper format is prepared and finally the work is evaluated. The modality and components of the internal assessment and their weightages shall be notified at the beginning of each semester.

COURSE/LEARNING OUTCOMES

At the end of Project Phase II students will be able to

- CO1:** Find potential gaps and needs related to mechanical engineering through study of existing literature. (Remembering)
- CO2:** Interpret the potential gaps in mechanical engineering through literature review. (Understanding)
- CO3:** Develop a feasibility study on the proposed topic. (Applying)
- CO4:** Discover the problem statement. (Analysing)
- CO5:** Assess the proposed topic by application of basic principles of mechanical engineering. (Evaluating)
- CO6:** Evaluate and validate their respective results and propose further scope for advancement in that particular domain. (Evaluating)
- CO7:** Compile their results using various engineering application tools. (Creating)
- CO8:** Construct the mechanical engineering component using resources available. (Wherever applicable). (Creating)
- CO9:** Build reports of the work. (Creating)

MNHT6022: HEAT TRANSFER LAB

(2 credits)

Any eight experiments(1-11) from the following list

1. Determination of Thermal Conductivity of metal rod
2. Determination of Thermal Conductivity of insulating powder
3. Determination of Thermal Conductivity of Composite wall
4. Determination of heat transfer coefficient in Natural Convection
5. Determination of heat transfer coefficient in Forced Convection
6. Determination of temperature distribution, fin efficiency in Natural / Forced Convection
7. Determination of Emissivity of a Test surface
8. Determination of Stefan Boltzmann Constant
9. Determination of effectiveness of heat exchanger
10. Study of pool boiling phenomenon and determination of critical heat flux
11. Determination of equivalent thermal conductivity of heat pipe

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to

- CO1:** define basic mode of heat transfer. (Remembering)
- CO2:** illustrate the fundamental laws of heat transfer. (Understanding)
- CO3:** apply the basic mathematical formulae to determine the characteristics of various heat transfer equipments. (Applying)
- CO4:** Analyse the characteristics parameter of various heat transfer equipments. (Analysing)
- CO5:** assess the characteristics parameter of various heat transfer equipments. (Evaluating)
- CO6:** estimate the characteristics parameter of heat transfer equipments. (Creating)

MNWM6023: WORKSHOP/MANUFACTURING PRACTICES**(3 Credits) (L-T-P: 1-0-4)****I) Manufacturing Practice**

Objective: Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 hours)
2. CNC machining, Additive manufacturing (1 hour)
3. Fitting operations and power tools (1 hour)
4. Electrical and Electronics (1 hour)
5. Carpentry (1 hour)
6. Plastic moulding, glass cutting (1 hour)
7. Metal casting (1 hour)
8. Welding (arc welding and gas welding), brazing (1 hour)

Suggested Readings

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

(ii) Workshop Practice

1. Machine shop (10 hours)
2. Fitting shop (8 hours)
3. Carpentry (6 hours)
4. Electrical and Electronics (8 hours)
5. Welding shop (8 hours (Arc welding 4 hrs + gas welding 4 hrs)
6. Casting (8 hours)
7. Smithy (6 hours)
8. Plastic moulding and Glass Cutting (6 hours)

COURSE/LEARNING OUTCOMES

At the end of the experiments students will be able to

- CO1:** Recognize different fabrication techniques. (*Remembering*)
- CO2:** Identify the tools and machinery involved in the various experiments related to material processing. (*Understanding*)
- CO3:** Demonstrate some of the advanced and latest manufacturing techniques being employed in the industry. (*Applying*)

- CO4:** Recognize the different manufacturing processes which are commonly employed in the industry. (*Understanding*)
- CO5:** Fabricate simple components using different materials and fabrication techniques. (*Applying*)

**MNMF6025: MECHANICAL ENGINEERING LAB 1: MATERIALS AND MANUFACTURING LAB
(2 Credits) (L-T-P: 0-0-4)**

Objectives:

- *To provide an understanding of various manufacturing processes.*
- *To get an idea of the dimensional and form accuracy of products.*

A:

1. Facing, Turning: Step turning, taper turning.
2. Thread Cutting- Internal and external thread cutting using a single point cutting tool.
3. Contour milling using vertical milling machine.
4. Spur gear cutting in milling machine.
5. Study of CNC part programming.
6. Use of CNC machine tools: Lathe (2 Axis)
7. Use of CNC machine tools: Milling (3 Axis)
8. Use of CNC machine tools: Milling (4 Axis)
9. Study and use of Universal Robot Arm.

B:

1. Use of slip gauges and sine bar.
2. To study the Brinell hardness testing machine and perform the Brinell hardness test.
3. To study the Rockwell hardness testing machine and perform the Rockwell hardness test.
4. To study the Vickers hardness testing machine and perform the Vicker hardness test.
5. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
6. To study the Impact testing machine and perform the Izod Impact tests.
7. To study the Impact testing machine and perform the Charpy Impact tests.
8. To study the Universal testing machine and perform the tensile test.
9. Use of Vernier caliper and height gauge.
10. Use of micrometer, depth gauge

COURSE/LEARNING OUTCOMES

After completion of this course, students will be able to

- CO1:** Label various engineering measurement devices with its characteristics and to perform some advanced manufacturing operations. (Remembering)
- CO :** Relate the theoretical learning into applications with various engineering measurement devices and tools. (Understanding)
- CO3:** Make use of various measuring devices for taking different measurements and to evaluate the accuracy and tolerance of components produced. (Applying)
- CO4:** Distinguish the implementations and critical use of various devices for precise measurement. (Analysing)
- CO5:** Justify theoretical and practical knowledge into actual working environment for various measurements. (Evaluating)
- CO6:** Elaborate the processes related to measurement in engineering and determine the use of various tools. (Creating)

DEPARTMENT OF COMPUTER APPLICATIONS

VISION

Imparting knowledge of Computer Applications to mould individuals into IT professionals, researchers and entrepreneurs who are innovative, versatile and committed to society.

MISSION

1. To prepare students for professional career and higher studies by providing conducive teaching, learning and research environment.
2. To produce skilled individuals and entrepreneurs in emerging areas of technologies by academia-industry collaboration.
3. To instill in individuals a sense of commitment to work for the betterment of society using technology.

PROGRAMME EDUCATIONAL OBJECTIVES

1. To enable graduates to establish themselves in technical and decision-making roles ranging from problem analysis and solving to design and development of software applications.
2. To inculcate ethics and professionalism in graduates who will be able to provide solutions to real world problems that contributes in self and societal growth.
3. To acclimatize graduates for eminence in research and advance technology and be a lifelong learner.

Programme – Bachelor of Computer Applications (BCA)

Programme Outcomes (PO):

BCA programme has been designed to prepare under-graduates for attaining the following programme outcomes:

- PO 1: Computer Application Knowledge:** Apply the knowledge of mathematics, science, computer application fundamentals to the solution of complex engineering problems.
- PO 2: Problem Analysis:** Identify, formulate, research literature, and Analyse complex problems reaching substantiated conclusions using the knowledge of basic computer application and computer science.
- PO 3: Design/development of Solutions:** Design solutions for complex computer application problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO 4: Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and computer related tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO 5: Service to Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practice.
- PO 6: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of computer application practice.
- PO 7: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- PO 8: Communication:** Communicate effectively on complex activities with the computer application community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO 9: Project Management and Finance:** Demonstrate knowledge and understanding of computer application and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO 10: Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
- PO 11: Innovation and Entrepreneurship:** Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

Programme – Master of Computer Applications (MCA)

Programme Outcomes (PO):

- PO 1: Computational Knowledge:** Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
- PO 2: Problem Analysis:** Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
- PO 3: Design /Development of Solutions:** Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
- PO 4: Conduct investigations of complex Computing problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO 5: Modern Tool Usage:** Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
- PO 6: Professional Ethics:** Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
- PO 7: Life-long Learning:** Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
- PO 8: Project management and finance:** Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

- PO 9: Communication Efficacy:** Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
- PO 10: Societal and Environmental Concern:** Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practices.
- PO 11: Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.
- PO 12: Innovation and Entrepreneurship:** Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

DETAILED SYLLABUS

THEORY COURSES

CALD0001: DIGITAL LOGIC DESIGN

(4 credits–60 hours)

***Objectives:** The topics below cover some of the basic understanding of a digital computer. The aim is to give an overview of the computer and its functions, with specific references to some of its parts. The student will also get an understanding of the application of Boolean Algebra in computer science and applications.*

Module I: Introduction to organization of digital computer (12 Hours)

Block diagram of a computer: Input Unit, Output Unit, Storage Unit, CPU. Control Unit, Arithmetic Logic Unit. System bus. Stored program concept. Number systems. Binary Arithmetic, Floating point number representation, Normalization of point number representation, Fixed point number representation, Signed-magnitude representation, overflow, underflow, Computer codes; Error detection and correction codes, parity, parity generator, parity checker.

Module II: Memory Unit (12 Hours)

Memory Hierarchy, Main Memory, Memory Address Map. Semiconductor Memory; Different types Cache Memory: Levels of Cache, Locality of reference, hit and miss; Magnetic Memory; Optical Memory

Module III: Boolean Algebra, Simplification of Boolean Functions (12 Hours)

Boolean Algebra: Various Boolean operations; Postulates, Theorems, Duality, Boolean functions, Canonical forms, Representation of Boolean expressions using truth tables, logic gates. Boolean expressions minimization using Karnaugh map, Realization of canonical forms from Karnaugh map, Don't Care Conditions - problems using Don't care conditions, benefit of using Don't care conditions. Tabulation method/Quine- Mc Kluskey method, prime implicants.

Module IV: Combinational Logic and Sequential Logic (24 Hours)

- a) Brief introduction to Microprocessor, Integrated circuits, SSI, MSI, LSI, VLSI, IC Digital logic families- TTL, ECL, MOS, CMOS and I²L.
- b) Positive and negative logic. Characteristic of IC logic families - fanout, power dissipation, propagation delay, noise margin.
- c) Digital devices: Logic gates, wired-logic, 8 non-degenerate forms of NOR and NAND, multilevel NAND and NOR gates (Boolean function implementation using block diagram method, analysis procedure, deviation of Boolean function by algebraic manipulation, derivation of truth table, block diagram transformation), buffer, 3-state buffer, high impedance state, Realization of other logic functions using NAND/NOR gates. Drawing logic diagrams for different types of Boolean expression derived from truth tables; A brief introduction to Combinational and sequential circuits. Difference between Combinational and sequential circuits; Arithmetic circuits: Half-adder, Full-adder, Binary Adder, Binary Parallel Adder, BCD Adder, Binary Adder-Subtractor, Half-subtractor, Half-subtractor, Binary Incrementer, carry propagation, look ahead carry, carry generator, magnitude comparator.; Encoders, Decoders, Multiplexers, Demultiplexers

- d) Code conversion, BCD-to-Excess3 Code converter. Analysis of Combinational circuits.
- e) Flip-flops: Different types of flip-flops, Flip-flop excitation tables, characteristic equations, truth tables, Triggering of Flip-flops.
- f) Registers: Registers (Register with Parallel Load), Shift registers(serial transfer, Bi- directional Shift Registers With Parallel Load, serial adder, Serial Register);
- g) Counters: Asynchronous counters, Synchronous counters; Binary Counter with Parallel Load, binary Ripple Counter, BCD ripple counter, synchronous binary counter, binary count-up-down counter, BCD synchronous counter, Decade Counter, Mod 6 counter. Timing sequences- word-time generation, timing signals, Johnson counter. Designing of counters using excitation tables of flip flops. Designing of counters using state equations.

COURSE / LEARNING OUTCOMES

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

- CO1:** define various terms related to digital logic. (Remembering)
- CO2:** list the postulates of Boolean algebra. (Remembering)
- CO3:** Outline the difference between analog and digital systems. (Understanding)
- CO4:** explain the difference between combinational and sequential circuits. (Understanding)
- CO5:** explain the working of different latches and flip-flops. (Understanding)
- CO6:** construct logic circuits for sequential circuits such as registers, counters etc. (Applying)
- CO7:** perform conversion of numbers from one number system to another. (Applying)
- CO8:** apply the postulates and theorems of Boolean algebra to minimize a Boolean expression. (Applying)
- CO9:** perform minimization using Karnaugh maps and Quine McCluskey method. (Applying)
- CO10:** construct logic circuits for combinational circuits such as adders, subtractors, comparators, multiplexers, decoders etc. (Applying)
- CO11:** Analyse logic circuits to derive its Boolean expression. (Analysing)
- CO12:** determine the output of a logic circuit for a given input. (Evaluating)
- CO13:** synthesize logic circuits for a given Boolean expression. (Creating)

Suggested Readings

1. M. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India Pvt. Ltd., New Delhi, 1994
2. Thomas L. Floyd, Digital Fundamentals, Fifth Edition, Pearson Education, 2002
3. V. Carl Hamacher, Zvonko G. Vranesic, Safwat G. Zaky, Computer Organization, Fourth Edition, McGraw Hill, 1996

CAPC0002: PROGRAMMING AND PROBLEM SOLVING THROUGH C

(4 credits – 60 hours)

Objectives: *The objective of the course is to introduce the fundamentals of C programming language and develop the skills 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 the 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.*
- *Make student well conversant with managing functions.*

- *Get introduced to pointers, arrays, structures and files in C.*
- *Understand the basics of graphics programming, VDU and interaction with hardware through C.*

Module I: C fundamentals (16 Hours)

Algorithms, key features of algorithms, flowcharts, pseudocode, structured programming languages, files used in C program, design and implementation of correct, efficient and maintainable programs, 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 in C, precedence and associativity of operators, type conversion and typecasting, preprocessor.

Module II: Decision Control Statements, Loops and Functions (13 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.

C 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, Strings and Pointers (12 hours)

Arrays and Strings: One-dimensional arrays, passing array to function, multidimensional arrays and their applications, character arrays and string operations.

Pointers: Introduction to pointers, pointer expressions, null pointers, generic pointers, pointers and arrays, drawback of pointers, dynamic memory allocation.

Module IV: Structures, Files and Preprocessor Directives (12 hours)

Structures and Unions: Declaration of structures and simple implementation of structures, unions, enumerated data types, structures and functions, pointer to structure.

Files: Introduction to files, file management – open, close, input/output operations, Commandline arguments.

Preprocessor Directives: Introduction to preprocessor directives, macros and file inclusion.

Module V: VDU Basics and Graphics Programming (10 hours)

VDU Basics: Screen memory accessing, memory segments, far pointers, writing to VDU memory, text mode, color attribute, Interrupts, interrupt vector table, WORD register, BYTE register, DOSinterrupts, BIOS interrupts, int86() functions and intdos() functions(make, remove, change directory and delete file).

Graphics Programming: Library file-graphics.h, 2-D Coordinate system, Built-in Graphics Functions.

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:** Explain and interpret information based on their understanding of the concepts of C language's syntax, data types, control statements, functions, pointers, arrays, structures, pointers, files, graphics and hardware programming using 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. Balagurusamy, E., Computer Fundamentals and C Programming, Tata McGraw Hill Publishing Company Limited, New Delhi.
3. Gottfried, Byron S., Programming with C (Schaum's Outlines Series), Tata McGraw Hill Publishing Company Limited, New Delhi.
4. Kanetkar, Y., Let us C, BPB Publication, New Delhi.
5. Kernighan, B.W., and Ritchie, Dennis M., The C Programming Language, Prentice Hall Pvt. Ltd, New Jersey.

E-resource for learning

C, www.spoken-tutorial.org

CATC0003: THEORY OF COMPUTATION

(3 credits – 45 hours)

Objective: *The objective of the Theory of Computation is to introduce and study abstract, mathematical models of computation (such as finite state, pushdown and Turing machines), and to use the abstract machine models to study the ability to solve computational problems. At the complete course students will be able to use regular expression effectively and appropriately, construct derivations and parse trees, write simple programs for a Turing machine, understand the equivalence of grammars, languages and automata and translate between grammars, languages and automata.*

Module I Theory of Automata (12 Hours)

Definition of an Automaton, Description of a Finite Automaton, Transition Systems, Properties of Transition Functions, Acceptability of a String by a Finite Automaton, Nondeterministic Finite State Machines, The Equivalence of DFA and NFA, Mealy and Moore Models, Minimization of Finite Automata.

Module II Formal Languages, Regular Sets and Regular Grammars (10 Hours)

Definition of formal languages, Chomsky Classification of Languages, Languages and Their Relation, Recursive and Recursively Enumerable Sets, Operations on Languages, Languages and Automata; Regular Expressions, Finite Automata and Regular Expressions, Pumping Lemma for Regular Sets, Application of Pumping Lemma, Regular Sets and Regular Grammars Exercises.

Module III Context-free Languages (11 Hours)

Context-free Languages and Derivation tree, Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars, Pumping Lemma for Context-free Languages, Decision Algorithms for Context-free Languages Exercises

Module IV Pushdown Automata Turing Machines and Linear Bounded Automata (12 Hours)

Basic Definitions, Acceptance by pda, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata; Turing machine Model, Representation of Turing Machine, Language Acceptability by Turing Machines, Design of Turing Machines, Universal Turing Machine and Other Modification, The Model of Linear Bounded Automaton, Turing Machines and Type 0 Grammars, Linear Bounded Automata and Languages, Halting Problem of Turing Machines, NP-Completeness.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define basic terminology like Deterministic and Non deterministic automata, Pushdown Automata, Parse Tree, Regular Languages, Turing Machines etc. (Remembering)
- CO2:** explain the concepts, core terms and tools used in automata theory (Understanding)
- CO3:** Make use of techniques, components and tools of a typical automated machine and apply it in designing new machines (Applying)
- CO4:** Choose which input pattern would be accepted by a Turing Machine, Pushdown Automata, Finite Automata etc. (Applying)
- CO5:** compare and contrast various types of machines in Automata theory and relate it to everyday appliances like washing machines, fans, etc (Analysing)
- CO6:** design an automata and evaluate it in terms of correctness, computation cost and complexity. (Evaluating)
- CO7:** design new automata for given problems by using most appropriate algorithmic strategy considering the problem domain. (Creating)

Suggested Readings

1. K.L.P. Mishra, N. Chandrasekaran, Theory of Computer Science, BPB Publication, Prentice-Hall of India, Second Edition.
2. H.R. Lewis and C.H.Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall of India.
3. H.E. Hopcraft and J.D. Ullamn, Introduction to Automata Theory, Languages and Computation, Narosa Publications.
4. J.C. Martin, Introduction to Languages and the Theory of Automata, Tata McGraw-Hill.
5. C.H. Papadimitriou, Computation Complexity, Addison-Wesley.

CADS0004: DATA STRUCTURES USING C++

(4 credits – 60 hours)

Objective: The objective of the course is to learn how to create data structures in a computer language, such as C++, to represent a collection of similar data, and how to process these data most efficiently for solving problems. 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++'
- Implement various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs
- Understand various searching and sorting techniques.
- It is expected that the student has adequate knowledge of C++ language basics, functions, arrays, structures, pointers and dynamic memory allocation.

Module I Arrays and Lists (16 Hours)

- a) Data Type, Abstract Data Type, Data Structure, Fundamental and Derived Data Types; Array as a data structure, Representation of arrays: single and multidimensional, Address calculation using column and row major ordering; insertion and deletion in arrays; use of arrays for matrix representation and manipulation (addition, multiplication), use of arrays for large integer representation and their addition.
- b) Linked List as a data structure; operations on lists; singly linked list (with one or two external pointers), doubly linked list, circular list; use of linked lists for polynomial representation and manipulation (addition and multiplication), and sparse matrix representation and manipulation (inputting, adding, and displaying in matrix form)

Module II Stacks and Queues (14 Hours)

Stacks and Queues as data structures; implementation of stacks and queues using arrays and linked lists; Circular Queue, Priority Queue; Application of stacks : Conversion of infix(containing arithmetic operators including exponential operator, and parenthesis) to postfix and prefix expressions; evaluation of postfix expression

Module III Trees and Graphs (16 Hours)

- a) Binary Trees and General Trees, Representation of trees using linked lists, Binary tree traversal methods, recursive and non-recursive algorithms for traversal methods, Binary search trees (creation, insertion and deletion of a node), threaded binary trees (construct and traverse a right in-threaded binary tree); Height balanced (AVL) binary trees (construct and traverse an AVL tree), multi-way search trees (construction and traversal); B-tree (construction and traversal of a B-tree of given order)
- b) Introducing Graphs; Graph representation : Adjacency matrix, adjacency lists, incidence matrix, Traversal schemes : Depth first search, Breadth first search (Recursive and non-recursive algorithms); Shortest Path algorithms (Dijkstra's), Spanning tree, Minimal spanning tree algorithms (Kruskal's algorithm)

Module IV Searching and Sorting (14 Hours)

Linear and binary search, Indexed search; Hashing, Hash Functions (division method, mid square method, folding), Analysis of ideal hash function; Conflict resolution (linear and quadratic probe, double hashing, separate chaining, coalesced chaining); Analysis of collision resolution techniques; Sorting algorithms(Insertion, Selection, Bubble, Quick, Merge, Radix, Heap)

COURSE / LEARNING OUTCOMES

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

- CO1:** list different data structures and define the purpose of using data structure. (Remembering)
- CO2:** explain the concept of various data structure like stack, queue, linked list, tree, graph etc. and describe their working mechanism. (Understanding)
- CO3:** apply their knowledge to solve practical problems like- expression conversion using stack, process management using queue and memory management using linked list and B tree.(Applying)
- CO4:** compare the efficiency of various data structure related algorithms with respect to time and space complexity. They would also be able to modify a weak algorithm into a more efficient one.(Analysing)
- CO5:** develop algorithms based on the knowledge they have gained to design cost effective and user friendly application using C++ programming language.(Creating)

CO6: Depending on the problem domain and input pattern students would be able to choose the appropriate data structure and would be able to justify their decision to use a particular data structure by evaluating the required parameters. (Evaluating)

Suggested Readings

1. Y. Langsam, M.J. Augenstein, A.M. Tenenbaum, Data Structures Using C and C++, Second Edition, Prentice Hall of India, 2000.
2. E. Horowitz, Sahni, D. Mehta, Fundamentals of Data Structures in C++, Galgotia Publication, 2002.
3. S. Chattopadhyay, D. Ghosh Dastidar, M Chattopdhayay, Data Structures Through C Language, BPB Publication, 2001.
4. Seymour Lipschutz, Theory and Problems of Data Structures, Schaum's Outline Series, International Edition, MacGraw Hill, 1986.
5. Niklaus Wirth, Algorithms + Data Structures = Programs, Prentice Hall of India, 1998.
6. Y.P. Kanetkar, Data Structures Through C Language, BPB Publishers, 2002.

CAOP0005: OBJECT ORIENTED PROGRAMMING AND DESIGN

(4 credits – 60 hours)

Objective: The Main aim of this paper is to give the students a broad understanding of the object oriented approach to problem solving through C++. It provides a practical, productive way to develop software for most applications. It also includes an introduction to object-oriented design, which can promote a better understanding of the requirements, cleaner designs, and more maintainable systems.

Module I Introduction To Object-Oriented Concepts And OOP (16 Hours)

- a) Introduction to Object-Oriented Programming: Basic concepts of OOP (Abstraction, Encapsulation, Inheritance, Polymorphism), comparison of procedural programming and OOP; code reusability, creating new data types. C++ Language basics, cin and cout, << and >> operators, setw and endl, Control statements, differences between C and C++.
- b) Classes and Objects: C++ extension to structures, member access operators static members, arrays of objects, returning objects from functions, Friend functions, Pointers to members, Friend classes, stack class.
- c) Constructors: Default constructors, overloaded constructors, constructors with default arguments default constructor, copy constructor, dynamic constructor, destructors.

Module II Templates and Exception Handling (12 Hours)

- a) Templates: string template, instantiation, template parameters, type-checking, function templates, template argument deduction, specifying template arguments, function template overloading, default template arguments, specialisation, conversions.
- b) Exception handling: Error handling, grouping of exceptions, catching exceptions, catch all, re-throw, resource management, auto ptr, exceptions and new, resource exhaustion, exceptions in constructors, exceptions in destructors, uncaught exception, standard exceptions.

Module III Inheritance, Virtual Functions and Polymorphism (16 Hours)

- a) Overloading: Defining operator overloading, operator function as member function and friend function, overloading unary and binary operators, type conversions, function overloading.
- b) Inheritance: Types of inheritance, Defining derived class, Access specifiers: public, private and protected; public and private inheritance, accessing base class members, ambiguity in multiple inheritance, virtual base classes, abstract classes, Derived class constructor with arguments, Initialization lists in constructors, classes within classes.

- c) Virtual functions and polymorphism: Virtual functions, pure virtual functions, abstract classes, implementation of virtual functions (virtual pointers and virtual tables in classes with virtual functions), this pointer, static and dynamic binding, virtual functions in derived classes, object slicing, virtual functions and constructors, calling virtual functions from constructors, destructors and virtual destructors, calling virtual functions from destructors, virtual base classes, Rules for virtual functions.
- d) File handling and streams.
- e) Basics of file handling in C++, classes for stream operations, operations on files, file opening modes, file pointer, error handling during file operations

Module IV Object Oriented Design (16 Hours)

Overview of object oriented designing (concepts), steps involved in object oriented designing, advantages of OOD, what is modeling, why modeling is required, UML, different views captured by UML diagrams, Use Case diagram(actors, generalization, association, include dependency, extend dependency etc.), organization of use cases, Use Case Packaging, constraints in use case models, how to find out actors, use cases and use case relationships, Class diagrams, representations, association and links, aggregation, composition, dependency, constraints, interaction diagrams(sequence diagrams and collaboration diagrams), representation, boundary objects, controller objects, entity objects, Booch's object identification method, CRC cards, equivalence of sequence diagram and collaboration diagrams, activity diagrams, representation(action states, action flow, object flow, initial state , final state etc.), swim lanes, branching, fork, join etc, OOD goodness criteria.

COURSE / LEARNING OUTCOMES

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

- CO1:** Describe the various features of Object Oriented programming by utilizing the C++ language construct. (Remembering)
- CO2:** Explain the standard library, scope and lifetime of a variable and various control statements used in C++ program. (Understanding)
- CO3:** Interpret the concept of classes and object in C++ and apply exception handling to solve various exceptions (Analysing, Applying)
- CO4:** Evaluate the different type of inheritance and polymorphism and Analyse it in resolving various problems (Analysing, Evaluating)

Suggested Readings

1. E. Balagurusamy, Object-Oriented Programming with C++, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Nabajyoti Barkakati, Object-Oriented programming in C++, Prentice hall of India private Limited, New Delhi, 2005.
3. James Rumbaugh, Micheal Blaha, William Premerlani, Frederick Eddy, William Loorenson, Object-Oriented Modeling and Design, Prentice hall of India private Limited, New Delhi, 2005.
4. Bjarne Stroustrup, The C++ Programming Language, Special edition, Pearson Education Publication.
5. David Parsons, Object-Oriented Programming with C++, BPB Publications, B-14 Cannaught Place, New Delhi.
6. Grady Booch, Object-Oriented Analysis and Design with Applications, Second Edition, Addison-Wesley Publishing Company.
7. Steve Qualline, Practical C++ Programming, Second Edition, Shroff publishers and Distributors Private limited.

CADM0006: DATABASE MANAGEMENT SYSTEMS I

(4 credits – 60 hours)

***Objective:** The objective of this course is to introduce to the students the fundamental concepts necessary for designing, using and implementing database systems and applications. The course stresses on database modeling and design, physical file storage techniques and language facilities provided by database management systems.*

Module I: Introduction and Conceptual Data modeling (18 Hours)

- a) Introduction: Introduction to databases, characteristics of the database approach, database users and designers, role of a DBA, advantages of using a DBMS, data models, schemas, instances, DBMS architecture (Three-Schema Architecture), Database systems- Network, Hierarchical, Relational, Data Independence
- b) Conceptual Data Modeling: Phases of database design, entity type, entity set, attributes, keys, value sets, relationships, relationship types, relationship sets, relationship instances, relationship degree, role names, recursive relationships, constraints on relationship types, attributes of relationship types, weak entity types, ER Diagram, naming conventions and design issues, EER concepts.

Module II: Relational Data Model and Structured Query Language (18 Hours)

Relational model concepts: Domain, attribute, tuple, relation, characteristics of relations, relational databases, relational database schemas, relational constraints (Domain constraint, constraints on null), entity integrity, referential integrity, foreign keys. ER to Relational mapping algorithm, Case study.

Relational Algebra: basic relational algebra operations-SELECT, PROJECT, UNION, INTERSECTION, SET DIFFERENCE, Cartesian PRODUCT, JOIN, Aggregate functions

Relational Calculus: Tuple Relational Calculus, Domain Relational Calculus

SQL: Characteristics of SQL, Data types in SQL, Types of SQL commands

Data Definition Commands: CREATE SCHEMA, CREATE TABLE, DROP TABLE, ALTER TABLE . Single table query commands: SELECT, SELECT with WHERE, SELECT with ORDER BY, SELECT with GROUP BY, SELECT with GROUP BY and HAVING, SQL built-in functions - SUM, MIN, MAX, COUNT, AVG.

Multi-table query commands: Retrieval using sub-query, JOIN, EXIST and NOT EXIST Special operators: IS NULL, IS NOT NULL, BETWEEN..AND, IN, LIKE, ANY, ALL

Data changing commands: INSERT, DELETE, UPDATE

Module III: Functional Dependencies and Normalization (10 Hours)

Functional Dependencies, First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Multivalued Dependencies, Join Dependencies, Fourth Normal Form, Fifth Normal Form, Denormalization

Module IV: File Organization (14 Hours)

Introduction to storage hierarchies, hardware descriptions of disk devices, Magnetic Tape Storage Devices, RAID technology, Organization of file records on disk (record and record types, Fixed-length records, variable-length records, record blocking, spanned and unspanned records, allocating file blocks on disk, file headers), Operations on Files (Open, Reset, Find, Read, Delete, Modify, Insert, Close), primary methods of file organization -Heap Files, Sorted Files, Hashed Files. Types of Single-level Ordered Indexes (Primary Indexes, Clustering Indexes, Secondary Indexes), Multilevel Indexes: Basic technique, Multilevel indexing using B tree and B+ tree, Indexing on multiple keys

COURSE / LEARNING OUTCOMES

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

- CO1:** have a clear understanding of the file organization for storing database records. (Remembering, Understanding)
- CO2:** use relational algebra, TRC, and SQL to solve queries related to database tables. (Applying)
- CO3:** Analyse the basic concepts of database management and its applications in various database projects. (Analysing)
- CO4:** design and Evaluate ER diagrams and schema diagrams for various database-oriented projects.(Creating, Evaluating)

Suggested Readings

1. R Elmasri, SB Navathe, Fundamentals of Database Systems, Addison, Wesley, 3rd Edition, 2000.
2. Silberschatz, HF Korth, S Sudarshan, Database System Concepts, Tata- McGraw Hill, 1997.
3. Bipin Desai, An Introduction to Database Systems, Galgotia Publications (West Publishing), 1991.
4. DM Kroenke, Database Processing: Fundamentals, Design and Implementation, Prentice-Hall of India, (Eighth Edition) 2002.
5. GW Hansen, JV Hansen, Database Management and Design, Prentice-Hall of India, (2nd Edition) 2001.
6. Thomas M Connolly, Carolyn E Begg, Database Systems, A Practical Approach to Design, Implementation and Management, Addison Wesley Longman Ltd. 1999.

CAOA0007: COMPUTER ORGANIZATION AND ARCHITECTURE

(4 credits – 60 hours)

Objective: *This course aims to provide the student with the concepts and basic knowledge necessary to understand the organisation and architecture of computing systems.*

Module I: Arithmetic Logic Unit (10 Hours)

Addition and Subtraction (Addition and Subtraction with Signed-Magnitude Data, Hardware Implementation, Addition and Subtraction with Signed-2's Complement Data); Booth's Multiplication Algorithm; Division Algorithm; Floating-Point Arithmetic Operations (Addition, Subtraction, Multiplication, Division).

Module II: Control Unit (12 Hours)

- a) Major Components of a CPU; General Register Organization; Stack Organization (Register Stack, Memory Stack, Reverse Polish Notation); Subroutine Call and Return; Fetch Routine; Types of Interrupts; Characteristics of Complex Instruction Set Computer (CISC) and Reduced Instruction Set Computer(RISC)
- b) Micro operations, Control Function, Role of Three-State Bus Buffers in Memory Transfers; Arithmetic Microoperations, Logic Microoperations, Shift Microoperations; Microprogrammed Control and Hardwired Control; Control Memory, Control Word, Microinstruction, Microprogram, Mapping of Instructions; Instruction Formats(Three- Address Instructions, Two-Address Instructions and Zero-Address Instructions); Addressing modes.

Module III: Parallel Processing and Multiprocessors (14 Hours)

- a) Parallel Processing: Flynn's Classification of computers; Pipelining, Data Dependency, Handling of Branch Instructions, Delayed Load, Delayed Branch; Vector Processing, Supercomputers; Array Processors.

- b) Multiprocessors: Tightly Coupled, Loosely Coupled; Interconnection Structures (Time-Shared Common Bus, Multiport Memory, Crossbar Switch, Multistage Switching Network, Hypercube Interconnection); Interprocessor Arbitration (Serial Arbitration Procedure, Parallel Arbitration Logic, Rotating Daisy-Chain); Interprocessor Communication and Synchronization, Mutual Exclusion with a Semaphore.

Module IV: Memory Organization (14 Hours)

Hardware Organization for Associative Memory; Mapping methods for Cache Memory (Associative Mapping, Direct Mapping, Set-Associative Mapping), Write Through, Write Back, Cache Initialization, Cache Coherence; Virtual Memory, Memory management hardware.

Module V: Input-Output Organization (10 Hours)

Input Output Interface, I/O Bus, Memory Bus, Isolated I/O, Memory-Mapped I/O; Asynchronous Data Transfer, Strobe Control, Handshaking; Modes of Transfer- viz. Direct Memory Access, Programmed I/O, and Interrupt-Initiated I/O; Priority Interrupt (Daisy-Chain Priority, Parallel Priority Interrupt, Priority Encoder); Input-Output Processor; Serial Communication(Character-Oriented Protocol and Bit-Oriented Protocol).

COURSE / LEARNING OUTCOMES

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

- CO1:** recognize, and define the basic components and design of a computer, including CPU, memories, and input/output units. (Remembering)
- CO2:** identify and classify the major components of a CPU and discuss, review the operations intrinsic to it. (Understanding)
- CO3:** discover the parameters of performance improvement and use them in predicting the issues in instruction cycle. (Applying)
- CO4:** Analyse the mapping techniques of different memory units; instruction sets interpret the different performance tradeoffs between them. (Analysing)
- CO5:** assess critique and evaluate the performance of CPU, Memory and I/O operations. (Evaluate)
- CO6:** summarize the concepts adhered to the principles and architectures of a digital computer system to design and develop new improvised systems. (Create)

Suggested Readings

1. M. Morris Mano, Computer System Architecture, Third Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
2. V. Carl Hamacher, Zvonko G. Vranesic and Safwat G. Zaky, Computer Organization, Fourth Edition, McGraw Hill, 1996
3. William Stallings, Computer Organization and Architecture, Sixth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2002

CACF0008: COMPUTER FUNDAMENTALS

(4 credits - 60 hours)

Objectives: *This course provides an introduction to the fundamentals and basic requirements of computer science. This course will enable the student to gain an understanding of the core concepts and technologies which constitute Information Technology and to articulate and demonstrate these basic fundamental concepts.*

Module I: Introduction to Computers (12 hours)

Introduction, brief history of development of computers, characteristics of computers, block diagram of computer; types of computers and features, analog, digital, hybrid, general, special purpose, micro, mini, mainframe supercomputers. Types of personal computers – desktop, laptop, palmtop etc. , types of programming languages (machine languages, assembly languages, high level languages, 4GL), data organization, drives, files, directories., basic components of computer system; Von Neumann architecture.; types of memory (primary and secondary) RAM, ROM, PROM, EPROM; secondary storage devices (FD, CD, HD, Pen drive) I/O devices (Scanners, Plotters, LCD, Plasma Display)

Module II: Data representation and operations (8 hours)

Simple model of memory, bits and bytes, introduction to binary, Hexadecimal, Octal, Decimal systems, conversion from one system to another, simple addition, subtraction, multiplication.

Module III: Algorithm and Flowcharts (10 hours)

Algorithm: Definition, Characteristics, Advantages and disadvantages, Examples Flowchart: Definition, Define symbols of flowchart, Advantages and disadvantages, examples.

Module IV: Operating System and Computer Software(12 hours)

- a) Introduction to O.S., historical evolution - first generations, second generations, third generations, fourth generation, phases of evolution-serial processing, simple batch systems, multi-programmed batch systems, time-sharing systems, personal-computer systems (PCs), parallel systems, multi processing system – symmetric, asymmetric, distributed system, real-time systems, need of Operating system, comparative study of popular operating systems. DOS – history, files and directories, internal and external commands, batch files, types of Operating systems, introduction to Windows, Linux, UNIX operating systems.
- b) Need of software, types of software, system software and application software, Application software-word processing, spreadsheet, presentation graphics, database management software.Introduction to Computer virus.Introduction to Internet and E-mail; searching information through a search engines (google, altavista, sulekha, khoj etc)

Module V: Windows Operating System (8 hours)

Introduction to microsoft windows; features of windows; Various versions of windows and its use; working with windows; my Computer and Recycle bin ; Desktop, Icons and Windows Explorer; working with files and folders; simple operations like copy, delete ,moving of files and folders from one drive to another, installing and uninstalling new hardware and software programs on computer.

Module VI: Unix Operating System (10 hours)

Introduction to UNIX OS, Salient features of UNIX, UNIX system architecture, shells and types of shells, file management, directories, file permissions, pipes and filters, various processes-foreground, background, parent, child, zombie, daemon; basic UNIX commands (log in, create/delete files/directories, listing files/directories, changing permission of files/directories etc), advanced UNIX commands (creating, listing and stopping process, printing files, sending E-mails etc), Built-in Functions (abs, log, sin, cos etc), signals and traps, system calls-basic idea,the UNIX file system.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the fundamental concepts of computers that includes understanding the hardware and software components as well as the role of each of these components. (Remembering)
- CO2:** Demonstrate an understanding of the various number systems as well as conversion from one number system to another and basic arithmetic binary operations. (Understanding)
- CO3:** work with files, folders, and applications.(Applying)
- CO4:** Analyse problems and develop a flowchart and/or an algorithmic solution for the same.(Analysing)
- CO6:** Assess the use of Windows and Unix Operating Systems efficiently to Analyse the structure and design of each of these two operating Systems. (Evaluating)
- CO5:** Discuss the role of an operating system (OS) and the various OS available for use with special reference to Windows and Unix. (Creating)

Suggested Readings

1. Rajaraman, V. Fundamentals of Computers, PHI Publications
2. Sinha P.K. Fundamental of Computers
3. Suresh Basandra, Computers Today
4. Kanetkar Y, UNIX Shell Programming
5. Manuals of Office Software

CACP0009: COMPUTER PROGRAMMING IN C LANGUAGE

(3 credits – 45 hours)

Objectives: 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 involved in the execution of a C program.*
- *Make the student well conversant with managing functions.*
- *Get introduced to pointers, arrays, structures and files in C.*

Module I: Introduction to Algorithms and Programming Languages (11 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 (12 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.

C 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, Strings and Pointers (12 hours)

Arrays and Strings: One-dimensional arrays, passing array to function, multidimensional arrays and their applications, character arrays and string operations.

Pointers: Introduction to pointers, pointer expressions, null pointers, generic pointers, pointers and arrays, dynamic memory allocation.

Module IV: Structures, Files and Preprocessor Directives (10 hours)

Structures and Unions: Declaration of structures and simple implementation of structures, unions, enumerated data types.

Files: Introduction to files, file management – open, close, input/output operations, Command line arguments.

Preprocessor Directives: Introduction to preprocessor directives, macros and file inclusion.

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:** 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. Balagurusamy, E., Computer Fundamentals and C Programming, Tata McGraw Hill Publishing Company Limited, New Delhi.
3. Gottfried, Byron S., Programming with C (Schaum's Outlines Series), Tata McGraw Hill Publishing Company Limited, New Delhi.
4. Kanetkar, Y., Let us C, BPB Publication, New Delhi.
5. Kernighan, B.W., and Ritchie, Dennis M., The C Programming Language, Prentice Hall Pvt. Ltd, New Jersey.

CAIF0010: INFORMATION SECURITY FUNDAMENTALS

(3 credits – 45 hours)

***Objectives:** Introduces concept of information security and discuss need for organizational policy to define required services such as confidentiality, authentication, integrity, nonrepudiation, access control, and availability, and mechanisms to implement those services. Covers different types of security including physical security, computer security, and network security; common threats to and attacks against information systems, including accidental damage.*

Module I: Information Security, Legal, Ethical and Professional issues related to information security (15 hours)

General security concepts and introduction to what is an “info sphere”, inside the security mind, operational security and people’s role in information security, components and characteristics of an information system, threats to an information system, ethical and professional issues.

Module II: Configuring network connectivity, Security policy and procedures (20 hours) Network configuration, troubleshooting connectivity issues, remote access protocols and configuration, security in systems’s project management, access control fundamentals, authentication and account management.

Module III: Information Security components (8 hours)

Physical threats to the information facility, firewalls, host hardening, application security, data protection , incident response , cryptography and security response

Module IV: Identification, assessment and control of risks related to Information Security (7 hours)

Risk identification and assessment, business continuity and risk control strategies , major security models

COURSE / LEARNING OUTCOMES

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

- CO1:** Define different terminology such as infosphere, information system, network troubleshooting, and host hardening. (Remembering)
- CO2:** Illustrate different threats to an information system, describe authentication and account management, interpret security response in a network(Understanding)
- CO3:** Apply the knowledge to troubleshoot a network, configure firewall in a network, and apply host hardening in a organization.(Applying)
- CO4:** Analyse the different connectivity issues, authentication and account management, compare different risk assessment and mitigation techniques. (Analysing)
- CO5:** Judge the need of an information system and methodologies to implement it, evaluate.(Evaluating)
- CO6:** Compile and correlate different activities into different layers of an information system, setup host hardening and firewall in a network (Creating)

Suggested Readings

1. Whitman, Michael, Security+ Guide to Network Security Fundamentals, Course Technology, 4 th edition ISBN: 9781111640125
2. Thomas R.Peltier, Justin Peltier, John Blackley, “Information Security Fundamentals”, Auerbach Publications.

CADS0011: DATA STRUCTURES USING C**(4 credits - 60 hours)**

Objective: *The objective of the course is to learn how to create data structures to represent a collection of similar data and solve problems using C language. After completion of this course, a student will be able to*

- *Understand and use the process of abstraction using a C programming language*
- *Implement various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs*
- *Understand various searching and sorting techniques.*

Module I: Arrays and Lists (16 Hours)

- a) Data Type, Abstract Data Type, Data Structure, Fundamental and Derived Data Types, Array as a data structure, Representation of arrays: single and multidimensional, Address calculation using column and row major ordering; insertion and deletion in arrays; use of arrays for matrix representation and manipulation (addition, multiplication).
- b) Linked List as a data structure; operations on lists; singly linked list (with one or two external pointers), doubly linked list, circular list; use of linked lists for polynomial representation and manipulation (addition and multiplication), and sparse matrix representation and manipulation (inputting, adding, and displaying in matrix form) .

Module II: Stacks and Queues (14 Hours)

Stacks and Queues as data structures; implementation of stacks and queues using arrays and linked lists; Circular Queue, Priority Queue; Application of stacks: Conversion of infix (containing arithmetic operators including exponential operator, and parenthesis) to postfix and prefix expressions; evaluation of postfix expression.

Module III: Trees and Graphs (18 Hours)

- a) Binary Trees and General Trees, Representation of trees using linked lists, Binary tree traversal methods, recursive and non-recursive algorithms for traversal methods, Binary search trees (creation, insertion and deletion of a node), Height balanced (AVL) binary trees (construct and traverse an AVL tree), multi-way search trees (construction and traversal); B-tree (construction and traversal of a B-tree of given order)
- b) Introducing Graphs; Graph representation: Adjacency matrix, adjacency lists, incidence matrix; Traversal schemes: Depth first search, Breadth first search

Module IV: Searching and Sorting (12 Hours)

Linear and binary search, Indexed search; Hashing, Hash Functions (division method, mid square method, folding), Sorting algorithms: Insertion, Selection, Bubble, Quick, Merge, Radix.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the basic C constructs and familiarize with basic C syntax, also define and outline the relationship between data and operations on these data using different data structures like arrays, linked list, stacks and queues, graph and trees. (Remembering)
- CO2:** define C constructs for explaining and generalizing these data structures and choosing appropriate algorithm for efficient program design using C syntax. (Understanding)

- CO3:** compute and demonstrate these data structures and algorithms in different real world problem domain(Applying)
- CO4:** compare and Analyse the performance of algorithms based on problem domain. (Analysing)
- CO5:** review the choice of data structure and algorithms based on problem domain, also would be able to judge and assess the algorithm efficiency based on space and time complexity which forms the fundamental step in the design of an efficient program. (Evaluating).
- CO6:** design and create efficient algorithm for application development related to academia and industry. (Creating)

Suggested Readings

1. Lipschutz, S., Theory and Problems of Data Structures (International Edition), Schaum's Outline Series, New Delhi: Tata McGraw-Hill.
2. Kanetkar, Y. P., Data Structures Through C Language, New Delhi: BPB Publications.
3. Chattopadhyay, S.; D. G. Dastidar; M. Chattopadhyay, Data Structures Through C Language, New Delhi: BPB Publications.

CANW0012: COMPUTER NETWORK FUNDAMENTALS

(3 Credits - 45 Hours)

***Objective:** The objective of this course is to make the students understand basic terminologies of computer network along with their types, mode of communication, models, transmission media, connecting devices. It also emphasizes to make the students aware about network security and basic conception of World Wide Web.*

Module I (15 Hours)

Computer Network: Definition, Goals, Applications, Structure, Components, Topology, Types of Topology, Types of Networks (LAN, MAN, WAN, Internet), Broadcast and Point-To-Point Networks, Communications Types (Synchronous, Asynchronous), Modes of Communication, Topology, Client/Server architecture, Network Models, Design issues of the layer, Protocol Hierarchy, ISO-OSI Reference Model (Functions of each layer),Terminology, SAP, Connection Oriented and connectionless services, Peer Entities, TCP/IP model, Layers, Ports, Protocol Stack, Comparison of ISO-OSI and TCP/IP Model

Module II (10 Hours)

Transmission Media, Classes of Transmission Media, Guided Media: Coaxial Cable, Twisted Pair, Fiber Optics Cable, Connectors. Unguided Media (Wireless) Electromagnetic Spectrum for Wireless Communication, Propagation Methods (Ground, Sky, Line-of-Sight), Wireless Transmission, Radio Waves, Infrared, Microwave, Wireless LANs Architecture, MAC Sublayer, Frame Format, Frame Types, Bluetooth Architecture.

Module III (10 Hours)

Analog and Digital Signals, Data Encoding, Parallel and Serial Transmission, Network Connectivity Devices, Categories of Connectivity Devices, Passive and Active Hubs, Repeaters, Bridges, Switches (2-Layer Switch, 3-Layer Switch (Router)), Gateways, Network Interface Cards (NIC), Internetworking Principles.

Module IV (10 Hours)

Network Security : Definition, Network Security Requirements and Attacks, Network Security Devices (firewalls, Proxy Server), Encryption and Digital Signatures, Internet Basics, Concept of Intranet and Extranet, Web Server, World Wide Web (WWW) Architecture, Web Documents, Search Engines, Internet Service Providers (ISP).

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the basic concepts of Computer Networks, its goals and network related terminologies. (Remembering)
- CO2:** Explain the concepts of Analog and Digital signals, Electromagnetic spectrum and related concepts on various architecture used in computer networks (Understanding)
- CO3:** Experiment with various Networks concepts such as Types of networks, Topologies, Transmission media and *implement* these concepts in setting up a lab in a real time scenario. (Applying)
- CO4:** Comprehend on Network Security Devices, Digital Signature and Internet Basics. (Understanding)
- CO5:** Evaluate the performance of the network based on the network criteria. (Evaluating)
- CO6:** Design the network with a suitable topology and network types.(Creating)

Suggested Readings

1. Andrew S. Tannenbaum, "Computer Networks", Tata McGraw-Hill Publishing Company Limited New Delhi.
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill Publishing Company Limited New Delhi.
3. William Stallings, "Data and Computer Communications", Pearson Education Asia.

CAWT0013: WEB TECHNOLOGIES**(4 credits-60 Hours)**

Objective: *The course provides an introduction to the fundamentals and basic requirements of web technologies. After completion of this course, students should be able to design and implement a website on their own by including client-side and server-side technologies. Finally, the course also provides a basic knowledge of querying web databases to support a website having back-end information.*

Module I: Basic Internet-related Terms and Static Web Development (18 Hours)

- a) Basic Terms: History of the Internet and the World Wide Web; W3C (World Wide Web Consortium); Levels of Internet Connectivity (Dial-up, Leased Line, DSL, VSAT); Requirements for Internet Connectivity; Search Engines, News-group, voice and video conferencing, E-mail and its Protocols; Web Portal; Different types of browsers (IE, Firefox, Chrome); URLs, Domain names
- b) Static Web Development: Introduction to XHTML; HTML vs. XHTML, XHTML comments; Basic Tags-XHTML, HEAD, TITLE, BODY; Paragraph Tag, Horizontal Rule Tag, Headings Tags, Blockquote Tag, Lists, Linking, Images, Tables, FONT Tag, PRE, DIV and SPAN tags; other different formatting tags; Forms; Frames

Module II: CSS, DHTML and JavaScript (18 Hours)

- a) Cascading Style Sheets: Types of Style Sheets-Inline, Embedded, and External; Conflicting Styles; Use of CSS for positioning elements, Background, and Text flow, CSS Box Model, CSS Borders and Outlines, Style class and Pseudo-class, CSS Image Gallery
- b) DHTML: Introduction to DHTML and JavaScript, JavaScript vs. VBScript, Adding script to documents, Data types, operators, variables, input and output statements, Built in functions, Arrays, If statement, Switch statement, Looping statements, Loops, JavaScript Form Validation, Events in JavaScript

Module III: Website Design Considerations and XML (10 Hours)

- a) Website Design Considerations: Planning to design a website, sitemaps, top-down vs. bottom up approach, Creating a Compatible web site for different color depths, resolutions, and browser considerations, validating a website) XML: Introduction to XML; Structuring Data; XML Namespaces; Document Type Definitions and Schemas; XML Parser; Document Object Model; Extensible Stylesheet Language (XSL)

Module IV: Web Servers and PHP (14 Hours)

- a) Web servers: Need of a web server; System Architecture of a Web server; HTTP Request Types; Client-side Scripting versus Server-side Scripting; Accessing Web servers; Various web servers- Microsoft IIS, Apache, NGINX, LAMP, WAMP
- b) PHP: Introduction to PHP; PHP Data Types; Control Structures; Functions; Strings; Arrays

COURSE / LEARNING OUTCOMES

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

- CO1:** examining the growth of Internet and recall the history behind it. (Remembering)
- CO2:** Illustrate and differentiate the various services provided by the internet. (Understanding)
- CO3:** experiment with various mark-up languages, style sheets and scripting languages. (Applying)
- CO4:** Analyse and design a website of their own and can also identify the faults in the design. (Analysing)
- CO5:** Summarize and validate a practical solution towards a web application development and also deploy a website of their own. (Evaluating)
- CO6:** develop and create a website of their own. (Creating)

Suggested Readings

1. Deitel and Deitel, Internet and World Wide Web: How to Program, 4th Edition, Prentice Hall of India Pvt. Ltd. , New Delhi, 2009.
2. E. A. Meyer, CSS The Definite Guide, 3rd Edition, O'Reily.
3. Douglas E. Comer, The Internet Book: Everything you need to know about Computer Networking and how the Internet works, 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi
4. R. Lerdorf, K. Tatro, P. MacIntyre, Programming PHP, 3rd Edition, O'Reily.
5. T. McNavage, JavaScript for Absolute Beginners, Apress, 2010.

CACG0014: COMPUTER GRAPHICS**(3 credits – 45 hours)**

Objective: *Computer graphics is one of the most exciting and rapidly growing computer fields. It has got numerous areas of applications such as user interface, data visualization, television commercials, motion pictures, etc. This paper is meant to give the students knowledge of hardware, graphics concepts and algorithms to implement the concepts.*

Module I (7 Hours)

Overview of Graphics Systems : Video Display Devices, Refresh cathode-ray Tubes, Raster Scan Display, Random Scan Display Color CRT Monitor, Direct View Storage Tubes, Flat panel Display, Three Dimensional Viewing Devices, Stereoscopic and Virtual-Reality Systems, Raster Scan Systems Video Controller, Raster Scan Display Processor, Random-Scan Systems, Graphics Monitors and Workstations, Input Devices, Hard Copy Devices, Graphics Software, Coordinate Representations, Graphics Functions, Software Standards, PHIGS Workstations.

Module II (10 Hours)

Output Primitives: Points and Lines, Line Drawing Algorithms, Loading the Frame Buffer, Line Functions, Circle –generating Algorithms, Ellipse-generating Algorithms, Other Curves, Conic Sections, Polynomial and Spline Curves, Parallel Curve Algorithms, Curve Functions, Pixel Address and Object Geometry Screen Grid Coordinate, Maintaining Geometric Properties of Displayed Objects, Filled-Area Primitives, Scan-line polygon Fill Algorithm, Inside Outside Test, Scan –Line Fill of Curved Boundary Areas, Boundary Fill Algorithm, Flood Fill Algorithm, Fill-Area Functions, Cell Array, Character Generations.

Module III (10 Hours)

Two- Dimensional Geometric Transformations : Basic Transformations: Translations, Rotations, Scaling; Matrix Representations and Homogeneous Coordinates, Composite Transformations: Translations, Rotations, Scaling, General Pivot Point Rotations, General Fixed Point Scaling, General Scaling Directions, Concatenation Properties, General Composite Transformations and Computational Efficiency, Other Transformations: Reflections, Shear; Transformations Between Coordinate Systems, Affine Transformations, Transformation Functions, Raster Method for Transformations.

Module IV (10 Hours)

Two-Dimensional Viewing: The Viewing Pipeline, Viewing Coordinate Reference Frame, Window-to-Viewport Coordinate Transformations. Two -Dimensional Viewing Functions, Clipping Operations, Point Clipping, Line Clipping: Cohen-Sutherland Line Clipping, Liang- Barsky Line Clipping, Nicholl-Lee-Nicholl Line Clipping; Polygon Clipping: Sutherland- Hodgeman Polygon Clipping, Weiler-Atherton Polygon Clipping; Curve Clipping, Text Clipping, Exterior Clipping.

Module V (8 Hours)

Three Dimensional Concept and Some Object Representation: Three-Dimensional Display Methods, Parallel Projections, Perspective Projections, Depth Cueing, Visible Line and Surface, Identification, Surface Rendering, Exploded and Cutway Views, Three-dimensional and Stereoscopic Views, Three Dimensional Graphic Packages, Polygon Surfaces, Polygon Tables, Place Equations, Polygon Meshes, Curved Line and Surfaces, Quadric Surfaces: Sphere, Ellipsoid, Torus, Superquadrics, Superellipse, Superellipsoid, Blobby Objects, Spline Representations, Interpolations and Approximations Splines, Parametric Continuity Conditions, Geometric Continuity Conditions, Spline Specifications,

Cubic Spline Interpolation Methods, Natural Cubic Splines, Hermite Interpolations, Cardinal Splines, Kochanek-Bartels Splines, Bezier Curves, Properties of Bezier Curves, Design Technique Using Bezier Curves, Cubic Bezier Curves, Bezier Surfaces.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define various graphics systems, Graphics software and software standards. (Remembering)
- CO2:** Explain the output primitives that will comprise of various algorithms. (Understanding)
- CO3:** write programmes to design simple applications of computer graphics. (Applying)
- CO4:** Examine the 2D transformations, 2D viewing and concepts on 3D dimensional concepts and some object representation. (Analysing)
- CO5:** Evaluate the performance of the algorithms that will be required to design the shapes and curves. (Evaluating)
- CO6:** Draw lines, curves, circle using algorithms and implement many functions to fill colors; further they will be able to design animations using various transformations. (Creating)

Suggested Readings

1. Donald Hearn and M Pauline Baker, Computer Graphics, 2nd Edition, PHI, India.
2. R Plastock and G Kalley, Theory and Problems of Computer Graphics, 2nd Edition, Schaum's Series, Mc GrawHill.
3. J Foley and A Van Dam, S Feiner , J Huges., Computer Graphics : Principles and Practice, Addison – Wesley.
4. D Rogers and J Adams, Mathematical Elements for Computer Graphics, 2nd Edition, McGraw Hill, International Edition.

CADC0015: DATA COMMUNICATIONS AND NETWORKS I

(4 credits – 60 hours)

Objective: *Data communications and networking may be the fastest growing technologies in our culture today. One of the ramifications of that growth is a dramatic increase in the number of professionals where an understanding of these technologies is essential for success. This course deals with the introduction and the first two layers of the OSI model. The students, at the end of this course, will have a more than elementary idea about the technologies/protocols involved in the physical and data link layer, including the medium access control sublayer of the latter.*

Module I: Introduction to Computer Networks (6 Hours)

Uses of Computer Networks; Wired and wireless Networks; Types of networks – LAN, MAN, WAN; Network Topology; OSI Reference Model – Outline, Protocol hierarchies, Design considerations; TCP-IP Reference Model; ATM Reference Model; Comparison among these reference models; Examples- Internet, X.25, Frame Relay, ATM

Module II: Physical Layer (17 Hours)

Fourier Analysis (Qualitative), Maximum data rate of a Channel, Bit rate and Baud; Baseband and Broadband; Guided Transmission Media- Magnetic, Twisted pair, Coaxial cable, Fibre Optics; Wireless transmission – Electromagnetic Spectrum, Radio transmission, Microwave Transmission, Infrared transmission; Comparison among the different transmission media – guided and unguided; Communication Satellite – LEO, MEO and GEO Satellite; Amplitude, Phase and

Frequency modulation – QPSK, QAM, Frequency Division and Time Division Multiplexing – PCM, Delta Modulation, SONET; Circuit, Message and Packet Switching; Outline of PSTN, ADSL, WLL, AMPS, D-AMPS, GSM, CDMA

Module III: Data Link Layer (17 Hours)

Design Issues - Services provided to the higher layer, Framing, Error Control, Flow Control; Error Detection and Correction – Error Correcting Codes, Error-Detecting Codes; Elementary Data Link Protocols – Unrestricted simplex protocol, Simplex stop-and-wait protocol, Protocol for Noisy Channel; Sliding Window protocols – One bit sliding window, Go Back n protocol, Protocol using Selective Repeat; Examples – HDLC, Data Link Layer in the Internet, PPP

Module IV: Medium Access Control Sublayer (20 Hours)

Channel Allocation Problem – Static and Dynamic channel allocation; Multiple access – Aloha, Slotted Aloha, CSMA; Collision free protocols; Limited Contention Protocols; Wireless LAN protocols – MACA, MACAW; IEEE Standard 802.3 – Ethernet, Cabling, Encoding, MAC Sublayer, Switched Ethernet, Fast Ethernet Gigabit Ethernet; IEEE Standard 802.11 – Protocol Stack, Physical Layer, MAC Sublayer, Frame Structure; IEEE Standard 802.16 – Protocol Stack, Physical Layer, MAC Sublayer, Frame Structure; Bluetooth- Architecture, Application, Protocol Stack, Radio Layer, Baseband layer, Frame Structure; Bridges – Spanning tree bridges, Remote bridges

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall different networking terminologies such as TCP/OSI, protocols, routing, link errors etc. (Remembering)
- CO2:** Explain different network typologies, Fourier analysis, data link layer design issues and channel allocation problem in network. (Understanding)
- CO3:** apply the knowledge to solve different problems related to Fourier analysis of a signal, spectrum analysis, medium access protocols etc. (Applying)
- CO4:** distinguish between TCP from OSI, different physical layer transmissions, modulation and demodulation techniques (Analysing)
- CO5:** Analyse the pros ,cons and implementation of different modulation techniques, encoding and decoding techniques, IEEE standards (Analysing)
- CO6:** judge which protocols operates in which layer and why, which encoding is efficient than the other and for what reason etc. (Evaluating)
- CO7:** create circuit design for LAN communication, signal modulation and demodulation. (Creating)

Suggested Readings

1. Andrew S. Tenenbaum, Computer Networks, Fourth Edition, Prentice Hall of India, 2002
2. Behrouz A Forouzan, Data Communication and Networking, Second Edition, Tata McGraw Hill, 2000
3. William Stallings, Data and Computer Communications, Sixth Edition, Prentice Hall of India, 2000
4. Fred Halsall, Data Communication, Computer Networks and Opens Systems, Fourth Edition, Pearson Education, 2000

CAOS0016: OPERATING SYSTEMS

(4 credits – 60 hours)

Objective: The main objective of this course is to introduce the students to a layer of software called Operating Systems, whose job is to manage all the devices of a computer system and provide user programs with a simple interface to the hardware. This course will familiarize the students with the concepts of processes, memory management, file management, Input/Output management and the potential problem of deadlocks. The students will also learn about the Linux operating system, which is a full-blown Unix clone and is fast gaining popularity worldwide.

Module I: Concepts, Processes and Threads (14 Hours)

Operating system as an Extended Machine and as a Resource Manager, Operating system concepts (Files, Deadlocks, Memory Management, Input/Output, Processes, The Shell, Security), The evolution of Operating Systems (Serial Processing, Simple Batch Systems, Multiprogrammed Batch Systems, Mainframe Operating Systems, Server Operating Systems, Time Sharing Systems, Multiprocessor Operating Systems, Real-Time Systems, Embedded Operating Systems, Smart Card Operating), System Calls (Process Management, File Management, Directory management), Introduction to Processes (The Process Model, Process Creation, Process Termination, Process Hierarchies, Process States, Implementation of Processes, Process Control Block), Threads (The Thread Model, Thread Usage, Implementing Threads(In User Space and Kernel), Scheduler Activation, Pop Up Threads, Interprocess Communication (Race conditions, Critical Sections, Mutual Exclusion with Busy Waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message Passing), Classical IPC problems (The Dining Philosophers Problem, The Sleeping Barber Problem), Process Scheduling (Scheduling in Batch Systems, Scheduling in Batch Systems, Scheduling in Interactive Systems, Scheduling in Real-Time Systems, Thread Scheduling)

Module II: Deadlocks and Memory Management (14 Hours)

- a) Resources, Deadlock (Conditions for Deadlock, Deadlock modeling), Deadlock detection and recovery, Deadlock avoidance, Deadlock prevention
- b) Memory management without swapping or paging (Monoprogramming without swapping or paging, Multiprogramming with fixed partitions, Relocation and Protection), Swapping, Virtual Memory (Paging, Page Tables), Page Replacement Algorithms (Not-recently-used, First in first out, Second Chance page replacement algorithm, The Clock Page Replacement Algorithm, Least Recently used page replacement algorithm, The Working Set Page Replacement Algorithm, Modeling Paging Algorithms (Belady's Anomaly, Stack Algorithms, Predicting page fault rates), Design issues for Paging Systems, Implementation issues, Segmentation (Implementation of pure segmentation, Segmentation with Paging: MULTICS)

Module III: Input/output and File Systems (16 Hours)

- a) Principles of I/O hardware (I/O devices, Device Controllers, Direct memory access), Principles of I/O software, I/O Software Layers, Disks (Disk hardware, disk formatting, disk arm scheduling algorithms, Error handling, Track-at-a-time caching, RAM disks) Clocks (Clock hardware, Clock software), Terminals (Terminal hardware, Input software, Output software)
- b) Files (File Naming, File structure, File types, File access, File attributes, File operations, Memory mapped files), Directories, File System layout (Implementing files, Implementing directories, Shared files), Security (The security environment, Generic Security Attacks, Design Principles For Security, User Authentication), Protection mechanisms (Protection Domains, Access Control Lists, Capabilities, Multilevel Security, Covert Channels), Type of File Systems (FAT, VFAT, FAT32, NTFS)

Module IV: Introduction to Linux OS design – Case study (16 Hours)

Overview of Unix, Processes in Unix (Fundamental Concepts, Process Management System Calls in Unix, Implementation of Processes in Unix), Memory Management in Unix, Input/Output in Unix, The Unix File System, Security in Unix

COURSE / LEARNING OUTCOMES

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

- CO1:** Elaborate what operating systems are, what they do and how they are designed and constructed. (Creating)
- CO2:** Define process concept like process scheduling, inter-process communication, process synchronization and concurrency. (Remembering)
- CO3:** Explain different memory management schemes, relate various approaches to memory management and effectiveness of a particular algorithm. (Understanding)
- CO4:** Identify different page replacement algorithms to solve problems. (Applying)
- CO5:** Explain how the file system, mass storage and I/O are handled in a modern computer system. (Remembering, Understanding)
- CO6:** Analyse the mechanisms necessary for the protection and security of computer systems. (Analysing)
- CO7:** Determine the concepts learned with case studies of Linux and Windows.(Evaluating)

Suggested Readings

1. Andrew S Tanenbaum, Modern Operating Systems , (Second Ed.), Prentice Hall of India, New Delhi, 2002
2. William Stallings, Operating Systems, Fourth Edition, Prentice Hall of India, New Delhi.
3. Silberschatz, Galvin, Operating System Concepts, Fifth Edition, John Wiley and Sons (Asia) Pte Ltd.
4. HM Deitel, Operating Systems, Second Edition, Pearson Education.
5. Pramod Chandra P. Bhatt, An Introduction to Operating Systems Concept, Prentice Hall of India.
6. Maurice J. Bach, The Design of the Unix Operating System, Prentice Hall of India, New Delhi.
7. Kernighan and Pike, The Unix Programming Environment, Prentice Hall of India, New Delhi.

CADA0017: 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) Models 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, Biconnectivity, 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 classes 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)

- a) Data Structures and Algorithms for External Storage: A model for External computation, External sorting, Storing information in files, External search trees.
- b) 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:** Define, Recall the basics of algorithms, importance of analysis of an algorithm and their asymptotic bounds and the different types of problem and their solutions. (Remembering)
- CO2:** Explain the different design strategies such as brute force, divide and conquer, dynamic programming, greedy and backtracking used for the design of algorithms. (Understanding)
- CO3:** design and Analyse algorithms for given problems. (Applying/Analysing)
- CO4:** compare and Analyse 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 and V)
3. Thomas H Corman, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, 2nd PHI, 2004
4. V Manbar, Introduction to Algorithms - A Creative Approach, Addison Wesley, 2000.
5. Ellis Harwitz, Sartaz Sahani, Fundamentals of Computer Algorithms.. ,Computer Science Press, 2000.
6. Peter Linz, An Introduction to Formal Languages and Automata. Narosa Publishing House 2001.

CAPJ0018: PROGRAMMING THROUGH JAVA

(4 credits–60 hours)

Objective: The course is designed to impart the knowledge and skill required to solve real world problem using object-oriented approach utilizing Java language constructs. This course covers the two main parts of Java i.e. Java Language and Java Library (JDK 5). After completion of the course, a student is expected to be able to

- Do Object Oriented Programming using Java
- Implement Exception handling and Multithreading in Java.
- Create Java I/O Applications and Applets.
- Set up a GUI using Swing components
- Do Network Programming in Java.
- Access relational databases from Java program and use Java Beans and Servlets.

Module I: Core Java Programming (14 Hours)

- a) Java Overview: Genesis, Java Philosophy, Java and Internet, Object-Oriented Programming features, Java Applet and Application, Java Environment and Java Development Kit (JDK) and Java Standard Library (JSL),
- b) Java language fundamentals: The scope and lifetime of variable, Type conversion and casting, Control statements, Arrays
- c) Classes and objects: The this keyword, Garbage collection, Overloading constructor, Using object as parameters, Argument passing, Returning objects, Recursion, Introducing Access control (public, private and protected), static, final, nested classes, String class, Command-line argument

Module II: Inheritance, Exception handling, Multithread and Applets (12 Hours)

- a) Inheritance: Member access and inheritance, method overriding, dynamic method dispatch, using abstract classes, using final with inheritance, the Object class; Packages, Interface, classpath
- b) Exception handling: Fundamentals, Exception types, Java’s built-in exceptions, user defined exceptions.
- c) Multithreaded Programming: The Java thread model (thread priorities, synchronization and inter-thread communication); Deadlock, Thread Group
- d) I/O Basics : Streams, the stream classes, the predefined streams, Reading console input, writing console output, the transient and volatile modifiers, using instance of native methods

Module III String handling, Utility classes, java.lang and java.io (12 Hours)

- a) String handling: String constructors, methods for character extraction, string searching and comparison, data conversion using valueof (), StringBuffer
- b) Exploring java.lang: Simple type wrappers, System class, class Class, Math functions
- c) The utility classes: Vector, Stack, HashTable, StringTokenizer, Bitset, Date, Calendar, Gregorian Calendar, Random, Observable
- d) Input/Output - Exploring java.io: The java.io classes and interface, File class and methods for creating, renaming, listing and deleting files and directories, I/O stream classes (FileInputStream, FileOutputStream, BufferedInputStream, BufferedOutputStream, PushBackInputStream, InputStreamReader, BufferedReader, BufferedWriter, PrintStream, RandomAccessFile)

Module IV: Networking, Images, Applet class and Swing (12 Hours)

- a) Networking: Socket overview, Stream Sockets, Datagram sockets, Manipulating URLs, Establishing a simple Server/Client using Stream Sockets, Connectionless Client/Server Interaction with Datagrams
- b) Images: File formats, image fundamentals, creating, loading and displaying images, ImageObserver, MediaTracker
- c) The Applet class: applet architecture, passing parameters to applets, getDocumentBase, getCodeBase, and showDocument, AppletContext and AudioClip interfaces, Graphics class and methods for drawing lines, rectangles, polygons and ovals
- i) Swing: Component and Container classes, Layout managers (FlowLayout, GridLayout, BorderLayout), Handling events, Adapter classes, Anonymous inner classes
- ii) Swing GUI components : JLabel, JTextField, JTextArea, JButton, JCheckBox, JRadioButton, JList, JComboBox, JScrollBar, JScrollPane, JToolTip, JPanel, JFrame iii) Menus: JMenuBar, JMenu, JMenuItem, JSeparator

Module V: Java Beans, JDBC, Java Servlets (10 Hours)

- a) Java Beans: Introducing JavaBeans Concepts and Bean Development Kit (BDK), Using the Bean Box, Writing a simple Bean, Bean Properties (simple properties), Manipulating events in the Bean Box
- b) Java database connectivity (JDBC): Introduction to JDBC, type of JDBC connectivity, Establishing database connections, Accessing relational database from Java programs

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the various features of Object Oriented programming by utilizing the JAVA language construct. (Remembering)
- CO2:** Explain the standard library, scope and lifetime of a variable and various control statements used in JAVA program. (Understanding)
- CO3:** Interpret the concept of classes and object in JAVA and *apply* exception handling to solve various exceptions (Applying)
- CO4:** Contrast the different type of inheritance and polymorphism and Analyse it in resolving various problems (Analysing)
- CO6:** Select the appropriate GUI and will be able to justify their decision to use a particular GUI by evaluating the required parameters depending on the domain and requirement. (Evaluating)

CO5: Develop algorithms based on the knowledge they have gained to design cost effective and user friendly application. (Creating)

Suggested Readings

1. Deitel, H. M.; P. J. Deitel, Java : How To Program (Sixth Edition), New Delhi: Prentice-Hall India, 2005
2. Schildt, H., The Complete Reference Java 2 (Fifth Edition), New Delhi: Tata McGraw-Hill, 2005
3. Moss, K., Java Servlets (Second Edition), New Delhi: Tata McGraw-Hill
4. Russel, Java Programming for the absolute Beginner , New Delhi: Prentice-Hall India
5. Hanagan D., Java Examples in a Nutshell (Third Edition), New Delhi: O' Reilly, 2001

CASE0019: SOFTWARE ENGINEERING

(4 credits–60 hours)

Objective: *The field of software engineering aims to find answers to the many problems that software development project is likely to meet when constructing large software systems. The objective of this paper is to make students aware of the problems incurred by large-scale software development and the solutions proposed. It covers a framework for studying and evaluating software tools, and stresses the importance of theory in the development of software.*

Module I (10 Hours)

- a) The Product and The Process: The Product - Evolving Role of Software, Software (Characteristics, Components and Applications);
- b) The Process – Software Engineering A Layered Technology, The Software Process, Software Process Models, The Linear Sequential Model, The Prototyping Model, The RAD Model, Evolutionary Process Models (The Incremental Model, The Spiral Model, The Component Assembly Model, The Concurrent Development Model), The Formal Methods Model, Fourth Generation Techniques;
- c) Project Management Concepts – The Management Spectrum (People, The Problem, The Process and The Project);
- d) Software Process and Project Metrics– Measures, Metrics and Indicators, Metrics in the Process and Project Domains, Software Measurement, Reconciling Different Metrics Approaches, Metrics for Software Quality;
- e) Software Project Planning – Observation on Estimating, Project Planning Objectives, Software Scope, Resources, Project Estimation Technique – Empirical estimation techniques (Expert Judgement Technique, Delphi Cost Estimation), Heuristic estimation techniques (COCOMO Model), Halstead Software Science (An Analytical Technique), The Make-Buy Decision;

Module II (10 Hours)

- a) Project Scheduling and Tracking - Basic Concepts, The Relationship between People and Effort, Defining a Task set for the Software Project, Selecting Software Engineering Tasks, Defining a Task Network, Scheduling, The Project Plan;
- b) Software Projects Risks, Quality Assurance and Configuration Management: RiskManagement-Reactive Vs. Proactive Risk Strategies, Software Risk, Risk Identification, Risk Projection, Risk (Mitigation, Monitoring and Management), Safety Risks and Hazards, The RMMM Plan;
- c) Software Quality Assurance - Quality Concepts, The Quality Movement, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Statistical Quality Assurance, Software Reliability, The SQA Plan, The ISO 9000 Quality Standards;

- d) Software Configuration Management - Software Configuration Management, The SCM Process, Identification of Objects in the Software Configuration, Version Control, Change Control, Configuration Audit, Status Reporting;
- e) System Engineering - Computer Based Systems, Product Engineering

Module III (20 Hours)

- a) Analysis and Design: Analysis Concepts and Principles - Requirements Analysis, Communication Techniques, Analysis Principles, Software Prototyping, Specification, Specification Review;
- b) Analysis Modeling- The Elements of the Analysis Model, Data Modeling, Functional Modeling and Information Flow, Behavioral Modeling, The Mechanics of Structured Analysis, The Data Dictionary;
- c) Design Concepts and Principles - Software Design And Software Engineering, The Design Process, Design Principles, Design Concepts, Effective Modular Design, Design Heuristic for Effective Modularity, The Design Model, Design Documentation;
- d) Design Methods - Data Design, Architectural Design, The Architectural Design Process, Architectural Design Optimization, Interface Design, Human-Computer Interface Design, Interface Design Guidelines, Procedural Design;
- e) Design For Real Time systems - Real Time Systems;
- f) Case studies on diagram - Use case, Class, Activity, Sequence

Module IV (10 Hours)

- a) Software Testing: Software Testing Methods - Software Testing Fundamentals, Test Case Design, White Box Testing, Basis Path Testing, Control Structure Testing, Black Box Testing, Testing for Specialized Environments;
- b) Software Testing Strategies - A Strategic Approach to Software Testing, Strategic Issues, Unit Testing, Integration Testing, Validation Testing, System Testing, The Art of Debugging;
- c) Technical Metrics For Software - Software Quality, A Framework For Technical Software Metrics, Metrics for the Analysis Model, Metrics for the Design Model, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance

Module V (10 Hours)

- a) Object Oriented Software Engineering: Object Oriented Concepts and Principles - The Object Oriented Paradigm, Object Oriented Concepts, Identifying the Elements of an Object Model, Management of Object Oriented Software Projects
- b) Object Oriented Analysis - Object Oriented Analysis, Domain Analysis, Generic Components of the Object Oriented Analysis Model, The OOA Process, The Object Relationship Model, The Object Behavior Model
- c) Object Oriented Design - Design for Object Oriented Systems, The Generic Components of the OO Design Model, The Systems Design Process, The Object Design Process, Design Patterns, Object Oriented Programming
- d) Advanced Topics In Software Engineering: Cleanroom Software Engineering- The Cleanroom Approach, Functional Specification, Design Refinement and Verification, Cleanroom Testing
- e) Software Reuse - Management Issues, The Reuse Process, Domain Engineering, Building Reusable Components, Classifying and Retrieving Components, Economics of Software Reuse
- f) Reengineering - Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering, Economics of Reengineering

- g) Computer Aided Software Engineering - Case Definition, Building Blocks of Case, Taxonomy of Case Tools, Integrated Case Environments, The Integration Architecture, The Case Repository

COURSE / LEARNING OUTCOMES

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

- CO1:** define the life cycle models of software. (Remembering)
- CO2:** Explain, identify and differentiate various software life cycle models (Understanding)
- CO3:** experiment with different software architectures and identify the best feasible one (Applying)
- CO4:** maintain the software project by using maintenance plan. (Applying)
- CO5:** Analyse and design the software requirement specification (Analysing)
- CO6:** summarize, Evaluate and validate a practical solution towards a software application development and also deploy a product of their own. (Evaluating, Creating)
- CO7:** develop and create various design diagrams and find solutions to problems.(Creating)

Suggested Readings

1. Roger S. Pressman, Software Engineering A Practitioner's Approach, Fourth Edition, Tata McGraw Hill.
2. Rajib Mall, Fundamentals of Software Engineering, Second Edition, Prentice Hall of India Private Limited.
3. Ian Sommerville, Software Engineering, Sixth Edition, Addison Wesley, Pearson Education.
4. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals Of Software Engineering, Second Edition, Prentice Hall of India Private Limited, New Delhi, 2002.
5. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, Modern Systems Analysis and Design, Second Edition, Pearson Education.
6. Richard E Fairley, Software Engineering Concepts, Tata McGraw Hill Publishing Company Limited, New Delhi, 1997.
7. Hans Van Vilet, Software Engineering Principles and Practice, Second Edition, John Wiley and Sons, Ltd.

CADC0020: DATA COMMUNICATIONS and NETWORKS II AND NETWORK PROGRAMMING USING LINUX

(4 credits – 60 hours)

Objective: *This course, being a continuation of the course Data Communication and Networks I of the previous semester, builds on the concepts of data communications and computer network. It deals with the remaining three main layers – the Network layer, the Transport layer and the Application Layer. This paper also introduces the students to network security and cryptography. While the aforesaid topics are dealt for the theory part of this paper, the practical section deals with network programming.*

Module I (17 Hours)

Network Layer : Design Issues – Store and forward packet switching, Services provided to higher layer, Connection Oriented and Connectionless services, Virtual Circuits and Datagram subnets; Routing Algorithms – Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Routing for Mobile Hosts, Routing in Adhoc networks; Congestion Control Algorithms – General Principles, Congestion Prevention Policies, Congestion control in Virtual Circuit and Datagram Subnets, Load shedding, Jitter control, QoS, Leaky Bucket Algorithm, Token Bucket Algorithm, RSVP;

Internetworking – Tunneling, Fragmentation; Internet Protocol – IP addresses, Subnets, CIDR, Network address translation,; Internet Control Protocol – ICMP, ARP, RARP, BOOTP, DHCP; Mobile IP – Routing

Module II (17 hours)

Transport Layer : Design Issues, Services presented to higher layers; Transport Service Primitives; Berkeley Sockets; Transport protocols – Addressing, Connection Establishment and Release, Flow Control and Buffering, Multiplexing, Crash Recovery; Internet Transport Protocols: UDP – Remote Procedure Call, Real-time transport Protocol; TCP – Service Model, Protocol, Header, Connection Establishment and Release, Connection Management, Transmission Policy, Congestion Control, Timer Management

Module III (10 Hours)

Application Layer : Domain Name System – name space, resource records, name servers; Electronic Mail - architecture and services, user agent, Message formats – MIME, Message Transfer - SMTP, Message Delivery – POP3 and IMAP, Web mail

Module IV (16 Hours)

Network Security : Cryptography, Substitution Ciphers, Transposition Ciphers, One time pads, Quantum Cryptography, Cryptographic principles; Symmetric Key Algorithms – Data Encryption Standard, Advanced Encryption Standard, Cipher Modes; Public Key Algorithms – RSA; Digital Signatures – Symmetric Key, Public Key, Message Digest, Birthday Attack; Communication Security - IPSec, Firewalls, Virtual Private Networks; Wireless Security – 802.11 Security, WAP Security; Authentication Protocols – Based on shared secret key, Diffie-Hellman Key Exchange, Key Distribution Center, Kerberos, Public Key

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the different protocols, their purpose and architectures used in Network, Transport and Application Layers. (Remembering)
- CO2:** explain the routing algorithms, congestion control mechanism and their policies used in Network Layer. They will further comprehend the design issues of each layers, examine the issues related to network security and learn the algorithms used to provide solutions to the related issues (Analysing/ Remembering/ Understanding)
- CO3:** apply their knowledge to solve problems where data need to be transmitted in a network using the shortest path algorithm (Applying)
- CO4:** Analyse the purpose of using different Cryptographic principles. (Analysing)
- CO5:** Depending on the purpose of data communication in a network, *choose* the appropriate algorithms to dispatch the packets and decide whether to opt for TCP or UDP client-server programming. Also, justify the decision to choose a particular scheme. (Evaluating, Creating)

Suggested Readings

1. Andrew S. Tenenbaum, Computer Networks (Fourth Ed.), Prentice Hall of India, 2002
2. W Richard Stevens, UNIX Network Programming – Volume I (2nd Ed.), Prentice Hall of India, 2002
3. William Stallings, Data and Computer Communications (Sixth Ed.), Prentice Hall of India, 2000
4. Fred Halsall, Data Communication, Computer Networks and Opens Systems, (4th Ed.), Pearson Education, 2000
5. William Stallings, Cryptography and Networking Security - Principles and Practice, Pearson Education, 2000

CADM0021: DATABASE MANAGEMENT SYSTEM II**(4 credits – 60 hours)**

Objective: *The objective of this paper is to present to the students some advanced database management concepts like query procession and transaction procession. Also, an introduction to some emerging database management technologies like data mining, data warehousing, multimedia databases etc, is also included.*

Module I: Query Processing and Optimization (10 Hours)

Query Processing: Overview of query processing, translation of SQL queries into relational algebra, Algorithms for SELECT, JOIN, PROJECT and SET operations, pipelining of operations, heuristics, selectivity and cost estimates in query optimization

Module II: Transaction Processing and Concurrency Control (25 Hours)

- a) Transaction Processing: Transaction, ACID properties of transaction, transaction states, schedules, serializability, tests for serializability, recoverability, transaction definition in SQL.
- b) Concurrency Control: Concurrent execution of transaction, Lock-based techniques for concurrency control, Graph-based protocol, Timestamp based protocol, Deadlock, Deadlock prevention methods, Deadlock detection Deadlock recovery

Module III: Recovery and Security (10 Hours)

- a) Recovery system: Types of failure, types of storage, recovery and Atomicity, Log-based recovery, shadow paging, recovery with concurrent transactions, buffer management, logical undo logging, transaction rollback, checkpoints, restart recovery, fuzzy checkpointing
- b) Security: Security and Integrity-security violations, authorization and views, granting of privileges, security specifications in SQL, encryption, and statistical databases.

Module IV: Database System Architectures and New Applications (Introduction)(15 Hours)

Centralized Systems, Client-Server Systems, Parallel Systems, Distributed Systems, Decision-Support Systems, Data Mining Concepts- Association Rules, Classification, Clustering, Applications of Data Mining, Commercial Data Mining Tools, Other Database Technologies (introduction)-Data Analysis, Data Warehousing, Spatial and Geographical Databases, Multimedia Databases, Mobility and Personal Database.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall and identify the techniques used by a DBMS to process, optimize and execute high level queries.(Remembering)
- CO2:** describe fundamentals of transaction processing system, including ACID properties of a transaction.(Understanding)
- CO3:** illustrate concurrency control & Analyse several concurrency control techniques for ensuring serializability, locking, timestamping. (Analysing)
- CO4:** discuss some of the techniques that can be used for database recovery from failures. (Understanding)
- CO5:** classify security issues and threats to databases and summarize the control measure for securing databases against a variety of threats.(Creating, Understanding)
- CO6:** describe different computer system architecture and show the influence of underlying computer system on the database system. (Applying, Understanding)

Suggested Readings

1. Silberschatz, HF Korth, S Sudarshan, Database System Concepts, Tata- McGraw Hill, 1997.
2. R Elmasri, SB Navathe, Fundamentals of Database Systems, Addison, Wesley (Third Edition) 2000.
3. DM Kroenke, Database Processing: Fundamentals, Design and Implementation, Prentice-Hall of India, (Eighth Edition) 2002.
4. GW Hansen, JV Hansen, Database Management and Design, Prentice-Hall of India, (2nd Edition) 2001.
5. Thomas M Connolly, Carolyn E Begg, Database Systems, A Practical Approach to Design, Implementation and Management, Addison Wesley Longman Ltd. 1999.

CAIT0022: INTERNET TECHNOLOGY AND APPLICATIONS

(3 credits – 45 hours)

Objective: *The objective of the course is to familiarize the students with a discussion on Internet and its growth. It also provides the students a study on the basic services provided by the Internet. A familiarization on the markup languages, scripting languages and web application development are also being discussed to make the student competent to design websites. It has been taken into consideration that this paper assumes that the students must know well in advance about the various protocols of the Internet and the knowledge of HTML and databases.*

Module I: Introduction to Internet (9 Hours)

History of the Internet; History of the World Wide Web; W3C (World Wide Web Consortium); Levels of Internet Connectivity (Dial-up, Leased Line, DSL, VSAT); Requirements for Internet connectivity; Use of Browsers; Different types of browsers (IE, Opera, Netscape, Firefox); Search engines; FTP; Electronic Mail; Instant Messaging; DHCP; DNS; HTTP; URL; Proxy Servers.

Module II: Internet Markup Languages (12 Hours)

- a) XHTML: What is XHTML?; Components of XHTML; Elements of XHTML (Headers, Paragraphs,
- b) Linking, Images, Special Characters, Lists, Tables, Forms, Framesets)
- c) Cascading Style Sheets: Inline Styles; Embedded Style; Conflicting Style; Linking External Styles; W3C CSS Validation Service; Use of CSS (Positioning Elements, Backgrounds, Text flow)
- d) XML: What is XML? Structuring Data; XML Namespaces; Document Type Definitions and Schemas; XML Vocabularies; Document Object Model (DOM and its methods); Extensible StyleSheet Language (XSL)

Module III: Web servers, Databases and Scripting Languages (12 Hours)

- a) Web servers: What is a web server; HTTP Request Types; System Architecture of a Web server; Client-side Scripting versus Server-side Scripting; Accessing Web servers; Apache Web Server.
- b) Databases: Introduction to each one of the following: SQL, MYSQL, DBI
- c) Scripting Languages: Javascript: Operators, Data Types, Control Structures, Functions, Arrays, String Manipulation. JQuery, ASP.NET. Introduction to Perl and CGI (Common Gateway Interface). JSP: Introduction; JSP Overview; Scripting; Standard Actions; Directives
- d) Java Servlets: Servlet overview and architecture, Servlet Interface and Servlet life cycle, HttpServlet Class, HttpServletRequest Interface, HttpServletResponse Interface, Handling HTTP get Requests, Deploying a web application, Handling HTTP get requests containing data, Handling HTTP post requests

Module IV: Web Application Development Using PHP (12 Hours)

- a) Web Site Design Considerations: Using Logical Design: Planning your website, drawing a map, using a top-down approach, flexibility, other web design metaphors. Creating templates. Creating a Compatible Design: Designing for different color depths, resolutions, different browser considerations, accommodating limited bandwidth. Validating your work.
- b) PHP: Introduction to PHP; Data Types; Control Structures; Functions; Strings; Arrays; Querying Web Databases using PHP; Writing to Web Databases; Errors, Debugging and Deployment; Reporting in PHP; Validation Techniques in PHP.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall and examine the growth of Internet and identify the history behind it. (Remembering)
- CO2:** identify and differentiate the various services provided by the internet. (Understanding)
- CO3:** experiment with various mark-up languages and scripting languages. (Applying)
- CO4:** Analyse and design a website of their own and can also identify the faults in the design. (Analysing)
- CO5:** develop and create a website of their own. (Creating)
- CO6:** summarize and validate a practical solution towards a web application development and also deploy a website of their own. (Evaluating)

Suggested Readings

1. Deitel and Deitel, Internet and World Wide Web: How to Program, 2nd Edition, Prentice Hall of India Pvt. Ltd. , New Delhi
2. Hugh E. Williams and David Lane, PHP and MySQL, 2nd Edition, O'Reilly, Shroff Publishers and Distributors Pvt. Ltd.
3. Moss, K., Java Servlets (Second Edition), New Delhi: Tata McGraw-Hill
4. Internet Complete, 2nd Edition, BPB Publications., New Delhi
5. Douglas E. Comer, The Internet Book: Everything you need to know about Computer Networking and how the Internet works, 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi

CASG0023: SYSTEM PROGRAMMING

(3 credits – 45 hours)

Objective: The course is aimed at presenting the programming concepts of several system software such as assembler, linker, loader, macro processor, and other software.

Module I: Assemblers (12 hours)

Overview of the assembly process, Machine dependent assembler features, Machine independent assembler features, Design of two pass assembler, single pass assembler.

Module II: Loaders and linkers (13 hours)

Loader functions, program relocatability, absolute and bootstrap loader, Overview of linkage editing- linking loader-Dynamic linking, Design of the linkage editor, study of executable linkable file, DLL.

Module III: Macroprocessors (15 hours)

Macro definition and usage, two pass macro, one pass macro, Schematics for Macro expansion- Generation of unique labels, Conditional macro expansion, Recursive macro expansion, Macro with language interpreter.

Module IV: Software tools (5 hours)

Introduction to software tools, text editor, Interpreter, Program generator, Debug monitor.

COURSE / LEARNING OUTCOMES

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

- CO1:** List the data structures used in designing –assembler, macro preprocessor, linkers- loaders and will also be able to state their functions in a computer system. (Remembering).
- CO2:** Recognize different types of assembly statements and thus will be able to label the statements of a given assembly program as one of the type. (Understanding)
- CO3:** Differentiate between system programs and application programs and will also be able to discuss the role of system program in a computer system. (Applying)
- CO4:** Describe different types of editors and will also be able to illustrate their working principle. (Analysing)
- CO5:** Produce the machine code for a given assembly code. (Creating)
- CO6:** Justify the requirement of multiple passes in designing assembler, macro preprocessor, loaders and linkers. (Evaluating)

Suggested Readings

1. John J. Donovan, Systems Programming, 1st ed., McGraw Hill.
2. Leland L. Beck, System Software - An Introduction to System Programming, 3rd ed., Pearson.
3. D.M.Dhamdhare, System Programming and Operating Systems, TMH.
4. P. Balakrishna Prasad, Operating Systems and system Programming, 2nd ed., Scitech.

CAEP0024: ENTERPRISE RESOURCE PLANNING

(3 credits–45 hours)

Objective: To help the student understand the conceptual elements of ERP and its theory and implementation. This is especially poignant in view of large number of organizations implementing ERP applications in recent years. The student will appreciate the impact that ERP brings into the daily operations of firms with respect to their productivity, integration, communication, etc.

Module I: ERP Basics (15 hours)

- a) Evolution and structure of ERP, ERP concepts, growth of the ERP market, conceptual model of ERP, 2-tier and 3-tier architecture, elements in ERP architecture, advantages/benefits of ERP, overview of an enterprise, integrated management information, business modeling, integrated data model
- b) ERP and related technologies: Business Process Reengineering (BPR), Management Information Systems (MIS), Decision Support Systems (DSS), Data Warehousing, Data Mining, Online Analytical Processing (OLAP), Supply Chain Management.

Module II: ERP Modules (9 hours)

Item types in ERP, Manufacturing, distribution and Financial requirements, item control module in ERP, Finance module, Manufacturing and Production Planning module, Sales and Distribution module, Plant Maintenance module, Quality Management module, Materials Management module, Capital Requirement Planning module, Purchase Control module, Human Resources modules; concept of Bill of materials, concept of formula management.

Module III: Profiling ERP Vendors (8 hours)

- a) SAP AG : R/3 –, overview of R/3 system, R/3 modules, R/3 and the internet
- b) BAAN : Baan ERP modules, Baan ERP Tools
- c) Oracle : Oracle modules – Financials, Human Resources, Projects, Manufacturing, Supply chain.
- d) PeopleSoft : Accounting and control, Treasury Management, Performance Management, Sales and Logistics, Procurement.

Module IV: ERP Implementation Lifecycle (6 hours)

Elements of implementation methodology, Pre-evaluation Screening, Package evaluation, project planning phase, Gap Analysis, Business Process Re-engineering, configuration, Implementation team training, testing, product migration and support, Problems in ERP implementation, cost of ERP.

Module V Best Practices in ERP (7 hours)

- a) Concept of Best Practices, concept of Customer Order Decoupling Point(CODP), Demand Management – Sales and Operations Planning, ERP scenario in India, future directions in ERP.
- b) Case studies should also be introduced to highlight situations where ERP projects are implemented, and the success stories/benefits/difficulties of these implementations.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the conceptual elements of ERP. (Remembering)
- CO2:** Demonstrate the Influence of ERP in Large organization. (Understanding)
- CO3:** Identify the impact of ERP into the daily operations of firms with respect to their productivity, integration, communication etc. (Applying)
- CO4:** Analyse the practical side of ERP implementation with different vendors. (Analysing)
- CO5:** Discuss and evaluate the best practices of ERP with various case studies and real time examples. (Creating, Evaluating)

Suggested Readings

1. O’Leary, Daniel E, Enterprise Resource Planning Systems: systems, life cycle, electronic commerce and risk, Cambridge University Press.
2. Alexis Leon, Enterprise Resource Planning, 14th reprint, Tata McGraw Hill, New Delhi 2005
3. Rahul V Altekar, Enterprise Resource Planning (Theory and Practice), Prentice Hall India, New Delhi 2004
4. Alexis Leon, ERP Demystified, Tata McGraw Hill Pub. Co. Ltd, 2000
5. Kent Sandoe, Enterprise Integration, John Wiley and Sons
6. Garg and Venkitakrishnan, Enterprise Resource Planning : Concepts and Practice, 2nd edition, Prentice Hall India
7. Garg and Venkitakrishnan, ERPWARE : ERP Implementation Framework, Prentice Hall India
8. ERP – Concepts and Cases, ICFAI University Press, 2004

CAOS0025: INTRODUCTION TO OPERATING SYSTEMS

(4 credits -60 hours)

Objective: To provide the basic functionalities and services provided by an operating system. This subject provides an overview of process management, memory management, deadlock, file system, input-output systems and protection and security. It give knowledge on existing common operating system like UNIX, Linux and Windows.

Module I: Introduction to Operating systems (8 Hours)

Definition of Operating Systems, Functions of Operating Systems, Types of Operating Systems: Batch, Multiprogrammed, Time sharing, Multi-Processor, Real-time and Distributed Operating Systems, Operating System Structures, Components and Services, System calls.

Module II: Process Management (10 Hours)

Process Concept-Definition, Process States, Process Control Block, Process Schedulers- Short term, Medium term and Long term schedulers, Scheduling Algorithms - Preemptive and Non- Preemptive, Co-operating process, Threads, Inter-process communication.

Module III: Process Synchronization and Deadlock (12 Hours)

Process Synchronization-the Critical Section Problem, Classical Problems of Synchronization, Semaphores. Deadlocks - Definition of a Deadlock, System model, Characterization, Deadlock Handling-Prevention, Avoidance, Detection and Recovery (Banker's Algorithms and Resource Request Algorithm

Module IV: Memory Management (10 Hours)

Memory Management- Logical and Physical Address Space, Address Mapping, Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with Paging. Virtual memory- Demand paging and its performance, Page replacement algorithms- FIFO and LRU, Thrashing.

Module V: File and I/O System Management (12 Hours)

- a) File management (Systems, Secondary Storage Structure)-File Concepts, Access methods, Directory Structure, Protection and consistency, Recovery.
- b) I/O System Management- Overview of I/O Systems, I/O Interface, Secondary Storage Structure-Disk Structure and Scheduling methods, Disk management, Swap – Space management.

Module VI: Protection and Security (8 Hours)

Goals of protection, Domain Protection, Access matrix, Security Problem, Authentication, Case Study of Windows and Linux Operating System.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the basic concepts of operating systems and terminology related to operating systems.(Remembering)
- CO2:** Explain various management concepts and can apply process management techniques with respect to operating systems.(Understanding, Applying)
- CO3:** Analyse the memory management techniques for operating systems. (Analysing)
- CO4:** Discuss and examine the importance of File and I/O system management in operating systems. (Evaluating, Creating)

Suggested Readings

1. Abraham Silberschatz and Peter Baer Galvin, "Operating System Concepts", 7th Edition, Pearson Education, 2002.
2. Tannenbaum, "Modern Operating Systems", PHI
3. William Stallings, "Operating Systems", 6th Edition, Pearson Education, 2010.
4. Harvey M. Deitel, Operating Systems, Second Edition, Pearson Education Pvt. Ltd.
5. Mandik and Donovan, Operating Systems, Mcgraw Hill.

CASD0026: SYSTEM ANALYSIS AND DESIGN**(4 credits - 60 hours)**

Objective: To provide various concepts of systems analysis and design. It will impart the knowledge and skills required for analysis, design, and development of an information system. Upon completion, students should be able to Analyse a problem and design an appropriate solution using a combination of tools and techniques.

Module I : Introduction to Information Systems (15 hours)

Types of Information Systems, Architecture based Information systems - Centralized Systems, Distributed Systems. The concept of system analysis and design, the stakeholders and their role: Systems users, Systems owners, Systems designers, Systems builders, Systems analysts. Tools for system development - Analysis tools, Fact Finding Techniques, Design tools and Development tools. Determination of system requirement, Activities in requirement determination. Fact Finding Techniques - Interview, Questionnaire, Record review, Observation.

Module II: Structured analysis (18 hours)

- a) Methods and tools, Role of prototyping in the analysis. Tools and techniques for Modeling, Data flow diagram, Data dictionary, documenting decisions and procedures - Decision trees and Decision tables, Structures English. System Flow Charts, Program Flow Charts.
- b) System Development Life Cycle, Phases of SDLC, SDLC models - Waterfall Model, Iterative Model, Spiral Model, etc.

Module III: The design concept of a system (15 hours)

The Design phase, Elements of design- design of Input, the design of output, the design of files, the design of control and procedure, the design of database interactions. Top down and Bottom up design.

Module VI: Testing and Documentation (12 hours)

Testing strategies, types of testing. User training, System audits. Documentation, Program structured charts, Software design and documentation tools, structured flow charts. Selection of Hardware and Software, Categories of automated tools- Front-end tools, Back- end tools, integrated tools, Case Tools.

COURSE / LEARNING OUTCOMES

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

- CO1:** define and describe the five phases of the system development life cycle. (Remembering)
- CO2:** Explain how to gather data to Analyse and specify the requirements of a system and design system components and environments.(Understanding)

- CO3:** Plan how to build general and detailed models that assist programmers in implementing a system.(Applying)
- CO4:** Analyse a problem and design an appropriate solution using a combination of tools and techniques.(Analysing)
- CO5:** Decide methods for evaluating the effectiveness and efficiency of a system.(Evaluating)
- CO6:** design a database for storing data and a user interface for data input and output, as well as controls to protect the system and its data.(Creating)

Suggested Readings

1. System Analysis and design - Preeti Gupta, Firewall media
2. Systems Analysis and Design, 9th Edition Kenneth E. Kendall, Julie E. Kendall, Pearson
3. System Analysis and Design, Fifth Edition by Roberta M. Roth, Barbara Haley Wixom, Alan Dennis, John Wiley and Sons
4. System Analysis and Design - Hitesh Gupta, India Book House Ltd
5. System Analysis And Design – V. K. Jain, Dreamtech Press

CAIG0027: INTRODUCTION TO COMPUTER GRAPHICS

(2 credits - 30 hours)

Objective: This course aims to give an overview of Computer Graphics System and to give the understanding the mathematics behind computers graphics and their implementation on computer.

Module I (6 Hours)

Introduction to computer Graphics - Video display devices- Raster scan Systems -Random Scan Systems - Interactive input devices - Hard copy devices - Graphics software - Output primitives. Shadow Mask CRT.

Module II (10 Hours)

Line drawing algorithms-DDA, Bresenham, circle generating algorithms. Boundary Fill Algorithm, Flood Fill Algorithm. Two dimensional transformation-translation, scaling, rotation, reflection, shear. Viewing Pipeline.

Module III (14 Hours)

Window to viewport co-ordinate transformation, clipping operations: point clipping, line clipping. 3D transformation and viewing: 3D transformations: translation, rotation, scaling and other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; Projection-parallel, perspective.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define different graphics systems comprising of software and hardware. (Remembering)
- CO2:** Explain the fundamentals of graphical operations and the mathematics behind computer graphics. (Understanding)
- CO3:** write program to design simple applications of computer graphics.(Applying)

- CO4:** compare and Analyse different drawing and clipping algorithms.(Analysing)
CO5: evaluate different techniques used to design various applications of computer graphics.(Evaluating)
CO6: create simple animations using various transformations. (Creating)

Suggested Readings

1. Hearn, Baker, “ Computer Graphics (C version 2 nd Ed.)” – Pearson education
2. Mukherjee Arup, Introduction to Computer Graphics, PHI
3. D. F. Rogers, J. A. Adams, “ Mathematical Elements for Computer Graphics – TMH
4. Buford J. K., “Multimedia Systems” – Pearson Education

CADB0028: RELATIONAL DATABASE MANAGEMENT SYSTEMS

(4 credits – 60 hours)

Objective: *The objectives for this course are to give students an in-depth understanding of the relational model for establishing fundamental skills with SQL and the operation of an RDBMS. The course also provides concept of data modelling, design and management for solving realistic problems.*

Module I (15 hours)

- a) Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages.
- b) Data models - Entity Relationship(ER), Enhanced Entity Relationship (EER): specialization, Aggregation, Mapping ER Model to Relational Model, Network. Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

Module II (22 hours)

Relation Query Languages, SQL queries for retrieval and data changing commands, Relational Algebra, Tuple and Domain Relational Calculus, SQL and QBE. Relational Database Design: Domain and Data dependency, Armstrong’s Axioms, Normal Forms, Dependency Preservation, Lossless design.

Module III (8 hours)

Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Optimization Algorithms.

Module IV (15 hours)

- a) Storage Strategies: Indices, B-Trees, Hashing, Transaction processing: Recovery and Concurrency Control, Locking and Timestamp based Schedulers, Multiversion and Optimistic Concurrency Control Schemes.
- b) Advanced topics: Object-Oriented and Object Relational databases. Logical Databases, Web Databases, Distributed Databases, Data Warehouse and Data Mining.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the terminology, features, classifications, and characteristics embodied in database systems. (Remembering)
CO2: Differentiate database systems from file systems and describe each in both function and benefit. (Understanding)

- CO5.** Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database. (Understanding)
- CO3:** Master sound design principles for logical design of databases, including the E-R method and normalization approach. (Understanding/Evaluating)
- CO4:** Transform an information model into a relational database schema and to use a data definition language and/or utilities to implement the schema using a DBMS. (Applying)
- CO6.** Use an SQL interface of a multi-user relational DBMS (Oracle) package to create, secure, populate, maintain, and query a database. (Applying/Creating)

Suggested Readings

1. Ramez Elmasri and Shamkant B Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education
2. Abraham Silberschatz, Henry F Korth and S Sudarshan, Database System Concepts, 5th Edition, Mc-Graw Hill.
3. C.J. Date, Introduction to Database Systems, 8th ed., Pearson Education.
4. Bipin Desai, An introduction to Database System, Galgotia Publication.

CASE0029: BASIC SOFTWARE ENGINEERING

(4 credits - 60 hours)

Objective: To provide ability Analyse a scenario and produce a problem statement. The learners will be able to produce a conceptual solution which includes sample prototypes, domain models, and user stories. The learners will be able to describe the attributes and activities involved in software development process models and testing.

Module I: Introduction (10 Hours)

Problems and solutions: Why software is developed. Problem and vision statements. Goals and objectives. Definitions and paradigms, A generic view of software engineering. Software development life cycle, Role of quality, metrics and measurement.

Module II: Requirements Analysis (15 Hours)

The feasibility study, Software Requirement Analysis and Specifications, work breakdown structure (WBS), Problem Analysis, Creating software requirement specification document (SRS).

Module III: Designing Software applications (15 Hours)

Process Models: How software is built. The fundamental design concept for data, architectural and procedural designs. Conceptual solutions. Agile concept and User stories. Domain modeling with UML diagrams-Class diagram, Use cases etc, Object oriented design paradigm; Creation of technical design document.

Module IV: Software Implementation (10 Hours)

The relationship between design and implementation, Implementation, Coding the procedural design, Good coding style and review of correctness and readability.

Module V: Software Testing and Maintenance (10 Hours)

Strategies of software testing. Types of testing, functional testing, validation and verifications. Test Case Design. Maintenance as part of software evaluation, techniques and procedures for maintenance. Introduction to configuration Management. The concept of CASE, green engineering.

COURSE / LEARNING OUTCOMES

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

- CO1:** Relate and examine the life cycle models of software. (Remembering)
- CO2:** Interpret and differentiate various software life cycle models (Understanding)
- CO3:** experiment with different software architectures and identify the best feasible one (Applying)
- CO4:** Analyse and design the software requirement specification (Analysing)
- CO5:** Evaluate the software project by using maintenance plan. (Evaluating)
- CO6:** develop and create various design diagrams and find solutions to problems. (Creating)

Suggested Readings

1. Sommerville, "Software Engineering", Addison Wesley.
2. Roger S. Pressman, "Software Engineering—A Practitioner's Approach", McGraw Hill Companies.
3. Rajib Mall, Fundamentals of Software Engineering, PHI.

CAPA0030: PRINCIPLES OF ARTIFICIAL INTELLIGENCE

(4 credits – 60 hours)

Objective: Artificial Intelligence has embraced the larger scientific goal of constructing information-processing theory of intelligence. If such a science of intelligence could be developed, it could guide the design of intelligent machines as well as explicate intelligent behaviour as it occurs in humans and other animals. This paper describes the fundamental AI ideas that underlie many of the AI applications and provides a base for understanding natural intelligence.

Module I: General Issues and Overview of AI (12 Hours)

Introduction to AI: The AI problems, the underlying assumption, AI techniques, the level of the model, criteria for success, AI applications. problem solving, search and control strategies: defining the problem as a state space search, production systems, control strategies, breadth-first search, depth-first search, problem characteristics, production system characteristics, issues in the design of search programs.

Module II: Search Strategies for AI Production Systems (16 Hours)

Heuristic search techniques: generate-and-test, hill climbing, simple hill climbing, steepest-ascent hill climbing simulated annealing, best-first search, OR-graphs, the A* algorithm, problem reduction, AND-OR graphs, the AO* algorithm, constraint satisfaction, means-end analysis. game playing: overview, the minimax search procedure, adding alpha-beta cutoffs, additional refinements, iterative deepening.

Module III: Knowledge Representation (16 Hours)

Knowledge representation issues: representations and mappings, representing simple facts in logic, knowledge representation attributes, computable functions and predicates, resolution, conversion to clause form, the basics of resolution, resolution in propositional logic, procedural vs. declarative knowledge, logic programming, forward vs. backward reasoning, matching, control knowledge. statistical reasoning: probability and Bayes' theorem, certainty factors and rule-based systems, Bayesian networks, Dempster-Shafer theory, basic notions and concepts of fuzzy sets, fuzzy set operations, information - based characterization of fuzzy sets, fuzzy relations and their calculus.

Module IV: Advanced AI (16 Hours)

Natural language processing: overview, morphological analysis, syntactic analysis, semantic analysis, discourse integration, pragmatic analysis, parsing techniques, top-down parsing, bottom-up parsing, augmented transition networks (ATN). Learning: rote learning, learning by taking advice, learning by induction, explanation-based learning. Expert system: representing and using domain knowledge, expert system shells, explanation, knowledge acquisition.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall and identify the need of incorporating human intelligence into machine and define the basic terms related to the concept of knowledge and representation, learning and reasoning, communication and language processing. (Remembering)
- CO2:** define problem state space, design algorithms to solve problems, generalized schema for knowledge interpretation and planning and language processing. (Understanding)
- CO3:** compute and demonstrate the problem in terms of state space and apply different AI algorithms to *solve* problems and *construct* a logic to represent knowledge in computational domain and also to interpret the natural language. (Applying)
- CO4:** Compare and analyse the performance of algorithms based on problem domain. (Analysing)
- CO5:** Design and create new intelligent algorithm for application development by integrating experience based learning. (Creating)
- CO6:** judge and assess the algorithms based on completeness, optimality, and space and time complexity for solving a problem in intelligent manner. (Evaluating)

Suggested Readings

1. Rich, E.; K. Knight, Artificial Intelligence, (Second Edition), New Delhi: Tata McGraw-Hill, 1997
2. Nilson, N. J., Principles of Artificial Intelligence, New Delhi: Narosa Publishing House, 2002
3. Pedrycz, W.; F. Gomide, An Introduction to Fuzzy Sets: Analysis and Design, New Delhi: Prentice-Hall India, 2004.
4. Winston, P. H., Artificial Intelligence, New Delhi: Pearson Education Asia, 2002
5. Charniak, E.; D. McDermott, Introduction to Artificial Intelligence, New Delhi: Pearson Education, 2002
6. Russell, S.; P. Norvig, Artificial Intelligence: A Modern Approach (Second Edition), New Jersey: Prentice-Hall, 2003

CAET0031: EMERGING TRENDS IN CLOUD COMPUTING

(4 credits – 60 hours)

Objective: The purpose of this course is to make the student of Computer Applications aware of the trends of changes in technologies, applications and systems in the world of Information Technology specially in areas of cloud computing and related

Module I: E-Commerce and CRM (10 Hours)

- a) Model of E-Commerce, Application with respect to models, BPR and E-Commerce,
- b) CRM-Sales, Marketing and Service Management, What is BPO/BCP, Why it is required?
Guidelines, Merits/De-Merits, Call Center – brief perspective technology wise, Functioning, Ethics, Disaster Recovery Management, Case Study

Module II: E-Banking Transactions, Content Management and Disseminations (10 Hours)

- a) Inter Banking, Intra Banking, Electronic Payments, (Payment – Gateway Example, Securities in E-banking (SSL, Digital Signatures – Examples), Services Provided: ATM, Smart Card ECS(Electronic Clearing System),e.g. Telephone, Electricity Bills
- b) E-learning – Models WBT, CBT, Virtual Campus, LMS and LCMS, Video Conferencing, Chatting Bulletin, Building Online Community, Asynchronous/ Synchronous Learning, Case Study

Module III: Introduction to cloud computing (16 hours)

- a) Introduction to Cloud Computing, the Evolution of Cloud Computing, Hardware Evolution, Internet Software Evolution, Server Virtualization, Web Services Deliver from the Cloud, Communication-as-a-Service, Infrastructure-as-a-Service, Monitoring-as-a- Service, Platform-as- a-Service, Software-as-a-Service, Building Cloud Network
- b) Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Map-reduce.

Module IV: Security in Cloud (14 hours)

Understanding Security Risks, Reducing Cloud Security Breaches, Implementing Identity Management, Benefits of identity management, Aspects of identity management, Playing Detective: Detection and Forensics, Activity logs, HIPS and NIPS, Data audit, Encrypting Data, Creating a Cloud Security Strategy

Module V: Virtualization (10 hours)

Virtualization and the Cloud: Visualizing Virtualization, Characteristics, Using a hypervisor in virtualization, Abstracting hardware assets, Managing Virtualization, Foundational issues, Abstraction layer, Provisioning software, Virtualizing storage, Hardware provisioning, Security issues, Taking Virtualization into the Cloud

COURSE / LEARNING OUTCOMES

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

- CO1:** Distinguish and define the web services delivered via cloud. (Understanding/ Remembering)
- CO2:** Describe the models of E-Commerce and its application. (Understanding)
- CO3:** Paraphrase electronic payment gateways and securities in E-Banking. (Understanding)
- CO4:** Demonstrate and evaluate the models of E-Learning modules. (Applying/Evaluate)
- CO5:** Deploy and construct a virtual private cloud using amazon web service as IaaS. Run an application using map reduce program. (Applying)
- CO6:** Define and Analyse the concepts of Big data and Hadoop components. (Remembering/ Analysing)
- CO7:** Design a vulnerability assessment tool for cloud computation and create and assess a real time application deployed on cloud platform (Creating/Evaluating)

Suggested Readings

1. Arpita Gopal, Chandrani Singh, Emerging Trends in Information Technology, First edition, Excel books, New Delhi
2. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kaufman, F.Halper, (Wiley India Edition)
3. Enterprise Cloud Computing by Gautam Shroff, Cambridge 4. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
5. Google Apps by Scott Granneman, Pearson
6. Cloud Security and Privacy by Tim Malhar, S.Kumaraswamy, S.Latif (SPD,O'REILLY)
7. Cloud Computing : A Practical Approach, Anthony T Velte, et.al McGraw Hill,
8. Cloud Computing Bible by Barrie Sosinsky, Wiley India

CARM0032: INTRODUCTION TO RESEARCH METHODOLOGY AND STATISTICAL TOOLS

(3 credits – 45 hours)

Objective: Research is a tool which helps the student to identify, understand and solve management problems. Research improves one's decision making ability. The objective of this course is to create a scientific attitude towards understanding and solving a problem and to impart knowledge about tools available for carrying out research.

Module I: Research Methodology (20 Hours)

- a) Meaning, Objectives and Motivation in Research, types of Research, Research Approaches, Research Process, Validity and Reliability in Research, Obstacles in accepting research. Problem Formulation, Hypothesis Formulation, types of Hypothesis, characteristics of Good Hypothesis. Meaning and Significance of Research Designs, Features of a good research design, types of research design, contents of research design
- b) Census Vs. Sample - Steps in Sample Design, Determining the size of Sample. Sampling methods - Simple Random Sampling, Stratified Sampling, Systematic Sampling, Cluster Sampling, Selective Sampling.
- c) Data, Measurement and Scaling Techniques -Types of Data, Sources of Data – Primary and Secondary Data. Methods of collecting the data. Testing the validity of the data. Measurement and scaling techniques, errors in measurement, tests of sound measurement, scaling and scale construction techniques
- d) Questionnaire, Presentation and Report writing: Steps in Questionnaire design, characteristics of a good questionnaire .Presentation, Processing and Analysis and Interpretation of Data. Report Writing – layout of a Research Report, Characteristics of a good research report.

Module II: Statistical Tools (25 Hours)

- a) Measures of Central Tendencies and Dispersions – Simple Numerical calculations for understanding the characteristic values
- b) Linear Correlation and Linear Regression – 2 Variables c) Association of Attributes – 2 Attributes Only 2
- d) Testing of Hypothesis, Large Sample Tests, Small Sample Tests – t, F tests. χ^2 tests.
- e) Simulation Techniques

COURSE / LEARNING OUTCOMES

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

- CO1:** systematically state the several methods of conducting research including research designs, data collection and analysis (Remembering)
- CO2:** develop a scientific attitude towards understanding and solving a research problem. (Understanding)
- CO3:** use tools and techniques available for carrying out research (Applying)
- CO4:** compare and contrast the various data collection, sampling, and scaling techniques available for carrying out research (Analysing)
- CO5:** summarize the existing research work of a particular research topic for judging and assessing the given outcome and results (Evaluating)
- CO6:** integrate existing research work and write a survey research paper (Creating)

Suggested Readings

1. C.R. Kothari, Research Methodology Methods and Techniques, New Age International
2. S.P. Gupta, Statistical Methods, Sultan Chand, New Delhi
3. William G. Zikmund, Business Research Methods, Thomson South-Western
4. Mark Balnaves and Peter Caputi, Introduction to Quantitative Research Methods, Sage Publications

CACL0033: CYBERLAW and IT SECURITY

(4 credits – 60 hours)

Objective: *The objective of this course is to learn about IT security – threats, detection, laws and provisions.*

Module I (12 hours)

Object and Scope of the IT Act - Genesis, Object, Scope of the Act. Encryption -Symmetric Cryptography, Asymmetric Cryptography, RSA Algorithm, Public Key Encryption

Module II (14 hours)

Digital Signature- Technology behind Digital Signature, Creating a Digital Signature, Verifying a Digital Signature, Digital Signature and PKI, Digital Signature and the Law. E-Governance and IT Act 2000- Legal recognition of electronic records, Legal recognition of digital signature, Use of electronic records and digital signatures in Government and its agencies, Certifying Authorities. Need of Certifying Authority and Power. Appointment, function of Controller. Who can be a Certifying Authority? Digital Signature Certifications. Generation, Suspension and Revocation of Digital Signature Certificate.

Module III (12 hours)

Domain Name Disputes and Trademark Law: Concept of Domain Names, New Concepts in Trademark, Jurisprudence, Cyber squatting, Reverse Hijacking, Meta tags, Framing, Spamming, Jurisdiction in Trademark Dispute

Module IV (12 hours)

Cyber Regulations Appellate Tribunal: Establishment and Composition Of Appellate Tribunal, Powers of Adjudicating officer to Award Compensation, Powers of Adjudicating officer to impose Penalty.

Module V (10 hours)

The Cyber Crimes (S-65 to S-74): Tampering with Computer Source Documents(S-65), Hacking with Computer System(S-66), Publishing of Information Which is Obscene in Electronic Form(s-67), Offences: Breach of Confidentiality and Privacy (S-72), Offences : Related to Digital Signature Certificate(S-73 and S-74)

COURSE / LEARNING OUTCOMES

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

- CO1:** Identify the scopes of the IT ACT and their association with various aspects of cryptography. (Remembering)
- CO2:** Explain the need of digital signature and describe how a digital signature can be well recognized. (Understanding)
- CO3:** Describe and have a clear understanding of the domain name disputes and trademark law. (Understanding)
- CO4:** Explain the concept of cyber regulations appellate tribunal. (Understanding)
- CO5:** Demonstrate a value chain of an organization with their suppliers. (Applying/Analysing)
- CO6:** Explain and compare symmetric and asymmetric cryptosystem implementations in IT Security. (Evaluating)
- CO7:** Develop the skill of identifying cyber crimes and judge whether published information is obscene or not and also explain offence related to digital signature certificate. (Creating/Evaluating)

Suggested Readings

1. Farooq Ahmad, Cyber Law in India, Pioneer Books
2. Vakul Sharma, Information Technology Law and Practice, Universal Law Publishing Co. Pvt. Ltd.
3. Suresh T Vishwanathan, The Indian Cyber Law, Bharat Law house New Delhi.
4. P.M. Bakshi and R.K.Suri, Hand book of Cyber and E-commerce Laws, Bharat Law house New Delhi.
5. Rodney D. Ryder, Guide to Cyber Laws, Wadhwa and Company Nagpur.
6. The Information Technology Act, 2000, Bare Act, Professional Book Publishers, New Delhi.

CAEC0034: E-COMMERCE AND DATA SECURITY

(4 credits – 60 hours)

Objective: *The objective of the course is to introduce the main concepts related to electronic commerce (e-commerce), their forms common applications and the threat and vulnerabilities associated with them. The subject also introduces the security techniques that can be used to protect e-commerce transactions.*

Module I: Introduction to E-Commerce (15 hours)

Definition, Scope of E-Commerce, Hardware requirements, E- Commerce and Trade Cycle, Electronic Markets, Electronic Data Interchange and Internet Commerce. Business to Business E-Commerce: Electronic Markets, Electronic Data Interchange (EDI): Technology, Standards (UN/EDIFACT), Communications, Implementations, Agreements, Security, EDI and Business, Inter-Organizational E-commerce.

Module II: Legal issues (20 hours)

Risks - Paper Document vs. Electronic document, Authentication of Electronic document, Laws, Legal issues for Internet Commerce: Trademarks and Domain names, Copyright, Jurisdiction issues, Service provider liability, Enforceable online contract. Security Issues: Security Solutions- Symmetric and Asymmetric Cryptosystems, RSA, DES, AES and Digital Signature, Protocols for secure messaging, Secure Electronic Transaction (SET) Protocol, Electronic cash over internet, Internet Security.

Module III: Business to Consumer E-Commerce (10 hours)

Consumer trade transaction, Internet, Page on the Web, Elements of E-Commerce with VB, ASP, SQL.

Module IV: E-business (15 hours)

Internet bookshops, Software supplies and support, Electronic Newspapers, Internet Banking, Virtual Auctions, Online Share Dealing, Gambling on the net, E-Diversity, Case studies through internet.

COURSE / LEARNING OUTCOMES

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

- CO1:** Find the scopes of e-commerce and their association with different trade cycles. (Remembering)
- CO2:** Summarize the concept of business to consumer mode of transaction in e-commerce. (Understanding)
- CO3:** Define and interpret the legal issues associated with electronic documents, jurisdiction issues, copyrights etc. (Remembering/Understanding)
- CO4:** Develop and classify a value chain of an organization with their suppliers. (Applying/Analysing)
- CO5:** Explain and categorize the in-depth knowledge of EDI and its constituent elements. (Understanding/Analysing)
- CO6:** Explain and compare symmetric and asymmetric cryptosystem implementations on e-commerce. (Understanding / Evaluating)
- CO7:** Elaborate the above knowledge on certain case studies like internet bookshops, electronic newspapers, virtual auctions etc. (Creating)

Suggested Readings

1. D. Whitley, E-Commerce-Strategy, Technologies and Applications, TMH.
2. K.K.Bajaj, E-Commerce - The Cutting Edge of Business, TMH.
3. W. Clarke, E-Commerce through ASP, BPB.
4. M.Reynolds, Beginning E-Commerce with VB, ASP, SQL Server 7.0 and MTS, Wrox.

CADW0035: DATA WAREHOUSING AND DATA MINING

(4 Credits – 60 hours)

Objective: *The main purpose of the course is to develop and gain an understanding of the principles, concepts, functions and uses of data warehouses, data modeling and data mining in business.*

Module I: Data warehousing (15 hours)

Definitions and characteristics, Multi-dimensional data model, Warehouse schema. Data Marts: Data marts, types of data marts, loading a data mart, metadata, data model, maintenance, nature of data, software components; external data, reference data, performance issues, monitoring requirements and security in a data mart. Online Analytical Processing: OLTP and OLAP systems, Data Modeling, LAP tools, State of the market, Arbor Essbase web, Microstrategy DSS web, Brio Technology, star schema for multi dimensional view, snowflake schema; OLAP tools.

Module II: Developing a Data Warehouse (15 hours)

Building of a Data Warehouse, Architectural strategies and organizational issues, design considerations, data content, distribution of data, Tools for Data Warehousing Data Mining: Definitions; KDD (Knowledge Discovery database) versus Data Mining; DBMS versus Data Mining, Data Mining Techniques; Issues and challenges; Applications of Data Warehousing and Data mining in Government.

Module III: Association Rules (20 hours)

A priori algorithm, Partition algorithm, Dynamic inset counting algorithm, FP – tree growth algorithm; Generalized association rule. Clustering Techniques: Clustering paradigm, Partition algorithms, CLARA, CLARANS; Hierarchical clustering, DBSCAN, BIRCH, CURE; Categorical clustering, STIRR, ROCK, CACTUS. Decision Trees: Tree construction principle, Best split, Splitting indices, Splitting criteria, Decision tree construction with presorting.

Module IV: Web Mining (10 hours)

Web content Mining, Web structure Mining, Web usage Mining, Text Mining. Temporal and Spatial Data Mining: Basic concepts of temporal data Mining, The GSP algorithm, SPADE, SPIRIT, WUM.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the principles, concepts, functions and various applications of data warehouse. (Remembering)
- CO2:** Explain the concepts related to Online Analytical Processing. (Understanding)
- CO3:** Identify the association rules and can implement various Data Mining algorithms. (Applying)
- CO4:** Analyse the pros and cons of various data mining techniques. (Analysing)
- CO5:** Compare and assess different approaches of data ware housing and data mining with various technologies. (Evaluating)
- CO6:** Elaborate the various concepts of Web Mining for practical applications. (Creating)

Suggested Readings

1. C.S.R.Prabhu, Data Warehousing- Concepts, Techniques, Products, Application, PHI.
2. AK Pujari, Data Mining Techniques, Universities Press.
3. Berson and S.J.Smith, Data Warehousing, Data Mining and OLAP, TMH.
4. M.H.Dunham, Data Mining Introductory and Advanced Topics, Pearson.

CAAD0036: ANDROID APPLICATION DEVELOPMENT FUNDAMENTALS**(4 credits - 60 hours)**

Objective: This course is designed to enable students to get complete understanding of the android applications development. On completion of this course, students will be able to design, develop, debug and deploy various real-time applications.

Module I: Get started (2 hours Theory and 8 hours Lab)

- a) Get started: Build your first app, Introduction to Android, Create Your First Android App, Layouts, Views and Resources, Text and Scrolling Views.
- b) Activities: Understanding Activities and Intents, the Activity Lifecycle and Managing State, Activities and Implicit Intents.
- c) Testing, debugging, and using support libraries: The Android Studio Debugger, Testing your App, The Android Support Library

Module II: User experience (3 hours Theory and 10 hours Lab)

- a) User interaction: User Input Controls, Menus, Screen Navigation, RecyclerView,
- b) Delightful user experience: Drawables, Styles, and Themes, Material Design, Providing Resources for Adaptive Layouts
- c) Testing your UI: Testing the User Interface

Module III: Working in the background (2 hours Theory and 8 hours Lab)

- a) Background Tasks: AsyncTask and AsyncTaskLoader, Connect to the Internet, Broadcast Receivers, Services
- b) Triggering, scheduling and optimizing background tasks: Notifications, Scheduling Alarms, Transferring Data Efficiently

Module IV: All about data (4 hours Theory and 16 hours Lab)

- a) Preferences and Settings: Storing Data, Shared Preferences, App Settings b) Storing data using SQLite: SQLite Primer, SQLite Database,
- c) Sharing data with content providers: Share Data Through Content Providers d) Loading data using loaders: Loaders

Module V: What's Next? (1 hour Theory and 6 hours Lab)

- a) Permissions, Performance and Security
- b) Firebase and AdMob
- c) Publish

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the evolution of the Android operating system. (Remembering)
- CO2:** Explain the functionalities of the Android development framework. (Understanding)
- CO3:** Create applications for different requirements. (Applying)
- CO4:** Analyse the basics of commercializing an application.(Analysing)
- CO5:** Evaluate the working of Android Applications. (Evaluating)
- CO6:** Develop real time product for real time problems (Creating)

Suggested Readings

1. Android Developer Fundamentals Course – E-book by the Google Developer Training team.
2. The practical workbook: Android Developer Fundamentals Course—Practical's E-book.
3. Slide decks & Videos of lectures for reference provided by Google.

CADC0037: DATA COMMUNICATION

(4 credits – 60 hours)

***Objective:** The main objective of this course is to make the students understand the characteristics of signals propagated through different transmission media, including concepts of attenuation and noise, error-detection, and error-correction techniques and interfacing and synchronization issues.*

Module I (16 hours)

- a) Introduction to data communications: A communications model, Data communications, Networking, Protocols and Protocol architecture, Characteristics of data transmission: Concepts and Terminology, Analog and digital data transmission, Transmission impairments.
- b) Transmission media: Guided transmission media, Wireless transmission data encoding, Digital data-Digital signals, Digital data- Analog signals, Analog data-Digital signals, and Analog data-Analog signals.

Module II (13 hours)

Data communication interface: Asynchronous and Synchronous transmission, Line configurations, Interfacing. Data link control, Flow control, Error detection, Error control, High-level data link control (HDLC), Other data link control protocols.

Module III (16 hours)

Data communications hardware: Terminals- Introduction, Basic terminal components, Enhanced terminal components, General-purpose terminals, Remote job entry terminals, Transaction terminals, Clustering of terminal devices. Communications processing hardware introduction, Switching processors, Multidrop lines, Multiplexers, Concentrators, Front-end processors.

Module IV (15 hours)

Modems: Network attachment and regulations, Line conditioning and leased lines, Modems and modem circuits. Multiplexing: Frequency-division multiplexing, Synchronous time- division multiplexing: Characteristics, TDM Link control, Digital carrier systems statistical time-division multiplexing: Characteristics.

COURSE / LEARNING OUTCOMES

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

- CO1:** Define the fundamentals of data communication and various techniques of communications. They will also be able to recall the layered structure of computer network. (Remembering)
- CO2:** Explain about different network topology and the type of protocol required for different communication technique. (Understanding)
- CO3:** Understand the requirements of various networking devices and make use of the network accordingly. (Applying)
- CO4:** Compare different networking devices. They will also be able to analyse different network behaviour depending on performance parameters. (Analysing)

- CO5:** Compose a type of network required for an organization, Depending on availability of hardwares and softwares (Creating)
- CO6:** Establish and determine a computer network either Wired or Wireless, (Applying, Evaluating)

CAIJ0038: INTRODUCTION TO JAVA PROGRAMMING

(4 Credits–60 hours)

Objective: The course is designed to impart the knowledge and skill required to solve real world problem using object-oriented approach utilizing Java language constructs. This course covers the two main parts of Java i.e. Java Language and Java Library (JDK 5). After completion of the course, a student is expected to be able to

- Do Object Oriented Programming using Java
- Implement Exception handling and Multithreading in Java.
- Create Java Applets.
- Set up a GUI using Swing components
- Do Network Programming in Java.

Module I: Java Fundamentals (16 hours)

Genesis, Java Philosophy, Java & Internet, Object-Oriented Programming features, Java Applet and Application, Java Environment and Java Development Kit (JDK) and Java Standard Library (JSL), Tokens, Expressions, Using Data Types, Declarations, Control Flow

Module II: Java Classes, Packages and Interfaces, Java Streams (14 hours)

- a) Introduction, Classes, Working with Objects, Packages, Inheritance, Interfaces
- b) Data Flow with Java Streams, Input Streams, Output Streams

Module III: Exception Handling in Java and Java threads (10 hours)

- a) Introduction, Exception Methods, java.lang Exceptions
- b) Introduction, Creating Threads, The Life Cycle of a Thread, Thread Methods, Using Threads, Synchronization of Threads

Module IV: Java Applets (10 hours)

Introduction, Applet Examples, The java.applet.Applet Class, The Five Stages of an Applet's Life Cycle, Methods for Adding UI Components, Methods for Drawing and Event Handling

Module V: Java AWT (10 hours)

Introduction, Swing Component and Container classes, Layout managers (FlowLayout, GridLayout, BorderLayout), Handling events, Adapter classes, Anonymous inner classes, Swing GUI components :JLabel, JTextField, JTextArea, JButton, JCheckBox, JRadioButton, JList, JComboBox, JScrollBar, JScrollPane, JToolTip, JPanel, JFrame, introduction to database connectivity with JDBC.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the knowledge of the structure and model of the Java programming language, (Remembering)
- CO2:** Explain the use of Java programming language for various programming technologies (Understanding)

- CO3:** develop software in the Java programming language. (Applying)
- CO4:** Analyse user requirements for software functionality required to decide whether the Java programming language can meet user requirements (Analysing)
- CO5:** choose an engineering approach to solving problems, starting from the acquired knowledge of programming and knowledge of operating systems. (Evaluating)
- CO6:** propose the use of certain technologies by implementing them in the Java programming language to solve the given problem (Creating)

Suggested Readings

1. Deitel, H. M.; P. J. Deitel, Java : How To Program, New Delhi: Prentice Hall India
2. Schildt, H., The Complete Reference Java 2 , New Delhi: Tata McGrawHill
3. Moss, K., Java Servlets , New Delhi Tata McGraw-Hill
4. Russell, Java Programming for the absolute Beginner , New Delhi: Prentice-Hall India
5. Hanagan D., Java Examples in a Nutshell ,New Delhi: O' Reilly

CACL0039: CLOUD COMPUTING

(4 Credits–60 hours)

Objective: This course is designed to enable students

- *To get acquainted with the latest computational model, i.e. cloud computing*
- *To understand the basic foundational elements of cloud computing*
- *To study details of Data storage in cloud, big data file handling and parallel computing basics*
- *To get familiarized with popular cloud platforms and applications*

Module I (15 hours)

Introduction to cloud computing, the evolution of cloud computing, hardware evolution, internet software evolution, server virtualization, web services deliver from the cloud, communication-as-a-service, infrastructure-as-a-service, monitoring-as-a-service, platform- as-a- service, software-as-a-service, building cloud network

Module II (18 hours)

Data in the cloud: Relational databases, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Map-reduce.

Module III (15 hours)

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud, Cloud computing security architecture: Architectural Considerations- General Issues, Trusted Cloud computing, Cloud computing security challenges: Virtualization security management virtual threats, VM Security Recommendations, Secure Execution Environments and Communications in cloud.

Module IV (12 hours)

Issues in cloud computing, implementing real time application over cloud platform, Issues in Inter cloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall and Recognize the differences in cloud services and deployment models. (Remembering)
- CO2:** Describe the behaviors of Big Data and the components of Hadoop. (Understanding)
- CO3:** Describe and compute MapReduce programs. (Understanding/Applying)
- CO4:** Illustrate the security principles in cloud computing and predict the vulnerabilities. (Applying/ Analysing)
- CO5:** Demonstrate the application of HDFS by transferring a file from local file system to HDFS or vice versa and justify the transactions using HDFS commands. (Applying/ Evaluating)
- CO6:** Analyse the hosting of real time application on cloud platform. (Analysing)
- CO7:** Design and build a cloud network using OpenStack. (Creating)

Suggested Readings

1. Enterprise Cloud Computing by Gautam Shroff, Cambridge
2. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
3. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, (Wiley India Edition)
4. Google Apps by Scott Granneman, Pearson
5. Cloud Security and Privacy by Tim Malhar, S. Kumaraswamy, S.Latif (SPD,O'REILLY)
6. Cloud Computing : A Practical Approach, Anthony T Velte, et.al McGraw Hill
7. Cloud Computing Bible by Barrie Sosinsky, Wiley India

CANS0040: NETWORK SECURITY

(4 Credits–60 hours)

Objective: *This course provides a beginners approach to understanding the basic security concepts in a Network along with different mitigation techniques of several attacks. After the completion of the course students will be able to understand security measures to be adopted in different devices and network applications used to interface with inter network.*

Module I (18 hours)

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

Module II (18 hours)

Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC, Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service.

Module III (12 hours)

Email privacy: Pretty Good Privacy (PGP) and S/MIME. IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

Module IV (12 hours)

Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET). Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats. Firewall Design principles, Trusted Systems, Intrusion Detection Systems, Ransomware and different types of Ransomware, Methodology of execution of Ransomware.

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall and identify the different security attacks, requirements, mechanisms and services in the practical field. (Remembering)
- CO2:** recognize and summarize the core principles of cryptography and cryptanalysis available today, including symmetric and asymmetric encryption, hashing, and digital signatures. (Understanding)
- CO3:** discover and relate themselves with the different vulnerabilities, a system in a network can have. (Applying)
- CO4:** interpret and predict the issues of securing computer and information systems. (Analysing)
- CO6:** assess and critique references to computer security appearing in other academic and non-academic curriculum. (Evaluating)
- CO5:** reconstruct how malicious code functions, relate the vulnerabilities that make proliferation possible and rewrite methods and practices are available for alleviation. (Creating)

Suggested Readings

1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.
2. Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W. Manzuik and Ryan Permech, Wiley Dreamtech.
3. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.
4. Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.
5. Cryptography and network Security, Third edition, Stallings, PHI/Pearson
6. Principles of Information Security, Whitman, Cengage Learning.
7. Cryptography and Network Security, S. Bose, Pearson

CAMC0041: MOBILE COMMUNICATION

(4 Credits–60 hours)

Objective: The course on mobile communications introduces the principles of mobile systems and its technical aspects and services. The evolution of services related to technical aspects is emphasized for both public and professional mobile telephony standards. Indoor access standards as Wireless LAN and adhoc networks based on Bluetooth are also considered in the frame of the migration to wireless of wired applications. The course also emphasizes on cellular networks.

Module I: Introduction to Personal Communications Services (PCS) (12 hours)

Personal Communications Services (PCS): Architecture, Cellular Telephony, Coreless Telephony; Overview of AMPS, GSM, DAMPS, CDMA; 3G Wireless Systems

Module II: Wireless LANs (15 hours)

Infra-red vs. Radio Transmission, Infrastructure and Ad-hoc Network; IEEE 802.11: Architecture, Medium Access Control Layer, MAC Management, 802.11a, 802.11b; HIPERLAN: HIPERLAN 1, WATM, BRAN, HIPERLAN 2; Bluetooth

Module III: Mobile Transport and Network Layer (18 hours)

- a) Mobile Transport Layer: Traditional TCP: Congestion Control, Slow Start, Fast Retransmission, Fast Recovery; Classical TCP Improvements: Indirect TCP, Snooping TCP, Mobile TCP, Fast Retransmission, Fast Recovery
- b) Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol, Mobile ad-hoc networks

Module IV: Cellular Networks (15 hours)

Cellular Concept: Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Improving Capacity in Cellular Systems, Cell Splitting, Sectoring, Microcell Zone Concept

COURSE / LEARNING OUTCOMES

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

- CO1:** Recall the concepts of different mobile communication technology including AMPS, GSM, GPRS etc (Remembering)
- CO2:** Illustrate about wireless communication, relevant protocols, layer structure, function of different layers etc. (Understanding)
- CO3:** work in mobile environment, creation of mobile network and understanding their functions(Applying)
- CO4:** Analyse packet structure and functions of packet header with respect to different fields(Analysing)
- CO5:** evaluate network performance and also be able to know how to get mobile communication in best possible way. (Evaluate)
- CO6:** synthesize mobile protocols, data communications and variation with respect to different network parameters. (Creating)

Suggested Readings

1. J. Schiller, Mobile Communications, Addison-Wesley.
2. T. S. Rappaport, Wireless Communications: Principle and Practices, Pearson.
3. R. Pandya, Mobile and Personal Communication Systems and Services, PHI.
4. J. Burkhardt, Pervasive Computing: Technology and Architecture, Pearson.

CAPM0042: PYTHON AND MACHINE LEARNING**(4 credits- 60 hours)**

Objective: The course is intended to give the students an insight into python programming language and its application extended to machine learning techniques in different problems of applications.

Module I(14 hours)

Introduction to python, Python basics: Data types and variables, data type conversions, command line argument, data input, Flow control: if, if _elif_ else statement, while loop, for loop, break & continue, Python sequences: Range, String, List, Tuple, Dictionary, Set, Shallow and deep copy, Introduction to PyCharm & Jupyter, Functions and modules: Function, Pass arguments, Arguments with default values and arbitrary arguments, local and global variables, returning single and multiple values from functions, Mathematical functions, Random number functions, python modules, import statement for importing modules.

Module II (16 hours)

File operations handling: Reading, writing, manipulations, Exception handling: try, except, finally, raise exception, user defined exception, Python class & objects: Constructors, creating objects, Destructors, Inheritance, Overriding, Overloading, Data hiding, Functional programming: Iterators, Generators, lambda construct, Comprehensions, Map reduce and filter. NumPy: selecting data using slicing, numerical processing with multidimensional array, 2D plotting with matplotlib Pandas: Loading from CSV and other structured formats, 1D and 2D data structures-Series and DataFrame, Normalizing data, dealing with missing data.

Module III(18 hours)

Introduction to Machine learning: Basic definition, types of learning, hypothesis space and inductive bias, Cost functions, transforms: logarithmic and curvilinear, Linear regression, l1 and l2 normalization, Decision trees, Probability and Bayes learning, Logistic regression, SVM (Support Vector Machine), Instance Based Learning: K-Nearest Neighbours Algorithm, K-Means Algorithm

Module IV (12 hours)

Soft computing techniques: Fuzzy Computing: Fuzzy set, Fuzzy logic, Fuzzy theory, Neural Network: Artificial Neural Network (ANN).

COURSE/LEARNING OUTCOMES

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

- CO1:** Understand python and its usage with respect to different machine learning algorithms. (Remembering)
- CO2:** Differentiate learning algorithms for different classification problems together in combination with soft computing techniques (Understanding)
- CO3:** Build machine learning programs for designing self-learning solutions to different problems in the real world.(Applying)
- CO4:** Experiment with different learning techniques & parameters and conclude the pros and cons of each with respect to different problem domain.(Analysing)
- CO5:** Evaluate results of the learning algorithms using different representations.(Evaluating)
- CO6:** Create new solutions that may be ensemble of learning techniques or create new learning algorithm for different problem domain.(Creating)

Suggested Readings:

1. Python Cookbook-by Alex Martelli, Anna Martelli Ravenscroft, and David Ascher
2. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
3. Introduction to Machine Learning Edition 2, by Ethem Alpaydin.

LABORATORY COURSES

CAPC6001: PROGRAMMING AND PROBLEM SOLVING THROUGH C LAB

(2 credits)

1. C Fundamentals
2. Functions, arrays and pointers
3. Structure and Union, Data files
4. VDU and Keyboard Basics
5. Graphics and Mouse programming

COURSE / LEARNING OUTCOMES

At the end of the experiments students will be able to:

- CO1:** Define basics programming logic. (Remembering)
- CO2:** demonstrate the theoretical concepts learned in C programming language. (Understanding)
- CO3:** apply existing algorithms in writing programs using C language and also do graphics programming. (Applying)
- CO4:** apply their analytical skills for choosing the right data structure, function, data types and develop logic to write programs in C. (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. through implementation in terms of correctness and computation cost. (Evaluating)

CADL6002: DIGITAL LOGIC DESIGN LAB

(2 credits)

1. Study of the Truth tables of logic gates
2. Realization of half/full adder and half/full adder subtractor
3. Binary number to Gray code conversion and vice versa
4. Verify truth table of multiplexer and demultiplexer
5. Verify truth table of one bit and four bit comparators
6. Verify truth table of flip-flops
7. Realization of 3-bit asynchronous counter and Mod-N counters
8. Realization of 3-bit synchronous counter
9. Realization of 2:4 decoder and 4:2 encoder
10. Simulation with VDHL
 - a. Adders
 - b. Subtractors

- c. Logic gates
- d. MUX and DEMUX

COURSE / LEARNING OUTCOMES

At the end of the experiments students will be able to:

- CO1:** List and label the various logic gates. (Remembering)
- CO2:** Explain the working of the various logic gates. (Understanding)
- CO3:** Experiment with different logic gates to solve any given problem. (Applying)
- CO4:** Analyse a given logic circuit and point out errors in it. (Analysing)
- CO5:** Evaluate the output of a logic circuit for given inputs. (Evaluating)
- CO6:** Design combination and sequential digital circuits for any given real life problem. (Creating)

CADS6003: DATA STRUCTURES USING C++ LAB

(2 credits)

Programs on

1. Arrays and Lists
2. Stacks and Queues
3. Linked Lists, Circular and Doubly Linked Lists.
4. Trees and Graphs
5. Searching and Sorting techniques

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** List various data structures and select the suitable data structure to resolve a given problem.(Remembering)
- CO2:** Convert a given mathematical expression into its various forms like – infix to postfix or prefix. (Understanding)
- CO3:** Apply their knowledge to solve practical problems like- expression conversion using stack, tower of hanoi using stack and recursion, process management using queue and memory management using linked list and B tree.(Applying)
- CO4:** Analyse the efficiency of various programs with respect to time and space complexity. They would also be able to modify a less efficient program into a more efficient one and implement using Object Oriented Programming Language.(Analysing)
- CO6:** Depending on the problem domain, input pattern and size of the input, *evaluate* the performance of various sorting and searching techniques and would also be able to justify their decision by doing complexity analysis.(Evaluating)
- CO5:** Design code using C++ language for simulating the working of various data structures like- stack, queue, linked list, tree, graph etc. and based on their practical knowledge would be able to develop cost effective and user friendly applications.(Creating)

CAOP6004: OBJECT ORIENTED PROGRAMMING AND DESIGN LAB**(2 credits)**

Programs on

1. Concept of classes and objects, constructors and destructors
2. Use of memory management.
3. Inheritance
4. Virtual functions
5. Using polymorphism – i) operator overloading ii) dynamic binding
6. Use of operator overloading.
7. Exception handling and use of templates.
8. File handling in C++.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Identify classes, objects, members of a class and relationships among them needed for a specific problem. (Remembering/Evaluating)
- CO2:** Write C++ programs using OOP principles and proper Program structuring. (Applying/Understanding)
- CO3:** Demonstrate the concepts of polymorphism and inheritance .(Applying)
- CO4:** Write C++ programs to implement error handling techniques using exception handling.(Applying)
- CO 5:** Analyse the real world problems and solve using C++ programming.(Analysing/ Applying)

CADM6005: DATABASE MANAGEMENT SYSTEMS I LAB**(2 credits)****Module I: Query handling with SQL in Oracle**

1. Creation, altering and dropping of tables and inserting rows into a table (use of constraints while creating tables) examples using SELECT command.Queries using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSECT, Constraints.
2. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.Queries implementing various joins (left,right,full). Implementation of complex queries: nested queries,sub queries.
3. Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions

Module II: PL/SQL Programming

1. Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date
2. i) Creation of simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)

- ii) Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
3. Develop a program that includes the features NESTED IF, CASE and CASE expression.
4. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT-IN Exceptions, USE defined Exceptions, RAISE-APPLICATION ERROR.
5. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
6. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
7. Program development using creation of package specification, package bodies, private objects, package variables and cursors and calling stored packages.
8. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
9. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Identify basic SQL operations and fetch results with respect to specific requirement. (Remembering/Evaluating)
- CO2:** Write SQL queries to handle multi-table queries and other complex queries.(Applying/Understanding)
- CO3:** Demonstrate the concepts of PL/SQL blocks. (Applying)
- CO4:** Analyse the real world problems and to handle basic log-based DBMS operations. (Analysing/Applying)

E-resource for learning

PHPMySQL, www.spoken-tutorial.org

CAOA6006: COMPUTER ORGANISATION AND ARCHITECTURE LAB

(2 credits)

1. Some experiments using hardware trainer kits for floppy drive, dot matrix printer etc.
2. Dismantling and assembling a PC along with study of connections, ports, chipsets, SMPS etc.
3. Assembly language programming using IA32(gcc) I. Introduction gcc assembly programming II. Verification of Instruction Set. III. Arithmetic operations
4. Addition, Subtraction, Multiplication and Division of two 8-bit numbers.
5. Multi byte Addition and Subtraction, Multiplication and Division – Signed and unsigned Arithmetic operation, ASCII – arithmetic operation.
6. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
7. By using string operation and Instruction prefix: Move Block, Reverse string, Sorting, Inserting, Deleting, Length of the string, String comparison.
8. DOS/BIOS programming: Reading keyboard (Buffered with and without echo) – Display characters, Strings.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall different OP codes used in 8086 (Remembering).
- CO2:** Recall the syntax of 8086 assembly language (Remembering).
- CO3:** Illustrate the syntax of 8086 assembly language (Understanding).
- CO4:** Solve problems related to arithmetic (Applying).
- CO5:** Categorize different types of OP codes (Analysing).
- CO6:** Choose the appropriate method to write an 8086 assembly program (Evaluating).
- CO7:** Develop an assembly language program to program a microprocessor system (Creating)
- CO8:** Design a hardware component for an embedded system (Creating)

CACF6007: COMPUTER FUNDAMENTALS LAB

(2 credits)

Module I: Word Processing

- a) Word Processing Basics: introduction to office software; introduction to word processing software; features and area of use; menus and commands; toolbars and buttons; shortcut menus, wizards and templates; creating a new document; different page views and layouts; applying various text enhancements; working with styles, text attributes; paragraph and page formatting; text editing using various features ; bullets, numbering, auto formatting, printing and various print options
- b) Advanced word processing features: spell check, thesaurus, find and replace; headers and footers; inserting – page numbers, pictures, files, auto texts, symbols etc.; working with columns, tabs and indents; creation and working with tables including conversion to and from text; margins and space management in document; adding references and graphics; mail merge, envelopes and mailing labels. importing and exporting to and from various formats.

Module II: Spreadsheet

Introduction and area of use; concepts of workbook and worksheets; using wizards; various data types; using different features with data, cell and texts; inserting, removing and resizing of columns and rows; working with data and ranges; different views of worksheets; column freezing, labels, hiding, splitting etc.; using different features with data and text; use of formulas, calculations and functions; cell formatting including borders and shading; working with different chart types; printing of workbook and worksheets with various options.

Module III: Presentation

Introduction and area of use; creating a new presentation; working with presentation; using wizards; slides and it's different views; inserting, deleting and copying of slides; working with notes, handouts, columns and lists; adding graphics, sounds and movies to a slide; working with objects; designing and presentation of a slide show; printing presentations, notes, handouts with print options.

Module IV: UNIX Commands

Basic unix commands (log in, create/delete files/directories, listing files/directories, changing permission of files/directories etc), file related commands, process related commands, i/o redirection and piping, vi editor, gedit

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Label and Identify hardware commonly found in or attached to computing devices and identify software commonly installed on computing devices. (Remembering)
- CO2:** Demonstrate working with files, folders, and applications. (Understanding)
- CO3:** Make use of basics of word processing techniques to create a document, format it, and make changes to it. They explore the use of graphics and different fonts that add more to documents. (Applying)
- CO4:** Examine a situation and learn how to do basic troubleshooting, what tool or application works best for the situation, and how to ask for help when they need it. (Analysing)
- CO5:** Evaluate that a document or presentation is ready for publication. (Evaluating)
- CO6:** Improve their learning through tips and tricks to make presentations and documents more professional. (Creating)

Suggested Readings

1. Manuals of the Office Software
2. A. Mansoor, I.T. Tools and Applications, Pragya Publications, Matura
3. Yashwant Kanetkar, UNIX Shell Programming

CACP6008: COMPUTER PROGRAMMING IN C LANGUAGE LAB

(2 credits)

1. Introduction to OS: Linux/Unix, Vi editor, file handling, directory structures, creating and editing simple C programs.
2. C programming using variables, assignment and simple arithmetic expressions
3. If else
4. Switch-case statements
5. Break, continue
6. Loops
7. Single and multidimensional arrays
8. Functions and recursion
9. Pointers, address operator, declaring pointers and operations on pointers
10. File handling in C.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Define the basics of programming logic. (Remembering)
- CO2:** Illustrate the theoretical concepts learned in C programming language. (Understanding)
- CO3:** Apply existing algorithms in writing programs using C language. (Applying)
- CO4:** Apply their analytical skills for *choosing* the right data structure, function, data types and develop logic to write programs in C. (Analysing)
- CO6:** Evaluate various algorithms used for searching, sorting etc. through implementation in terms of correctness and computation cost. (Evaluating)

CO5: combine the various concepts and ideas learnt in C to plan, propose and develop a product. (Creating)

E-resource for learning

C, www.spoken-tutorial.org

CADS6009: DATA STRUCTURES USING C LAB

(2 Credits)

Solution of problems on

1. Arrays
2. Stacks and Stack Application, Queues
3. Linked Lists, Circular and Doubly Linked Lists
4. Binary Trees
5. Searching and data modification: Linear search, Binary search, Hashing
6. Sorting Techniques: Selection, Insertion, Bubble, Merge, Quick and Merge sort.

COURSE/LEARNING OUTCOMES

At the end of the experiments, students will be able to

- CO1:** Recall the basic C constructs and familiarize with basic C syntax, also define and outline the relationship between data and operations on these data using different data structures like arrays, linked list, stacks and queues, graph and trees (Remembering)
- CO2:** Explain C constructs for generalizing these data structures and choosing appropriate algorithm for efficient program design using C syntax. (Understanding)
- CO3:** Compute and demonstrate these data structures and algorithms in different real world problem domain (Applying)
- CO4:** Compare and Analyse the performance of algorithms based on problem domain. (Analysing)
- CO5:** Review the choice of data structure and algorithms based on problem domain, and *judge* and *assess* the algorithm efficiency based on space and time complexity which forms the fundamental step in the design of an efficient program. (Evaluating).
- CO6:** Design and create efficient algorithm for application development related to academia and industry. (Creating)

CANW6010: COMPUTER NETWORKS FUNDAMENTALS LAB

(2 Credits)

1. Basic Networking Commands and troubleshooting.
2. Introduction and implementation of LAN Trainer for various topologies and protocols simulation.
3. Programs using TCP Sockets (like date and time server and client, echo server and client, file transfer, etc.)
4. Programs using UDP Sockets (like simple DNS, file transfer, etc.)
5. Program to implement Remote Command Execution.
6. Create HTTP socket for web page upload and download.

7. Perform a case study on the following routing algorithms to select the optimum network path for data transfer.
 - i. Shortest path routing
 - ii. Flooding
 - iii. Distance vector

COURSE/LEARNING OUTCOMES

At the end of the experiments, students will be able to

- CO1:** Implement various commands used in networking. (Remembering)
- CO2:** Infer the concepts related to socket programming and their significance. (Understanding)
- CO3:** Apply the concepts of client –server communication using TCP and UDP sockets. (Applying)
- CO4:** Analyse and interpret the results obtained from Routing algorithms-(Shortest Path routing algorithms), and understand the underlying principles. (Analysing)
- CO5:** Make distinctive *comparison* of various routing algorithm *to select* the optimum network path for data transfer. (Evaluate)
- CO6:** Develop source codes to connect between client and server. Also perform the remote command communication (Creating)

Suggested Readings

1. Behrouz A. Forouzan, “TCP/IP Protocol Suite”, Tata McGraw Hill.
2. Laboratory Manual

CAWT6011: WEB TECHNOLOGIES LAB

(2 credits)

1. Creating static websites involving various XHTML elements.
2. Designing web pages that use CSS for standard formatting.
3. Designing websites that use JavaScript for creating interactive web pages.
4. Designing web pages that use PHP for handling loops, strings and arrays.

COURSE/LEARNING OUTCOMES

At the end of the experiments, students will be able to

- CO1:** Define various mark-up languages, style sheets and scripting languages (Remembering)
- CO2:** Explain what HTML elements and formatting styles to be used for a given web page design.(Understanding)
- CO3:** Experiment with various mark-up languages, style sheets and scripting languages. (Applying)
- CO4:** Analyse and design a website of their own and can also identify the faults in the design. (Analysing)
- CO5:** Summarize and validate a practical solution towards a web application development and also deploy a website of their own. (Evaluating)
- CO6:** Develop and create a website of their own. (Creating)

CAOS6012: OPERATING SYSTEMS LAB**(2 credits)**

1. Introduction to Linux
2. File System (Types of file, Filename, parent-child relationship, absolute and relative pathname, file and directory permissions) Introduction to vi editor (start vi, the three modes, create, save and open a text file, positioning by character, positioning by line, positioning by word, positioning in the word, positioning on a numbered line, inserting text, deleting text), Simple Linux commands, Shell Programming
3. Semaphores, Shared Memory and Message Queues: Semaphore (Binary semaphore, Linux Semaphore Facilities, Using Semaphores), Shared Memory, Message Queues
4. Processes and Signals : Process Structure, Starting a new Process, Replacing a Process Image, Duplicating a Process Image, Waiting for a process, Zombie Processes, Terminating a Process, Signals (Signal handling, Sending signals, Signal interface, Signals sets).
5. POSIX Threads: Creating threads, Simultaneous execution of threads, Synchronization and Critical sections, Synchronization with Semaphores, Synchronization with Mutexes, Thread Attributes, Cancelling a thread.
6. Inter-Process Communication: Pipes, Process Pipes, and The Pipe Call, Parent and Child processes, FIFOs (Accessing a FIFO, Opening a FIFO, Reading and Writing FIFO).

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall and label the basic commands in Linux. (Remembering)
- CO2:** Classify system calls, library functions calls to write on standard output device. (Understanding)
- CO3:** Experiment with shell programs.(Applying)
- CO4:** Analyse and compare between different file systems like ext4/FAT/NTFS.(Analysing)
- CO5:** Construct programs on process scheduling, page replacement algorithms.(Creating)
- CO6:** Evaluate free space management using programs.(Evaluating)

E-resource for learning

Linux-Ubuntu, www.spoken-tutorial.org

CAOS6012: OPERATING SYSTEMS LAB**(2 credits)**

1. Introduction to Linux
2. File System (Types of file, Filename, parent-child relationship, absolute and relative pathname, file and directory permissions) Introduction to vi editor (start vi, the three modes, create, save and open a text file, positioning by character, positioning by line, positioning by word, positioning in the word, positioning on a numbered line, inserting text, deleting text), Simple Linux commands, Shell Programming
3. Semaphores, Shared Memory and Message Queues: Semaphore (Binary semaphore, Linux Semaphore Facilities, Using Semaphores), Shared Memory, Message Queues
4. Processes and Signals : Process Structure, Starting a new Process, Replacing a Process Image, Duplicating a Process Image, Waiting for a process, Zombie Processes, Terminating a Process, Signals (Signal handling, Sending signals, Signal interface, Signals sets).

5. POSIX Threads: Creating threads, Simultaneous execution of threads, Synchronization and Critical sections, Synchronization with Semaphores, Synchronization with Mutexes, Thread Attributes, Cancelling a thread.
6. Inter-Process Communication: Pipes, Process Pipes, and The Pipe Call, Parent and Child processes, FIFOs (Accessing a FIFO, Opening a FIFO, Reading and Writing FIFO).

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall and label the basic commands in Linux. (Remembering)
- CO2:** Classify system calls, library functions calls to write on standard output device. (Understanding)
- CO3:** Experiment with shell programs.(Applying)
- CO4:** Analyse and compare between different file systems like ext4/FAT/NTFS.(Analysing)
- CO5:** Construct programs on process scheduling, page replacement algorithms.(Creating)
- CO6:** Evaluate free space management using programs.(Evaluating)

E-resource for learning

Linux-Ubuntu, www.spoken-tutorial.org

CADA6013: DESIGN AND ANALYSIS OF ALGORITHMS LAB

(2 credits)

1. Prove that bubble sort algorithm has time complexity (n^2) by showing the graph notation.
2. Implement the Dynamic programming technique and Analyse the algorithm showing the graph notation.
3. Implement the Greedy programming technique and Analyse the algorithm showing the graph notation.
4. Implement the Divide and Conquer technique and Analyse the algorithm showing the graph notation.
5. Design a small file compressor and de-compressor by using Huffman coding technique

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall existing algorithms and how to Analyse them using graph notation. (Remembering)
- CO2:** Demonstrate implementation of the existing algorithms. (Understanding)
- CO3:** Apply existing algorithms in developing different applications. (Applying)
- CO4:** Analyse the time complexity of standard algorithms. (Analysing)
- CO5:** Evaluate an algorithm in terms of time and space efficiency. (Evaluating)
- CO6:** Create efficient applications by using right algorithm depending on input pattern and size. (Creating)

CAPJ6014: PROGRAMMING THROUGH JAVA LAB**(2 credits)**

1. Implement a simple calculator in java using remote method invocation
2. To find the shortest path using Breadth First Search Algorithm
3. To create a new text editor like the notepad
4. The reservation system code which register a passenger for different categories.
5. This Code can find a file Located anywhere in your computer (Hard Drive).
6. Calculator with both Standard and Scientific Mode
7. Program for Student Management
8. Calling Windows Runtime Commands.
9. A Ball Moving round the window.
10. Travel agent
11. Hundred Year Calendar(2001-2100)
12. Program to create GUI for Bank Account Simulation.
13. Write the java source code for “the 8 Puzzle” program and the html Java applet to execute interactive content on the World Wide Web.

COURSE / LEARNING OUTCOMES

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

- CO1:** List various GUI and thus will be able to select the suitable GUI to resolve a given problem. (Remembering)
- CO2:** Distinguish among the various utility class like vector, stack, Hash Table, String Tokenizer, etc. (Understanding)
- CO3:** Apply their knowledge to solve practical problems like reading from a dataset, writing into a file and develop games using JAVA program. (Applying)
- CO4:** Analyse the efficiency of various programs with respect to time and space complexity. They will also be able to modify a weak program into a more efficient one. (Analysing)
- CO5:** Evaluate the performance of various swing GUI components and design various applications using Swings depending on the domain and requirement. (Evaluating)
- CO6:** Design various methods for drawing lines, rectangles, polygons and ovals and based on their practical knowledge will be able to develop cost effective and user friendly applications. (Creating)

E-resource for learning

Java, www.spoken-tutorial.org

CACG6015: COMPUTER GRAPHICS LAB**(2 credits)**

1. Algorithms discussed in the theory should be implemented using C/C++.
2. Graphics using OPEN GL: Introduction to OPEN GL, Drawing lines, Drawing polylines, Drawing polygons, Drawing aligned rectangles, clipping a line, Drawing arcs, Drawing circles, Drawing 3D curves, Circles rolling around a circle.
3. GUI using X-Windows: X Windows, Xaw-an X Toolkit, Introduction to Motif.

COURSE / LEARNING OUTCOMES

At the end of Computer Graphics Lab students will be able to:

- CO1:** Recall the various inbuilt functions of graphics packages. (Remembering)
- CO2:** Illustrate the task of each inbuilt functions used in graphics programming. (Understanding)
- CO3:** Implement various graphics related algorithms to draw various shapes such as line, curve, circle etc. (Applying)
- CO4:** Analyse the graphics packages. (Analysing)
- CO5:** Evaluate the performance and complexity of the program written for designing the shapes and curves. (Evaluating)
- CO6:** Design simple animations, draw shapes, fill colors using mathematical logics and transformations. (Creating)

CADC6016: DATA COMMUNICATION and NETWORKS II and NETWORK PROGRAMMING USING LINUX LAB

(2 credits)

Objective: Network programming involves writing programs that communicate with other programs across a computer network. Most operating systems provide pre-compiled programs that communicate across a network. This course envisages providing an introduction to such networking programming, whereby students will learn to write their own network programs. At the end of this course in network programming, the students are expected to have elementary ideas about the Berkeley sockets and their usage in setting up TCP and UDP communications.

Module I

- a) Introduction to Network Programming : Introduction to Sockets; Address Structure – IPv4, IPv6; Value-Result Arguments; Byte Order Functions; Byte Manipulation Functions; inet_aton, inet_addr, inet_ntoa, inet_pton, inet_ntop, readn, written, readline, isfdtype functions
- b) Elementary TCP Sockets : Introduction; socket, connect, bind, listen, accept, fork, exec, close, getsockname, getpeername functions; TCP Client Server example; signal, sigaction, wait, waitpid functions; Connection Termination; SIGPIPE signal
- c) I/O Multiplexing : I/O models; select function; Batch input; shutdown, pselect, poll functions; Example – TCP Echo Server.
- d) Socket Options : getsockopt, setsockopt, fcntl, ioctl functions; Socket status – generic socket options
- e) Elementary UDP Sockets : Introduction; recvfrom, sendto functions; UDP Examples; connect function with UDP; UDP socket receive buffer; Example – UDP Echo Server

Module II

- a) Elementary Name and Address Conversion : Introduction; gethostbyname function; RES_USE_INET6 resolver option; gethostbyaddr, uname, gethostname, getservbyname, getservbyport functions.
- b) IPv4 and IPV6 Interoperability : Introduction; IPv4 Client - IPv6 Server, IPv6 Client – IPv4 Server; IPv6 Address Testing Macros, IPV6_ADDRFORM.
- c) Advanced Name and Address Conversions : Introduction; getaddrinfo, gai_strerror, freeaddrinfo, getnameinfo functions; Reentrant functions.

- d) Daemon Processes : Introduction; syslogd daemon; syslog, daemon_init functions; inetd daemon; daemon_inetd function.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** List various network related commands. They will get introduced to socket programming in TCP and UDP environment.(Remembering)
- CO2:** Illustrate the functions used in TCP and UDP client server communication. (Understanding)
- CO3:** Apply their knowledge of socket programming to perform various types of communications, address conversions and so on. (Applying)
- CO4:** Analyse the efficiency of TCP and UDP client –server communication. (Analysing)
- CO5:** Design and evaluate code for conducting chat or communication between client and server in UDP environment. (Creating, Evaluating)

Suggested Readings

1. W Richard Stevens, UNIX Network Programming – Volume I , Second Edition, Prentice Hall of India Pvt. Ltd., 2002
2. Douglas E Comer, Internetworking with TCP/IP: Principles, Protocols, and Architectures – Volume I, Fourth Edition, Prentice Hall of India Pvt. Ltd.
3. Douglas E Comer, David L Stevens, Internetworking with TCP/IP: Design, Implementation, and Internals – Volume II,Third Edition, Prentice Hall of India Pvt. Ltd.
4. Douglas E Comer, David L Stevens, Internetworking with TCP/IP: Client Server Programming and Applications – Volume III, Second Edition, Prentice Hall of India Pvt. Ltd.

CAIT6017: INTERNET TECHNOLOGY AND APPLICATIONS LAB

(2 credits)

Module I

- a) XHTML:Components of XHTML; Elements of XHTML (Headers, Linking, Images, Special Characters, Lists, Tables, Forms, Framesets)
- b) Cascading Style Sheets: Inline Styles; Embedded Style; Conflicting Style; Linking External Styles; W3C CSS Validation Service; Use of CSS (Positioning Elements, Backgrounds, Text flow)
- c) XML: XML Structuring Data; XML Namespaces; Document Type Definitions and Schemas; XML Vocabularies; Document Object Model (DOM and its methods); Extensible StyleSheet Language (XSL)

Module II

- a) Web servers: HTTP Request Types; System Architecture of a Web server; Client-side Scripting versus Server-side Scripting; Accessing Web servers; Apache Web Server. b) Databases: Introduction to each one of the following: SQL, MYSQL, DBI
- c) Scripting Languages: Javascript: Operators, Data Types, Control Structures, Functions, Arrays, String Manipulation. VBScript Introduction to Perl and CGI (Common Gateway Interface). JSP: Introduction; JSP Overview; Scripting; Standard Actions; Directives
- d) Web Site Design Considerations: Using Logical Design: Planning your website, drawing a map, using a top-down approach, flexibility, other web design metaphors. Creating templates. Creating a Compatible Design: Designing for different color depths, resolutions, different browser considerations, accommodating limited bandwidth. Validating your work.

- e) PHP: Introduction to PHP; Data Types; Control Structures; Functions; Strings; Arrays; Querying Web Databases using PHP; Writing to Web Databases; Errors, Debugging and Deployment; Reporting in

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Experiment with various mark-up languages and scripting languages. (Applying)
- CO2:** Analyse and design a website of their own and can also identify the faults in the design. (Analysing)
- CO3:** Develop and create a website of their own. (Creating)
- CO4:** Summarize and validate a practical solution towards a web application development and also deploy a website of their own. (Evaluating, Creating)

Suggested Readings

1. Deitel and Deitel, Internet and World Wide Web: How to Program, 2nd Edition, Prentice Hall of India Pvt. Ltd. , New Delhi
2. Hugh E. Williams and David Lane, PHP and MySQL, 2nd Edition, O'Reilly, Shroff Publishers and Distributors Pvt. Ltd.
3. Internet Complete, 2nd Edition, BPB Publications. , New Delhi
4. Douglas E. Comer, The Internet Book: Everything you need to know about Computer Networking and how the Internet works, 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi

CADM6018: DATABASE MANAGEMENT SYSTEM II LAB

(2 credits)

Module I: PL/SQL Programming

- a) Language fundamentals - PL/SQL block structure, character set, identifiers, literals, delimiters, comments, data types in PL/SQL
- b) Program Structure - Conditional constructs, Iterative constructs, Exception handling
- c) SQL in PL/SQL- DML and Transaction Management (Commit and Rollback), Data Retrieval, Cursors (Explicit and Implicit), error handling with Cursors
- d) Procedures, Functions, packages, Triggers- creating and managing functions, procedures, packages and triggers
- e) Built-in functions - String functions (ascii, chr, concat, greatest, instr, least, length, lower, lpad, ltrim, replace, rpad, rtrim, substr, trim, upper) Numeric functions (bitand, ceil, exp, floor, ln, mod, power, round, sign, sqrt, trunk) , Date and time functions (add_months, current_date, current_timestamp, last_day, months_between, next_day, round, sysdate, systimestamp, trunk) Conversion functions (to_number, to_char, cast, to_date, to_timestamp)

Module II: Forms Builder

Components of application development in Oracle Forms (Form modules, menus, PL/SQL libraries, Object libraries, Database objects), components of a form module, creating single table forms, creating tabular forms, changing attributes of form objects, validations, triggers, adding PL/SQL codes to triggers, creating master-details form, PL/SQL libraries, creating and adding library to modules, creating multi-canvas forms, error handling, creating multi-form applications, creating menus, adding PL/SQL code to menu items, adding libraries to a menu module, attaching menu to a form, properties of menus, creating iconic toolbar, creating master-details iconic toolbar menu

Module III: Reports Builder and Graphics Builder

Features of the Report Builder, defining a data model for a report, specifying the layout of the report, specifying a runtime parameter form for a report, using the Oracle reports interface, using the Reports Wizard, changing report attributes, creating manual reports, creating master-detail reports, creating parameterized reports, running a report from a form, working with charts, tools available in the Graphics Builder, creating Graphs, embedding charts in forms and reports

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to: CO1: Define the PL/SQL language fundamentals. (*Knowledge*)

- CO1:** Define the PL/SQL language fundamentals. (Remembering)
- CO2:** Describe PL/SQL program structure like conditional constructs, iterative construct, and exception handling. (Understanding)
- CO3:** Use different program structure and apply them to solve problems.(Applying)
- CO4:** Apply and Analyse PL/SQL procedures, functions, packages, triggers to practice assignments.(Analysing)
- CO5:** Describe data model for a report and summarize using report builder and graphics builder.(Evaluating)
- CO6:** Create applications in ORACLE forms.(Creating)

Suggested Readings

1. Ivan Bayross, Commercial Application Development Using Oracle Developer 2000 Forms 6i, BPB Publications, 2nd Revised Edition, 2005
2. John Day, Craig Van Slyke, Starting out with Oracle, Dreamtech Press, 2004
3. Steven Feuerstein, Oracle PL/SQL Programming, O'Reilly Publications, 3rd Edition.

CASG6019: SYSTEM PROGRAMMING LAB**(3 credits)**

1. Design of a small Assembler
2. Design of loader.
3. Design of linker.
4. Design and implementation of Macro-processor.
5. Study of Debugger (GDB)

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** List C function for string and file processing. (Remembering)
- CO2:** Explain the working of two pass assemblers, macro preprocessors, linkers, loaders and debuggers. (Understanding)
- CO3:** Construct the data structures for symbol table, literal table, macro name table etc. (Applying)
- CO4:** Point out errors in programs using a debugger. (Analysing)
- CO5:** Justify the output generated by the assemblers, macro preprocessors etc. (Evaluating)
- CO6:** Combine data structures and algorithms to create assemblers, macro preprocessors etc. (Creating)

CAOS6020: INTRODUCTION TO OPERATING SYSTEMS LAB

(2 credits)

1. Simple Unix-C programs: Programs using system calls, library function calls to display and write strings on standard output device and files.
2. Programs using fork system call.
3. Programs for error reporting using `errno`, `perror()` functions.
4. Programs using pipes.
5. Shell programming.
6. Programs to simulate process scheduling- FCFS, SJF and Round Robin.
7. Programs to simulate page replacement algorithms-FIFO, LRU.
8. Programs to simulate free space management.
9. Programs to simulate deadlock detection.
10. Study of file system-UNIX/FAT/NTFS

COURSE / LEARNING OUTCOMES

At the end of Introduction to Operating Systems Lab students will be able to:

- CO1:** Identify, recall and outline the concepts of system calls, library function calls and to display and write strings on standard output devices. (Remembering)
- CO2:** Infer the concepts related to shell programming and their significance. (Understanding)
- CO3:** Use the concepts of error reporting functions, pipes, various scheduling algorithms (FCFS, SJF and Round Robin). (Applying)
- CO4:** Analyse and interpret the results obtained from page replacement algorithms-(FIFO, LRU), and understand the underlying principles and working of space management concepts. (Analysing)
- CO5:** Compare, contrast and assess their hypotheses with the file system concepts (UNIX/FAT/NTFS). (Evaluating)
- CO6:** Simulate deadlock detection in operating system and summarize some critical functionalities related to deadlock in operating systems.(Creating)

E-resource for learning:

Linux-Ubuntu, www.spoken-tutorial.org

CAIG6021: INTRODUCTION TO COMPUTER GRAPHICS LAB

(2 credits)

1. Learning graphics functions in C,C++
2. Digital Differential Analyser line drawing algorithm.
3. Bresenham's line drawing algorithm.
4. Bresenham's circle drawing algorithm.
5. Polygon filling algorithm (Flood Fill, Boundary Fill)
6. Cohen Sutherland clipping algorithm.
7. 2D Transformations such as translation, rotation, scaling and shear.

COURSE / LEARNING OUTCOMES

At the end of Introduction to Computer Graphics Lab students will be able to:

- CO1:** Define basics of programming with graphics packages. (Remembering)
- CO2:** Illustrate the functioning of inbuilt functions of graphics packages. (Understanding)
- CO3:** design and implement computer graphics algorithms using graphics packages. (Applying)
- CO4:** Analyse various graphics packages and their applicability. (Analysing)
- CO5:** Evaluate mathematical logics used to design graphics applications. (Evaluating)
- CO6:** Create animation, drawing using mathematical logics and transformations. (Creating)

CADB6022: RDBMS LAB

(2 credits)

- a) Programs to be created and executed on the following areas
 1. Use of SQL Syntax: Insertion, Deletion Join), Updating using SQL.
 2. Program segments in embedded SQL using C as host language to find average grade point of a student, etc.
 3. Program for Log based data recovery technique.
 4. Program on data recovery using check point technique.
 5. Concurrency control problem using lock operations.
 6. Use of package (ORACLE) for programming approaches.
 7. Programs on JDBC/ODBC.
- b) PL/SQL Programming Language fundamentals
 1. PL/SQL block structure, character set, identifiers, literals, delimiters, comments, data types in PL/SQL
 2. Program structure- Conditional constructs, iterative constructs, exception handling
 3. SQL in PL/SQL - DML and Transaction Management (Commit and Rollback), Data Retrieval, Cursors (Explicit and Implicit), Error handling with cursors, Procedures, Function, Triggers- creating and managing functions, procedures.
- c) PHP, MYSQL

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Familiarize with database design using the ER Model and its mapping to a relational database representation. (Understanding/Applying)
- CO2:** Illustrate and manipulate SQL queries and relational algebra. (Understanding/Analysing)
- CO5:** Evaluate and Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database. (Evaluating/Applying)
- CO3:** Formulate, using relational algebra, solutions to a broad range of query problems. (Creating)
- CO4:** Formulate, using SQL, solutions to a broad range of query and data update problems. (Creating)

CASE6023: BASIC SOFTWARE ENGINEERING LAB

(2 credits)

- A. Lab using IBM RSA tools
- B. Virtual lab

Weblink: <http://iitkgp.vlab.co.in/?sub=38&brch=204>

Contents

1. Identifying the requirements from problem statements
2. Estimation of project metrics
3. Modeling Data Flow Diagrams
4. Development of User stories
5. Identifying domain classes from the problem statements
6. Modeling UML use case diagram & capturing use case scenarios
7. Class diagram, Activity diagram etc
8. Designing test suite and testing

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Implement the software engineering process to develop any software project. (Remembering)
- CO2:** Explain and formulate an effort estimation plan. (Understanding)
- CO3:** apply software design patterns.(Applying)
- CO4:** Examine an understanding of ISO, CMM level for the software project.(Analysing)
- CO5:** Test the software project through various testing approaches. (Evaluating)
- CO6:** Maintain the software project by using maintenance plan.(Creating)

CAPA6024: PRINCIPLES OF ARTIFICIAL INTELLIGENCE LAB

(2 credits)

List of Experiments

1. Write a LISP Program to solve the water-jug problem using heuristic function.
2. Create a compound object using Turbo Prolog.
3. Write a Prolog Program to show the advantage and disadvantage of green and red cuts.
4. Write a prolog program to use of BEST-FIRST SEARCH applied to the eight puzzle problem.
5. Implementation of the problem solving strategies: Forward Chaining, Backward Chaining, Problem Reduction.
6. Write a LISP Program to implement the STEEPEST-ASCENT HILL CLIMBING.
7. Write a PROLOG Program to implement COUNTING PROPAGATION NETWORK.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall how to Identify the problem state and solve the problem with AI technique (Remembering)
- CO2:** Explain the various search techniques. (Understanding)

- CO3:** Apply the performance of the search algorithm with complexity analysis. (Applying)
- CO4:** Analyse the concept of machine learning with reference to neural network, expert system.(Analysing)
- CO5:** Develop in Prolog and Lisp environment for interpreting knowledge and complex information and representing using the prolog interpreter. (Creating)
- CO6:** Evaluate the various search techniques. (Evaluating)

CARM6025: INTRODUCTION TO RESEARCH METHODOLOGY AND STATISTICAL TOOLS LAB

(2 credits)

List of Experiments

1. Use of LaTeX for publishing research articles and books.
2. Use of Python for Statistical and Data Analysis (such as measures of central tendency, dispersion, correlation, regression, association of attributes, z-test, etc.)
3. To conduct a small research project in group and apply the knowledge about research methodology
4. Use of SPSS, SCILAB/ MATLAB -Statistical Tool Box, etc. for Data Analysis is recommended.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Recall and recognize the structure of a LaTeX document and functions and syntaxes of SCILAB scripts. (Remembering)
- CO2:** Develop a scientific attitude towards understanding and solving a research problem. (Understanding)
- CO3:** Experiment with tools and techniques available for practically carrying out research (Applying)
- CO4:** Compare and Analyse the various sections of a standard research paper (Analysing)
- CO5:** construct a coherent research proposal that includes an abstract, introduction, literature review, research questions, ethical considerations, and methodology. (Creating)
- CO6:** Summarize the existing research work of a particular research topic for judging and assessing the outcome and results (Evaluating)

CAMN6026: MINOR PROJECT - MCA

(4 credits)

***Objective:** The objective of the Minor project is to consolidate the concepts and practices that were learned during the course and to serve as a record of competence. It should enable a student to apply concretely in a small package the concepts gained from Software Engineering.*

COURSE / LEARNING OUTCOMES

At the end of this Minor Project students will be able to:

- CO1:** Recall and distinguish client end programming from a server end programming, web based application from a smart phone based application, approach to an application based project from a research based project. (Remembering, Understanding)

- CO2:** Identify different API and development environment tools for building the project, research terminologies for research based project. (Applying)
- CO3:** Apply the knowledge of programming to develop application specific but not limited to Web, Android, IoT etc., for research based project the different algorithm design techniques. (Applying)
- CO4:** Analyse the advantage and limitation of different development languages, APIs, platforms, algorithms. (Analysing)
- CO5:** Create applications to meet real time needs (Creating)
- CO6:** Judge the efficiency of the project using various evaluation parameters and testing methodologies, efficiency of the algorithm for research based complexity measure. (Evaluating)

E-resource for learning

LaTeX, www.spoken-tutorial.org

CAMP6027: MAJOR PROJECT - MCA

(12 credits)

Objective: The primary objective of the Major Project is to enable students to have a thorough understanding of the theoretical principles learnt in earlier five semesters through a prolonged practical experience. The major project is oriented towards developing requisite skills, knowledge of latest technologies and an entrepreneurial attitude in a student which are needed to make an effective start as a computer/IT professional.

COURSE / LEARNING OUTCOMES

At the end of Major Project students will be able to:

- CO1:** Identify different API and development environment tools for building the project, research terminologies such as scaling, sampling, information gathering etc for research based project. (Understanding, Applying)
- CO2:** Learn different programming languages/research tools needed to meet different objectives of the project based on the company/institutional requirements. (Remembering)
- CO3:** Apply the knowledge of programming to develop application specific but not limited to Web, Android, IoT etc. For research based project, the different algorithm design techniques, classification & clustering techniques, etc. will be applied. (Applying)
- CO4:** Analyse the advantages and limitations of different development languages, APIs, platforms, algorithms (for research) (Analysing)
- CO5:** Create applications to meet real time needs. For research-based projects, students will be able to design novel or hybrid research techniques to meet the problem statement objectives (Creating)
- CO6:** Judge the efficiency of the project using various evaluation parameters and testing methodologies, efficiency of the algorithm for research based (complexity measure) (Evaluating)

CADC6028: DATA COMMUNICATION LAB**(2 credits)**

1. PC-to-PC communications under WinXP/Win98 direct cable connection with null modem
 - a) Using serial ports and RS-232 C cable connection, and
 - b) Using parallel ports and direct parallel cable connection.
2. PC-to-PC communications under WinXP/Win98 dial-up networking with modem and 4- line exchange.
3. PC-to-PC communications under WinXP/Win98 hyper terminal with modem and 4-line exchange.
4. Simple file transfer between two systems (without protocols): By opening socket connection to a server on one system and sending a file from one system to another.
5. Writing a Chat application:
 - a) One-One: By opening socket connection and displaying what is written by one party to the other.
 - b) Many-Many (Broad cast): Each client opens a socket connection to the chat server and writes to the socket. Whatever is written by one party can be seen by all other parties.
6. Introduction to Packet Tracer
7. Simulation of Telnet: Provide a user interface to contact well-known ports, so that client-server interaction can be seen by the user.
8. TFTP- Client: To develop a TFTP client for file transfer.
9. HTTP-Server: Develop a HTTP server to implement the commands – GET, POST, HEAD, DELETE. The server must handle multiple clients.

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Relate about networking devices and various networking commands(Remembering)
- CO2:** Illustrate different types of network (Understanding)
- CO3:** Implement different networking protocol in different network topology. (Applying)
- CO4:** Compare different topology and functioning of different protocols. (Analysing)
- CO5:** Formulate the types of network required for an organization, Depending on availability of hardwares and softwares (Creating)
- CO6:** Determine a computer network either Wired or Wireless(Evaluating)

Suggested Reading

1. Networking and Data Communications Laboratory manual, Frances S. Grodzinsky, PH, 1999.

CAIJ6029: INTRODUCTION TO JAVA PROGRAMMING LAB**(2 Credits)**

1. Java Fundamentals using Data Types, Declarations, Control Flow
2. Java Classes and Java Packages
3. Java Interfaces and Java Streams
4. Java Exception Handling
5. Java Threads

6. Java Applets

7. Java AWT

COURSE / LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

- CO1:** Identify classes, objects, members of a class and relationships among them needed for a specific problem.(Remembering/Evaluating)
- CO2:** Write Java application programs using OOP principles and proper Program structuring.(Applying/Understanding)
- CO3:** Demonstrate the concepts of polymorphism and inheritance .(Applying)
- CO4:** Write Java programs to implement error handling techniques using exception handling.(Applying)
- CO5:** Analyse the real world problems and solve using Java programming .(Analysing/ Applying)

E-resource for learning

Java, www.spoken-tutorial.org

CAMI6030: MINI PROJECT - BCA

(4 credits)

Mini projects are assigned to students in groups by the Department under the supervision of the designated faculty member. The objective of the mini project is to train the students to create Industry oriented software or hardware applications in his/her field of interest.

COURSE / LEARNING OUTCOMES

At the end of this Mini Project students will be able to:

- CO1:** Recall, identify and recognize the available project domains and its related requirements for project development. (Remembering)
- CO2:** Illustrate and explain the requirements and modules to be included in designing the system. (Understanding)
- CO3:** Estimate and predict the feasibility of the system/application/project to be developed. (Understanding)
- CO4:** Develop the system, by applying the knowledge they hold or (learn during or before the project phase). (Applying)
- CO5:** Evaluate, assess their work based on the certain defined metrics such as robustness, optimality, scalability, etc. (Evaluating)
- CO6:** Summarize their learning in the form of a final system/application/product. (Creating)

CAMP6031: MAJOR PROJECT - BCA

(10 credits)

Objective: The primary objective of the Major Project is to enable students to have a thorough understanding of the theoretical principles learnt in earlier five semesters through a prolonged practical experience. The major project is oriented towards developing requisite skills, knowledge of latest technologies and an entrepreneurial attitude in a student which are needed to make an effective start as a computer/IT professional.

COURSE / LEARNING OUTCOMES

At the end of Major Project students will be able to:

- CO1:** Locate the domain, explain the requirements and modules to be included in designing the system. (Remembering, Understanding)
- CO2:** Explain, estimate and predict the feasibility of the system/application/project to be developed. (Understanding)
- CO3:** Apply the knowledge of various tools and techniques in designing the system. (Applying)
- CO4:** Analyse and modify (if needed) the system based on the requirements. (Analysing)
- CO5:** Evaluate, assess their work based on the certain defined metrics such as robustness, optimality, scalability, etc. (Evaluate)
- CO6:** Develop the system, by applying the knowledge they hold or (learn during or before the project phase). (Creating)

CAPM6032: PYTHON AND MACHINE LEARNING LAB

(2 credits)

Objective: The course is intended to give students hands on experience on python and building machine learning systems using python.

List of experiments

1. Installation of PyCharm and Jupyter. Making Machine learning environment ready.
2. Practice of loops, iterators, string operations, file handling and classes in Python.
3. Use of Numpy and Pandas for data reading and preprocessing - standard dataset as an example.
4. Writing program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API
8. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

COURSE/LEARNING OUTCOMES

At the end of the Python and Machine Learning Lab students will be able to:

- CO1:** Using different control structures, python operators and built in functions for performing different basic operations.(Remembering)
- CO2:** Judging what Numpy or Pandas functions to use for data Preprocessing and what control structures to use for building the learning. (Understanding)

- CO3:** Apply python for building machine learning systems for classification problem (Applying)
- CO4:** Compare and judge on the learning parameter, weight vector space and proper error functions. (Analysing)
- CO5:** Apply different learning algorithms to a given problem, compare and contrast their results. (Evaluating)
- CO6:** Create new results after applying all the above to certain use case problems. (Creating)

Suggested Reading

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas Muller

SCHOOL OF COMMERCE AND MANAGEMENT

DEPARTMENT OF COMMERCE

CMMA0005: MANAGEMENT ACCOUNTING

(4 credits - 60 hours)

Objective: This course is intended to familiarize students with the process of using financial, costing and other relevant information for the purpose of managerial planning, control and decision making.

Module I: Introduction to Management Accounting (5 hours)

Meaning, objectives, scope and functions of management accounting; role of management accounting in decision making; management accounting vs. financial accounting and cost accounting, tools and techniques of management accounting.

Module II: Analysis of Financial Statement (15 hours)

Meaning & types of financial statements; Meaning, objectives and significance of financial statement analysis. Ratio analysis: Advantages of ratio analysis; limitations of accounting ratios, classification of ratios -profitability ratios, solvency ratios, liquidity ratios and turnover ratios.

Module III: Standard Costing and Variance Analysis (15 hours)

Meaning of standard cost and standard costing; advantages and application; variance analysis – material, labour and overhead variances.

Module IV: Absorption and Marginal Costing (15 hours)

Meaning, difference between absorption costing & marginal costing. Cost – volume - profit analysis. Application of marginal costing technique: pricing, shut down decision, selection of profitable product mix, make or buy, profit planning, exploring new market.

Module V: Responsibility Accounting (10 hours)

Concept and Significance, Different Responsibility Centres: Cost Centre, Profit Centre and Investment Centre.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning and concept of management accounting. (Remembering)
- CO2:** Demonstrate the accounting ratios for analysis purpose. (Understanding)
- CO3:** Apply the techniques of standard costing in variance analyses. (Applying)
- CO4:** Compare between absorption and marginal costing. (Analysing)
- CO5:** Assess the various costing techniques for various decisions in business like- make or buy, own or lease, profit planning, shut down decision and exploring profitable market. (Evaluating)
- CO6:** Adapt the various notions of cost, profit and investment centers of an organization. (Creating)

Suggested Readings

1. Baig, Nafees : Management Accounting & Control, Ashish Publishing House, New Delhi.
2. Arora M.N: Cost Accounting-Principles and Practices; Vikas Publishing House, New Delhi.

3. Arora M.N: Management Accounting, Himalaya Publishing House, New Delhi.
4. Jain S.P. & Narang K.L: Cost Accounting; Kalyani Publisher, New Delhi
5. Horngren, Charles, Foster and Datar et al: Cost Accounting - A Managerial Emphasis; Prentice Hall , New Delhi.
6. Khan M.Y. and Jain P.K: Management Accounting; Tata McGraw Hill, New Delhi.
7. Kaplan R.S. and Atkinson A.A.: Advanced Management Accounting; Prentice Hall India, New Delhi.
8. S.K. Gupta, R.K. Sharma, Management Accounting, Kalyani Publishers, New Delhi.
9. Lal Jawahar, & Srivastava. Seema. Cost Accounting, McGraw Hill Publishing, New Delhi.
10. Jhamb, H.V. Management Accounting, ANE Publishing House, New Delhi.

CMMK0012: MARKETING MANAGEMENT

(4 credits – 60 Hours)

Objective: *This course addresses the management challenge of designing and implementing the best combination of marketing actions to carry out a firm's strategy in its target markets. Specifically, this course seeks to develop the students' skills in applying the analytic perspectives, decision tools, and concepts of marketing to decisions involving segmentation, targeting and positioning, product offering, pricing, distribution channels and marketing communications.*

Module I: Introduction (9 hours)

- a) Introduction to marketing management: Nature, scope and importance of marketing, evolution of marketing concepts.
- b) Marketing mix: Meaning, importance, marketing environment - macro and micro environmental factors.

Module II: Consumer Behaviour and Market Segmentation (12 hours)

- a) Consumer Behaviour: Consumer buying process, factors influencing consumer buying decisions - an overview.
- b) Market segmentation: Concept, importance and basis; target market selection; positioning concept - importance and basis; product differentiation vs. market segmentation.

Module III: Product (12 Hours)

- a) Product: Meaning and importance; product classifications; concept of product mix; product life-cycle; new product development.
- b) Product Specifications: Branding, packaging and labeling; after-sales services.

Module IV: Pricing and Distribution (13 Hours)

- a) Pricing: Significance; Factors affecting price of a product; pricing policies and strategies.
- b) Distribution: Channels of distribution - meaning and importance; types of distribution channels; wholesaling and retailing; factors affecting choice of distribution channel; distribution logistics - meaning, importance and decisions.

Module V: Promotion and Recent Developments in Marketing Management (14 Hours)

- a) Promotion: Nature and importance of promotion; promotion tools: advertising, personal selling, public relations and sales promotion – concept and their distinctive characteristics, communication process; promotion mix, factors affecting promotion mix decisions.
- b) Recent developments in marketing: Social marketing; online marketing; direct marketing; services marketing; green marketing.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning and concept of marketing management (Remembering)
- CO2:** Explain consumer behaviour and market segmentation (Understanding)
- CO3:** Apply Product and its related concepts (Applying)
- CO4:** Analyse Pricing and Distribution strategies (Analysing)
- CO5:** Evaluate Promotion and Recent Developments in Marketing Management (Evaluating)

Suggested Readings

1. Kotler, Philip & Gary Armstrong, 'Principles of Marketing', Prentice Hall.
2. Kotler, Keller, Koshi, Jha, 'Marketing Management – A South Asian Perspective', Pearson.
3. Ramaswamy, V. S. & S. Namakumari, 'Marketing Management', Macmillan.
4. Majaro, Simon, 'The Essence of Marketing', Prentice Hall, New Delhi.

CMFS0013: INDIAN FINANCIAL SYSTEM

(4 Credits-60 Hours)

Objective: *This course primarily deals with the Financial System of India. It will enable students to acquire a basic understanding of the structure, organisation and functioning of the financial system and will give an exposure to different financial instruments and their implications in the existing regulatory framework.*

The aims of this course are:

- *To understand and develop knowledge about evolution of the structure and constituents of the Indian Financial System*
- *To understand the role of different financial markets*

Module I: Financial System (10 hours)

Introduction to financial system, institutions, financial system design; market structure and its components, functions and economic significance; reforms in the financial system.

Module II: Financial Markets (15 hours)

- a) Money Markets: Meaning, objectives, importance and characteristics.
- b) Role of Reserve Bank of India and Commercial Banks in the Indian money market.
- c) Capital Markets: Meaning, classification of capital markets, growth of stock exchange, functions of stock exchange, SENSEX, NIFTY, OTCEI (Over the Counter Exchange of India) and depositories.
- d) Primary Market; Secondary Market; Derivatives Market; Debt Market.

Module III: Financial Instruments (10 hours)

- a) Basic financial instruments; general issue, functional categories, maturity, currency, and type of interest rate
- b) Proposed functional category and instrument breakdown
- c) Investment, type of investments, assets, liabilities
- d) IAS 32 financial instruments

Module IV: Financial Institutions (10 hours)

Development Financial Institutions: IDBI, IFCI, SIDBI, NABARD, NEDFi; management of NPAs, changes in NPAs provisioning norms, BASEL III norms; Mutual Fund and insurance; financial regulatory authorities.

Module V: Financial Services (10 hours)

Investment banking; depositories and custodians; credit rating; factoring and forfaiting; housing finance; leasing and hire purchase; merchant banking.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain the importance of financial system for national economy. (Understanding)
- CO2:** Explain financial system design and market structure. (Understanding)
- CO3:** Compare the financial systems structures of different nations. (Understanding)
- CO4:** Identify the role of Money markets and Capital markets. (Applying)
- CO5:** Analyse the role of Reserve Bank of India in the Indian financial system. (Analysing)
- CO6:** Contrast between different financial instruments and investment types. (Analysing)
- CO7:** Evaluate the function of financial intermediaries. (Evaluating)
- CO8:** Summarize the functioning of development financial institutions. (Creating)
- CO9:** Explain the BASEL III norms and the regulatory framework in the financial system. (Creating)

Suggested Readings

1. Pathak, Bharati; Indian Financial System, Pearson India
2. Gupta, Shashi K.; Aggarwal, Nisha & Gupta, Neeti, Indian Financial System, Kalyani Publishers-New Delhi
3. Vohra, M, Indian Financial System, Anmol Publication
4. Gordon, Natrajan, Financial Markets and Services, Himalaya Publication House, New Delhi.
5. Khan, M. Y; Indian Financial System,

CMBI0014: PRACTICE OF BANKING AND INSURANCE

(4 Credits: 60 Hours)

Objective: The course is aimed at helping the students to get exposure in the operational environment in Banking, Insurance and other related firms in the financial service sector. The aims of this course are:

- To create professionals who are able to handle various financial activities associated with banking and insurance sector
- Exposure to banking and insurance products

Module I: Banking (10 hours)

- a) Introduction to Banking: concepts, definition, functions and types
- b) RBI: Role of RBI and its functions
- c) Commercial banks: Origin and Growth, Banking sector reforms, Global financial crisis and India's banking sector
- d) NBFCs, PDs, FIs,
- e) Credit guarantee institutions

Module II: New Dimensions and Products in Banking (10 hours)

- a) Operations of Banking: Cheques crossing, types and rules of crossing
- b) Banks Advances: Types of advances and deposits in banks, secured versus unsecured advances, advance against various securities
- c) Bank's Products: Credit cards, debit cards and smart cards, ATM card, stored-value card

Module III: E-banking (10 hours)

- a) Era of Internet banking, Mobile Banking, Virtual Banking, Electronic Clearing System(ECS)
- b) E-Payments, Plastic Money, Electronic Fund Transfer(EFT), E-money, Electronic Purse, Digital Cash
- c) Critical Comparison of traditional banking methods and E-banking

Module IV: Introduction to Insurance (15 hours)

- a) Insurance: Meaning and nature, purpose and need, principles of insurance, types of insurance, new insurance products, present state of insurance industry in India.
- b) Legal Framework: Types of insurance- life and non-life, re-insurance, risk and return relationship, Essential Feature of Insurance Contracts and Salient Features of Insurance Act 1938 , IRDA Act 1999, Bancassurance

Module V: Risk (15 hours)

- a) Basic concept of Risk – Kinds of Business Risks; Assessment and Transfer
- b) Basic Principles – Principle of utmost Good faith Interest, Indemnity, Economic function,
- c) Proximate Cause, Subrogation and Contribution; Types of Insurance; Reinsurance d) Risk and Return Relationship; Need for Coordination

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the role of Commercial Banks. (Remembering)
- CO2:** Explain the role of Credit Guarantee Institutions. (Understanding)
- CO3:** Apply the new dimensions of banking. (Applying)
- CO4:** Analyse the operations of banking instruments. (Analysing)
- CO5:** Determine the differences between traditional banking and E-Banking. (Evaluating)
- CO6:** Elaborate the concept of Insurance and Contract theory. (Creating)

Suggested Readings

1. Agarwal, O.P, Banking and Insurance: Himalaya Publishing House
2. Saxena, GS. Legal Aspects of Banking Operations, Sultan Chand and Sons
3. Gupta, P.K. Insurance and Risk Management, Himalaya Publishing House
4. Suneja, H.R., Practical and Law of Banking, Himalaya Publishing House
5. Gupta, Shashi K.; Aggarwal, Nisha & Gupta, Neeti, Indian Financial System, Kalyani Publishers-New Delhi

CMTX0015: TAXATION

(4 Credits-60 Hours)

Objective: *This course is designed to enable students to gain knowledge of the provisions of tax laws and to apply it to various situations in actual practice.*

Module I: Tax Concept and Residential Status (7 hours)

- a) Basic concepts: Income and Income Tax, person, assessee, assessment year, previous year, Permanent Account Number (PAN).
- b) Residential status: Residential status of different types of companies, individual and firm.

Module II: Tax Planning and E-Filing (8 hours)

- a) Tax planning: Concept of tax planning, types of tax planning, tax management, tax evasion, tax avoidance and difference between tax planning, tax evasion & tax avoidance.
- b) E- Filing: Concept of e-filing, procedure of e-filing of returns, tools used in e-filing.

Module III: Computation of Income under Different Headings (20 hours)

- a) Computation of income under the heading salaries and income from house property.
- b) Computation of income under the heading profits and gains of business and profession, capital gains and income from other sources.

Module IV: Computation of Tax under GST (15 hours)

- a) GST: Concept of GST, person liable to pay tax in GST, migration of the persons registered under earlier laws in GST.
- b) Supply: Value of supply, place of supply, determination of supply in the course of inter- state trade or commerce or intrastate supplies.

Module V: Indirect Tax Laws (10 hours)

- a) Central Excise Act, 1944 and the related rules, circulars and notifications, Central Excise Tariff Act, 1985 and the related rules.
- b) Customs Act, 1962 and the related rules, circulars and notifications, Customs Tariff Act, 1975 and the related rules.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the concept of tax and residential status of different types of companies, individual and firm.(Remembering)
- CO2:** Contrast the notion of tax planning, tax evasion and tax avoidance.(Understanding)
- CO3:** Identify the procedure of e-filing of income tax returns. (Applying)
- CO4:** Simplify the total income of individual, HUF and company under different heads of income. (Analysing)
- CO5:** Assess the concept of GST and the person liable to pay tax in GST.(Evaluating)
- CO6:** Discuss the value of supply under GST in course of inter-state trade. (Creating)

Suggested Readings

1. Haldia, Arpit. GST Made Easy: Answer to all Your Queries on GST, Taxman's PVT. Ltd. New Delhi.
2. Singhania, Vinod K. and Monica Singhania. Students' Guide to Income Tax, University Edition. Taxmann Publications Pvt. Ltd., New Delhi.

3. Ahuja, Girish and Ravi Gupta. Systematic Approach to Income Tax. Bharat Law House, Delhi.
4. Pagare, Dinkar. Law and Practice of Income Tax. Sultan Chand and Sons, New Delhi.
5. V.S. Datey. Indirect Tax Law and practice, Taxmann Publications Pvt. Ltd., Delhi, Latest edition.

CMFR0016: FINANCIAL REPORTING

(4 Credits-60 Hours)

Objectives: *This course is designed to*

- *gain ability to Analyse financial statements and financial reports of various types of entities.*
- *gain ability to apply valuation principles.*
- *familiarize with recent developments in the area of financial reporting.*

Module I: Indian Accounting Standards, IFRS & US GAAP (10 hours)

- a) Accounting standards and its necessity; interpretations of accounting standards and guidance notes on various accounting aspects issued by the ICAI and their applications; understanding of US GAAP and applications of IFRS (International Financial Reporting Standards) and US GAAP.
- b) Overview of International Accounting Standards (IAS)/International Financial Reporting Standards (IFRS), interpretations by International Financial Reporting Interpretation Committee (IFRIC) and significant differences vis-a-vis Indian Accounting Standards.

Module II: Corporate Financial Reporting and Reporting of Financial Instruments (10 hours)

- a) Corporate Financial Reporting - Issues and problems with special reference to published financial statements.
- b) Accounting and Reporting of Financial Instruments: Meaning, recognition, de-recognition, offset and measurement of financial instruments.

Module III: Financial Reporting by Mutual funds and Share Based Payments (10 hours)

- a) Financial reporting by mutual funds, Non-Banking Finance Companies, merchant bankers, stock and commodity market intermediaries.
- b) Share based payments and its role in financial reporting: Meaning, equity settled transactions, transactions with employees and non- employees.

Module IV: Valuation in Financial Reporting (15 hours)

- a) Valuation of tangible fixed assets and valuation of intangible assets including brand valuation and valuation of goodwill.
- b) Valuation of liabilities, shares and business.

Module V: Developments in Financial Reporting (15 hours)

Value Added Statement (VAS); Economic Value Added (EVA), Market Value Added (MVA), Shareholders' Value Added (SVA); Human resource reporting; Inflation accounting.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning of accounting standard (Remembering)
- CO2:** Explain the importance of accounting standards and interpret it in the field of accounting and reporting (Understanding)
- CO3:** Apply the various techniques and methods of corporate financial reporting. (Applying)

- CO4:** Analyse the various financial instrument and compare the recognition and de-recognition of financial instrument. (Analysing)
- CO5:** Evaluate the methods of valuation of tangible fixed assets and intangible assets including brand valuation. (Evaluating)
- CO8:** Make up the benefits of an effective performance management framework (Creating)

Suggested Readings

1. Vijay Kumar, M P. First Lessons in Financial Reporting, Snowwhite Publisher, Mumbai, Maharashtra.
2. Sekar, G. and Prasath, Saravana, Financial Reporting, Wolters Kluwer (India) Pvt. Ltd. Mohali – Chandigarh.
3. Sharma, Praveen. And Bhalla, Kapileshwar, Financial Reporting, Pooja law house, Delhi.
4. Tulsian, P.C. and Tulsian, Bharat, Financial Reporting, Paperback, New Delhi.
5. Sarada, Pawan. and Sharma, D. G. Financial Reporting, Paperback, New Delhi.

CMAA0017: AUDIT AND ASSURANCE

(4 Credits- 60 Hours)

Objectives: *To understand the concept of audit and auditing and its practical application in the field of business. The learning outcome is to enable students to gain working knowledge of generally accepted audit and auditing procedures and principles, techniques and skills needed to apply them in audit and attestation engagements.*

Module I Fundamental concepts of Audit (15 hours)

Nature of auditing; basic concepts in auditing: auditor’s independence, true and fair, audit evidence, types of audit evidence, audit procedure to obtain audit evidence, accounting policies; preparation of audit: audit engagement, audit documentation and audit sampling.

Module II Internal Control (15 hours)

Meaning and definition of internal control; types of control and audit approach, impact of control, regulations of international financial control; internal audit; appointment of internal auditor; audit risk; audit in automated environment: key features, impact of IT related risk.

Module III Vouching in Audit (15 hours)

Meaning and definition; audit of cash transactions; general considerations in vouching; internal control in respect of trading transactions; international control in respect of service; cut off arrangements in audit and balance sheet audit; verification of assets and liabilities; special audit of government expenditure.

Module IV Company Audit (15 hours)

Audit of shares; eligibility, qualifications and disqualifications of auditors; appointment of auditors; removal of auditors; remuneration of auditors; powers and duties of auditors; branch audit; joint audit.

Companies Act 2013: reporting requirements, other provisions relating to audit and auditors, audit of banks: statutory and internal; audit of other entities.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define audit and auditing. (Remembering)
- CO2:** Define with example the audit documentation (Remembering)

- CO3:** Explain audit evidence (Understanding)
CO4: Identify the accounting policies for audit. (Applying)
CO5: Examine what voucher is and how vouching is done (Analysing)
CO6: Explain in brief the audit engagement (Evaluating)
CO7: Elaborate the types of audit evidence (Creating)
CO8: Discuss the procedure to obtain audit evidence (Creating)

Suggested Readings

1. Garg, Pankaj, Auditing & Assurance, Taxmann Publications Pvt. Ltd.
2. Bansal, Surbhi, Auditing and Assurance, Bestword Publication.
3. Garg, Kamal, "Professional Approach to Advanced Auditing", Bharat Law House Pvt Ltd.
4. Garg, Kamal, "Systematic Approach to Auditing & Assurance", Bharat Law House Pvt Ltd.
5. Oswal, Vikash, "Simplified Approach to Auditing And Assurance", A Wolters Kluwer Business.

CMGR0018: GOVERNANCE, RISK AND ETHICS

(4 Credits- 60 Hours)

Objectives: To make the students competent in their respective professional fields and make them ethical in their approach and globally acceptable. The learning outcomes include:

- To identify issues usually addressed by corporate governance structures in India.
- To identify the other drivers of governance, such as government, legislation etc.

Module I Governance and Corporate Governance (12 Hours)

- a) Meaning of governance, need for governance, basic features of good governance, role of codes in ensuring good governance.
- b) Meaning of corporate governance, identify the need for corporate governance, its features, good corporate governance practices.

Module II Principles and theories of Corporate Governance (10 Hours)

Corporate Governance Code, Principles of Corporate Governance, Theories of Corporate Governance, Corporate Governance in India, Corporate Governance and its obligations towards stakeholders.

Module III Understanding Business Risk (10 Hours):

The concept of business risk, risk vs uncertainty, types of risk and its management, risk and reward, approaches to risk.

Module IV Risk Management and Control (13 Hours)

Risk management and its objectives, risk management by individuals, process of risk management by individuals, risk management process; Legislative framework for control of risk.

Module V Introduction to Ethics (15 Hours)

- a) Fundamentals of ethics and morality, moral standards, moral development and moral reasoning; goal conflict: personal and organizational.
- b) Concepts of human values and professional ethics; importance of human values at workplace, meaning of professional ethics and personal ethics, significance of professional ethics.
- c) Concepts of business ethics; principles and perspectives of business ethics.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define governance, corporate governance, risk and ethics (Remembering)
- CO2:** Explain the features of good governance and risk management (Understanding)
- CO3:** Identify the principles and theories of corporate governance and business ethics (Applying)
- CO4:** Examine the risk management and control methods; concepts of business ethics (Analysing)
- CO5:** Evaluate the approaches to risk, moral development and moral reasoning (Evaluating)
- CO6:** Construct framework for control of risk and importance of human values at work place. (Creating)

Suggested Readings

1. Dr. S.S. Khanka; Business Ethics and Corporate Governance; 1st edition, published by S. Chand.
2. Paul Hopkin, Fundamentals of Risk Management: Understanding, Evaluating and Implementing
 - a. Effective Risk Management, 4th edition, published by Kogan Page Limited, U.K.
3. James M. Childs; Ethics in Business: Faith at Work;
4. William H. Shaw, Vincent Barry; Moral Issues in Business, 13th Edition; Published by Cengage Learning.

CMFG0019: FINANCIAL MANAGEMENT

(4 Credits- 60 Hours)

Objectives: *To familiarize the students with the principles and practice of financial management.*

- *Apply the fundamental concepts and tools of finance.*
- *Apply financial management concepts and tools to the decisions faced by a manager in investment decisions.*
- *Appraise the risk profile of firms; specifically, estimate the costs of capital, including*
- *Debt and equity capital, using financial data. And the learning outcomes include,*
- *Apply and critically evaluate finance and investment theory. Apply and critically*
- *Evaluate corporate finance techniques;*
- *Apply and critically evaluate theories of financial statements and related analysis.*
- *Identify, define and analyse problems and identify and create process to solve them;*
- *Exercise critical judgement in creating new understanding.*

Module I Fundamentals of Financial Management (10 hours)

Introduction to financial management, Scope of finance, Profit maximisation vs Wealth maximization; Time value of money: Determination of present value for - annuity, single cash flow, growing cash flow; Present value of an uneven cash flow; Concept of Net Present value (NPV); Concept of Internal Rate of Return (IRR); NPV vs IRR.

Module II Capital budgeting (8 hours)

Nature of Investment decision, Importance of Capital Budgeting, Capital Budgeting Process – Investment criterion, Pay-back period, Rate of Return(ROR), Discounting Cash

Flow method, Cost-benefit ratio method.

Module III Financial Statement Analysis (20 hours)

Introduction to financial analysis; Nature of financial analysis; Liquidity ratios; Leverage ratios; Efficiency ratios; Profitability ratios; DuPont Analysis; Limitations of ratio analysis; management of retained earnings; Case study: Inter-firm analysis.

Module IV Valuation of Equity (14 hours)

Introduction to equity valuation; Capital Asset Pricing Model (CAPM); Beta estimation; Cost of equity; Cost of debt; Weighted average cost of capital (WACC); Valuation models – Discounted Cash Flow model, Dividend discount model; Case Study: Initiation coverage report of a stock exchange traded company.

Module V Valuation of Bonds (8 hours)

Introduction to bonds; Features of a bond; Bond values and Yield; Factors affecting bond yield; Yield to maturity; Present value of a bond; Introduction to term structures of interest rates.

COURSE/LEARNING OUTCOMES

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

- CO1:** Find the Net Present Value and Internal Rate of Return for investment projects. (Remembering)
- CO2:** Compare between the concepts of Profit maximisation and Wealth maximisation. (Understanding)
- CO3:** Apply the concept of Time Value of Money to solve for Present value and Future value of a series of cash flows. (Applying)
- CO4:** Apply different capital budgeting methods to evaluate the suitability of an investment proposal. (Applying)
- CO5:** Make use of Discounted Cash Flow method to formulate the valuation of a publicly listed company. (Applying)
- CO6:** Demonstrate the features of a Bond. (Understanding)
- CO7:** Find the Present value of a Bond. (Remembering)

Suggested Readings

1. Khan, M.Y. and P.K. Jain, Financial Management: Text and Problems, Tata McGraw Hill
2. Horne, Van; James C., John Wachowicz, Fundamentals of Financial Management, Pearson Education
3. Singh, Surender and Kaur Rajeev. Basic Financial Management, Mayur Paper Book Noida
4. Singh, J.K. Financial Management-text and problems, 2 nd edition, Dhanpat Rai and Company, Delhi
5. Rustagi, R.P., Financial Management, Galgotia Publishing Company
6. Pandey, I M. Financial Management, Vikas Publications

CMBL0020: BANKING LAW AND PRACTICE**(4 credits-60 hours)**

Objectives: To familiarize the students with the banking laws and best practices in the banking industry and to navigate the various overlapping legal and regulatory regimes applying to banks and bank holding companies. The learning outcomes include

- Able to critically compare the bank regulatory system operating in India with other countries.
- To develop a clear understanding and knowledge about the functioning of a Commercial bank.
- To develop their understanding and expertise in various matters relating to operations of a commercial bank in India and other countries.

Module I Overview of Banking system and regulatory framework (15 hours)

Indian banking system; Reserve Bank of India; Commercial Banks; Co-operative banking system; Reserve Bank Act 1934; Reserve Bank Act 1949; Setting up a new bank; New Bank licensing policy 2013; Branch Licensing; Cash Reserve Ratio; Statutory Liquidity Ratio(SLR); Corporate governance in Banks; Prevention of Money laundering Act, 2002: Fraud- Classification and Reporting.

Module II Aspects of Banking operations (15 hours)

Legal aspects of a Cheque, Definition of a Cheque, Different Types of Cheques, Crossing of a Cheque; Safe Deposit Locker/Safe Custody Article Facility; Principles of Lending, Credit Worthiness of Borrowers, Collection of Credit information, Cash Credit, Overdrafts, Bills Finance, Term Loans, Bank Guarantee, Bank Guarantee: Precautions; Letters of Credit; Categories Under Priority Sector

Module III International Banking management (15 hours)

International Banking Overview; Evolution of International Banking, Bretton Woods Conference; Bank for International Settlement (BIS); Basel norms; Legal Issues in international Banking Transactions, Syndicated Credit – Important Features; International Laws – Application in international Banking Scenario; International Banking Operations Management; Risk Management in international Banking, FOREX Markets – Features & Issues; Special Issues: Technology and international Banking, Globalization and International Banking: Important aspects, Financial Innovations in International Banking

Module IV Ethics and Corporate Governance in Banks (15 hours)

Ethics – An Overview, Ethical and Unethical Issues; Business Ethics; Code of Ethics; Ethical aspects in Human Resource Management; Ethical aspects in Marketing Management; Ethical aspect in Financial Management; Desired Ethical Practices and Corporate Governance; Corporate Social Responsibility in the Financial Sector ; Role of the Board of Directors; Role of Chairman and/or CEO; Compliance officer

COURSE/LEARNING OUTCOMES

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

- CO1:** Define and explain the bank regulatory system operating in India. (Remembering)
- CO2:** Explain the functioning of the Reserve Bank of India and the key Acts related to it. (Understanding)
- CO3:** Compare the different banking instruments like Cheques, Overdrafts, Letter of Credit. (Evaluating)
- CO4:** Identify the evolution and operations of International Banking system.(Applying)
- CO5:** Examine the ethical issues and their implications in Banking.(Analysing)
- CO6:** Adapt the notions of risk management, globalization and innovation in International Banking.(Creating)

Suggested Readings

1. M.L.Tannan, revised by : Banking Law and Practice, Wadhwa & Company, Nagpur C.R. Datta & S.K.Kataria
2. A.B. Srivastava and : Seth's Banking Law, Law Publisher's India (P) Limited K. Elumalai
3. R.K. Gupta : BANKING Law and Practice in 3 Vols.Modern Law Publications.
4. Prof. Clifford Gomez : Banking and Finance - Theory, Law and Practice, PHI Learning Private Limited
5. J.M. Holden : The Law and Practice of Banking, Universal Law Publishing.

CMCA0021: COST ACCOUNTING**(4 Credits-60 Hours)**

Objectives: *To understand the basic concept of cost, costing and cost accounting, its tools and techniques used to determine costs and production cost. Also, the learning outcomes are*

- *To be able to interpret cost accounting statements.*
- *To be able to Analyse and evaluate information for cost ascertainment, planning, control and decision making.*
- *To enable students to understand and interpret the cost related information provided in the accounting statement for key decision making purpose.*

Module I Introduction to Cost Accounting (15 hours)

Meaning and definition- cost, costing, cost accounting; classification of costs; scope and objectives of cost accounting; advantages and disadvantages of cost accounting; installation of costing system; difference between cost control and cost reduction; difference between cost accounting, management accounting and financial accounting.

Module II Ascertainment of Costs (15 hours)

Material cost- procurement and procedures in respect of receipts and issue of stock, stock verification, techniques of inventory control.

Labour cost- attendance and payroll procedures, Charging of labour cost, work orders remuneration systems, incentive schemes; direct expenses; overhead expenses; elements of cost; preparation of cost sheet.

Module III Methods of Costing (15 Hours)

Single output/unit costing; job costing- meaning of job costing, job cost cards and databases, collecting direct costs of each job, attributing overhead costs to jobs, applications of job costing; activity based costing; batch costing; contract costing- contract costing progress payments, escalation clause, contract accounts, accounting for material, accounting for plant used in a contract, contract profit and balance sheet entries; process/operational costing and costing of service sector.

Module IV Standard Costing and Budgetary Control (15 Hours)

Standard costing- setting up of standards, types of standards; variance analysis- material cost variance, labour cost variance; overhead variance; break-even analysis, budget and budgetary control- meaning of budget, essential of budget, budget manual, budget setting process, preparation of budgets and monitoring procedures, use of budget in planning and control, flexible budget preparation of functional budget for operating and non operating functions, cash budget, master budget, zero based budgeting, Bureau of Industrial cost and price.

COURSE/LEARNING OUTCOMES

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

- CO1:** Name different types of costs. (Remembering)
- CO2:** Compare between the cost control & cost reduction. (Understanding)
- CO3:** Identify material, labour and overhead expenses. (Applying)
- CO4:** Categorize the different methods or techniques used in costing.(Analysing)
- CO5:** Assess the concept of material, labour and overhead variances.(Evaluating)

CO6: Design the different types of budgets like – cash, functional, master and zero based budget.(Creating)

Suggested Readings

1. Jain, S and Narang, K., “Advanced Cost Accounting”, Kalyani Publisher.
2. Saxena, V and Vashist, C.(4th ed), “Advanced Cost & Management Accounting’, Sultan Chand & Sons.
3. Inamdar, S. M. (14th ed), “Cost & Management Accounting”, Everest.
4. Kishore, R. M. (4th ed), “Cost & Management Accounting”, Taxman Allied Service.
5. Jawahar, Lal(3rd ed), “Cost Accounting”, TMH.

CMED0022: ENTREPRENEURSHIP DEVELOPMENT

(3 Credits-45 Hours)

Objectives: *To introduce the students to the concept and characteristics of entrepreneurship, define entrepreneurial skills and their use in a variety of situations, examine the personal skills of the students. The learning outcome, is to enable students, to define the concept of entrepreneurial opportunity and help them to develop criteria to judge which situation would turn to be as an opportunity worth developing into a venture and explain the formal venture planning process and preparation of business plans considering the market, technical, financial and legal requirements*

Module I Introduction to entrepreneurship (10 hours)

- a) Meaning and qualities of an entrepreneur, entrepreneurship: meaning and factors influencing entrepreneurship, entrepreneurship and economic development, Intrapreneurship and entrepreneurship, Cultural entrepreneurship, international entrepreneurship, netpreneurship, ecopreneurship, and social entrepreneurship.
- b) Evolution and theories of entrepreneurship development, entrepreneurial competencies influencing an Entrepreneur,

Module II Entrepreneurial Opportunities and Assessment Tools (12 hours)

- a) Entrepreneurial opportunities; entrepreneurial opportunities in a number of commercial and non-commercial situations. Case analysis. Assessment tools for an entrepreneur: Achievement Motivation Training, Self-Rating, Thematic Apperception Test.
- b) Idea generation – sources and methods, environmental scanning and SWOT analysis, Innovation and creativity in entrepreneurship.
- c) Concept of business groups and role of business houses and family business in India. The contemporary role models in Indian business: their values, business philosophy and behavioural orientations.

Module III Project Analysis and Appraisal (10 hours)

- a) Preliminary Project appraisal methods - Selecting the right opportunity, market survey and research, techno-economic feasibility, financial feasibility- sources of finance – identify various sources of capital, ways to access the capital, role of government and government agencies.
- b) Designing business processes, location, layout, operation, planning & control; preparation of project report (various aspects of the project report such as size of investment, nature of product, market potential etc. may be covered). Project submission/ presentation and appraisal thereof by external agencies, such as financial/non-financial institutions

Module IV (5 hours)

Creating the business model: business plan preparation. Small Enterprises – definition, classification – characteristics, forms of business ownership structures and determining situations beneficial from each type of ownership. Case analysis

Module V Strategy for Development of Business Plans (8 hours)

- a) Mobilizing resources for start-up: Accommodation and utilities. Preliminary contracts with the vendors, suppliers, bankers, principal customers and the aspects of contract management. Basic startup problems
- b) Break-even analysis, recognize the common causes of failure of business ventures, how to deal with seven business crisis- planning for survival and growth.
- c) Corrective Measures – government policy and schemes for small scale enterprises – growth strategies in small industry: expansion, diversification, joint venture, merger and sub-contracting.
- d) Final outcome: feasibility report preparations

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning of entrepreneurship and its relation with problem-solving. (Remembering)
- CO2:** Identify and explain entrepreneurial opportunities. (Applying)
- CO3:** List various entrepreneurial opportunities in a number of commercial and non-commercial situations.(Remembering)
- CO4:** Construct various preliminary project appraisal methods like market survey, techno-economic feasibility, and financial feasibility.(Creating)
- CO5:** Identify the types of regulatory systems and predict their effects on the creation of entrepreneurial venture.(Applying)
- CO6:** Create the business model and prepare business plans. (Creating)
- CO7:** Identify and assess the expected life of a venture and use of break-even analysis. (Applying)
- CO8:** Examine the common causes of failure of business ventures.(Evaluating)
- CO9:** Summarize how to deal with seven business crisis and planning for survival and growth. (Understanding)

Suggested Readings

1. John Legge and Kevin Hindle, "Entrepreneurship- Context, vision and planning", Palgrave Macmillan.
2. Entrepreneurship Development Institute of India, "Handbook for New Entrepreneurs", Oxford University Press.
3. V. G. Patel, "When the Going Gets Tough – Strategic responses to Business Crisis", Tata McGraw Hill Publishing Company Limited.
4. Dr. Vasant Desai, "Small scale industries and entrepreneurship", Himalayan Publishing House.
5. Dr.Vasant Desai, "Management of small scale industries", Himalayan Publishing House.
6. William Bolton, "The University Handbook on Enterprise Development", Columbus.

CMES0023: ENTREPRENEURSHIP (AUDIT COURSE)

Objective: *The objective of the course is to introduce students to the concept of entrepreneurship, entrepreneurial skills and their use in a variety of situations. The students are examined on the personal skills to help them define entrepreneurial opportunity and are taught to develop a criteria to judge a situation to develop into a venture, plan and prepare business plans considering the market, technical, financial and legal requirements.*

The various topics that are generally covered in the course are:

- *Meaning of entrepreneur and entrepreneurship and its relation with problem- solving, characteristics of an entrepreneur, factors influencing entrepreneurship*
- *Identify and explain entrepreneurial opportunities, generating a list of entrepreneurial opportunities in a number of commercial and non-commercial situations*
- *Preliminary Project appraisal methods - Selecting the right opportunity, market*
- *Survey and research, techno-economic feasibility, financial feasibility- sources of finance – identify various sources of capital, ways to access the capital. Legal environment – identify the types of the regulatory systems and predict their effects on the creation of the entrepreneurial venture, role of government and government agencies.*
- *Creating the business model – business plan preparation.*
- *Recognize and assess the expected life of a venture, break-even analysis, recognize the common causes of failure of business ventures, how to deal with seven business crisis- planning for survival and growth.*

CMCO0025: CAPITAL MARKET OPERATIONS

(4 Credits-60 Hours)

Objectives:

- *To provide expert knowledge in the legislations, rules and regulations governing the capital market.*
- *To provide the basic ideas about the functioning of primary and secondary financial markets in India.*

Module I: Securities Laws (12 Hours)

Objectives of the SCR Act, Rules and Regulations made there under; Rules relating to Public Issue and Listing of Securities under Securities Contracts (Regulation) Rules, 1957; Securities and Exchange Board of India Act, 1992: Objective; Powers and functions of SEBI; Securities Appellate Tribunal; Penalties and appeals; Depositories Act.

Module II: Primary Market (18 Hours)

Capital Market Investment Institutions-Domestic Financial Institutions(DFI), Qualified Institutional Buyers(QIB), Foreign Portfolio Investors (FPI), Private Equity, Venture Capital, Capital Market Instruments- Equities, Preference Shares, Shares with Differential Voting Rights, Corporate Debt, Non-Convertible Debentures(NCD), Partly, Fully and Optionally Convertible Debentures, Bonds, Foreign Currency Convertible Bonds(FCCB), Foreign Currency Exchangeable Bonds (FCEB); Indian Depository Receipts (IDR), Global Depository receipts(GDRs).

Module III: Secondary Market (15 Hours)

Development of Stock market in India; Stock market & its operations, Trading Mechanism, Block and Bulk deals, Grouping, Basis of Sensex, Nifty; Suspension and Penalties; Risk management in Secondary market, Impact of various Policies on Stock Markets such as Credit Policy of RBI, Fed Policy, Inflation index, CPI, WPI.

Module IV: Securities Market Intermediaries (15 Hours)

Primary Market and Secondary Market Intermediaries: Role and Functions; Merchant Bankers, Stock Brokers, Syndicate Members, Registrars and Transfer Agents, Underwriters, Bankers to an Issue, Portfolio Managers, Debenture Trustees, Investment Advisers, Research Analysts, Market Makers, Credit Rating Agencies; Internal Audit of Intermediaries by Company Secretary in Practice.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define and explain the securities laws related to capital market (Remembering and Understanding)
- CO2:** Identify and interpret the domestic and qualified financial institutions (Applying and Analysing)
- CO3:** Determine and estimate the primary and the secondary market functioning (Evaluating and Creating)

Suggested Readings

1. Gordon, E & Natarajan, K., "Capital Market in India", Himalaya Publishing House", Mumbai.
2. Aggarwal, Sanjeev., "Guide to Indian Capital Market", Bharat Law House, New Delhi.
3. Khan, M. Y., " Indian Financial System", Tata McGraw Hill, New Delhi.
4. Gupta, S. K. & Agarwala, N.," Financial Institutions and Markets ; Kalyani Publishers', New Delhi.

CMPI0026: FINANCIAL PLANNING AND INVESTMENT**(3 Credits-45 hours)**

Objective: This course introduces to give knowledge on Setting financial goals and develop a financial plan to apply time value of money principles to personal financial decisions to Prepare a personal budget o Choose a financial institution appropriate for.

Module I: Introduction to Financial Planning (10 hours)

The process financial planning, Client interactions, Time value of money applications, Personal financial statements, Cash flow and debt management, planning to finance education

Module II: Risk Analysis & Insurance Planning (8 hours)

Risk management and insurance decision in personal financial planning, Various Insurance Policies and Strategies for General Insurance, Life Insurance, Motor Insurance, Medical Insurance.

Module III: Investment Planning (15 hours)

Risk Return Analysis, Mutual Fund, Derivatives, Asset Allocation, Investment strategies and Portfolio construction and management.

Module IV: Tax Planning (12 hours)

Income-tax computation for Individuals, Companies, Trusts and other bodies. Statutory provisions pertaining to Capital Gains and indexation, House Property, Deduction and Allowances, Non Resident Indian tax laws, and Tax Management Techniques

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning and need for financial planning. (Remembering)
- CO2:** Demonstrate a general understanding of the business environment (Understanding).
- CO3:** Apply functional knowledge of financial planning and investment to conduct investment planning, estate planning and for an individual client. (Applying)
- CO4:** Compare the various schemes of investment for effective portfolio construction and management. (Analysing)
- CO5:** Interpret the strategies adopted in insurance business with regard to risk management. (Evaluating)
- CO6:** Plan investments as a mode of making tax planning for tax savings. (Creating)

Suggested Readings

1. Singhanar V.K: Students' Guide to Income Tax; Taxmann, Delhi.
2. Prasaci, Bhagwati: Income Tax Law & Practice: Wiley Publication, New Delhi,
3. Girish Ahuja and Ravi Gupta: Systematic approach to income tax: Sahitya Bhawan Publications, New Delhi.
4. Ranganathan and Madhumathi: Investment Analysis and Portfolio Management: Pearson, New Delhi
5. George Rejda: Principles of Risk Management and Insurance: Pearson, New Delhi

SPECIALISATION: INTERNATIONAL ACCOUNTING AND FINANCE

CMRP0027: CORPORATE REPORTING

(4 Credits- 60 Hours)

Objectives: *The Objectives of this course*

- *To know the use and application of Indian and international accounting standards.*
- *To learn the accounting treatment of different business combination situation.*
- *To learn the external reporting of financial institutions.*

Module I: Evolution and Convergence of International Accounting Standards (5 Hours)

GAAP in India, Hierarchy of GAAP in India; International Financial Reporting Standards (IFRSs); Relative view of AS and IFRSs; Accounting Standards (AS) – applicability, Interpretation, scope and compliance.

Module II: Accounting for Business Combinations (As Per Indian As) (10 Hours)

Relevant Terms, Types of merger, methods of accounting, treatment of Goodwill arising on merger, Purchase consideration and settlement; Accounting in books of vendor/ transferor company; Accounting for investment in subsidiary; Corporate financial restructuring; Reconstruction schemes, De-merger.

Module III: Group Financial Statements (15 Hours)

Consolidation of foreign - holding Company, Subsidiary Company and Associate Company including multiple sub subsidiaries; Consolidation procedures - Minority interest, Goodwill, Treatment Pre - acquisition profit and Post -acquisition profit and concept of Fair value at the time of acquisition; Treatment of investment in associates in consolidated financial statements.

Module IV: Sustainability Reporting and Share Based Payments (15 Hours)

Concept of Triple Bottom Line Reporting; Global Reporting Initiative (GRI); International Federation of Accountants (IFAC) .

Share Based Payments: Meaning, Equity settled transactions, Transaction with employees and non-employees; Determination of fair value of equity instruments; Vesting conditions, Modification, cancellation and settlement, Disclosures.

Module V: Accounting and Reporting of Financial Instruments and Other External Reporting (15 Hours)

Meaning, recognition, de-recognition and offset, compound financial instruments; Measurement of financial instruments; External Reporting under capital market regulations, Disclosures; Annual Reports - Statutory requirement and External report, Preparation of Financial Information.

COURSE/LEARNING OUTCOMES

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

- CO1:** Name the different accounting standards.(Remembering)
- CO2:** Compare the different types of merger and acquisition.(Understanding)
- CO3:** Construct the consolidated financial statement.(Applying)
- CO4:** Analyse the external reporting of financial institutions.(Analysing)
- CO5:** Assess the thought of share base payment.(Evaluating)
- CO6:** Discuss the notion of sustainability reporting. (Creating)

Suggested Readings

1. Stolowy, H., “Corporate Financial Reporting”, Thompson Business, New Work.
2. Lodha, R., “Corporate Financial Reporting”, Lowpoint Publications, New Delhi.
3. Tulsian, P. C., “Corporate Financial Reporting”, S Chand & Co.”, New Delhi.

CMAY0028: BUSINESS ANALYSIS

(4 credits– 60 hours)

Objective: *The objective of this course is to make the students learn the basic concepts in Business Analysis. The course will increase the all round knowledge of the students and enhance their understanding of the business environment and build their professional competence in the workplace.*

Module I: Business Environment: Concept, Components and Importance (8 Hours)

Business Environment: Concept, Components and importance; Indian Business Environment; Economic trends (overview): National Income, sector wise analysis.

Module II: Government and Business (12 Hours)

Govt. budget and its impact on business; influence of inflation, interest, money supply and level of savings on business activities. The interrelationship between government and business, Role of the Government as a regulator, promoter, entrepreneur, educator of business ideas; Government’s role in changed environments. Government policies on business-Industrial Policy Resolutions and statement; Industrial Development and Regulation Act 1951; Industrial licensing-Critical analysis; Fiscal and monetary policy; Public Private Partnership Model.

Module III: International Business Environment (12 Hours)

- a) Role of multinational companies, WTO, IMF and World Bank in world economy; Tariffs, Subsidies and Import quotas; Government Intervention in Formulating Trade policies - International trade relations;
- b) International trading environment (overview); Trends in world trade and problems of developing countries; Foreign trade and economic growth; International/ Regional economic institutions: SAFTA, SAARC, ASEAN.

Module IV: Foreign Trade Policies and Investment (12 Hours)

Foreign trade-policies and plans; Control of foreign trade; EXIM policy and other recent export promotional measures; foreign investment-need and importance; types of foreign investment; its implication on domestic economy; foreign investment policy in India, technical foreign collaboration.

Module V: Business Scenario in North East Region (12 Hours)

Special package for economic development of north eastern region; DONER and its role in economic development; infrastructure and industry; North East Industrial Policy- promotional measures for cross-border trade; Role of NEC and NEDFI; Problems and prospects of the industry in Assam, Brief study of the tea industry, paper industry, food processing industry, silk industry and bell metal industry; tourism industry; industrial and investment policies in NE.

COURSE/LEARNING OUTCOMES

At the end of the course students will be able to: CO1: Define the concept of business environment and its significance. (Remembering)

- CO2:** Explain the interrelationship between government and business. (Understanding)
- CO3:** Identify the various factors affecting foreign investment. (Applying)
- CO4:** Examine the foreign trade policies critically in the context of foreign trade and investments. (Analysing)
- CO5:** Evaluate the business scenario of North East Region. (Evaluating)
- CO6:** Develop a strategy for the improvement of trade and commerce in North eastern region of India. (Creating)

Suggested Readings

1. A. N. Agarwal, Indian Economy, New Age International, New Delhi
2. Francis Cherunilam, Business Environment, Himalaya Publishing
3. P. Subba Rao, International Business Text and Cases, Himalaya Publishing House.
4. Francis Cherunilam, International Business Environment, Himalaya Publishing House.
5. Swabera Islam & Kharkongor; Business Environment, Taxman's Publication, New Delhi.
6. S.K. Misra, V.K. Puri; Indian Economy, Himalaya Publishing House, Mumbai.
7. Deepashree, Indian Economy, Tata McGraw Hill, New Delhi

CMSP0029: ACCOUNTING FOR SERVICE AND PUBLIC FINANCE

(4 Credits-60 Hours)

Objectives:

- *To be acquainted with the government accounting rules related to service sector accounting such as defence accounts and postal accounts.*
- *To impart knowledge about the functioning of public finance mechanism.*

Module I: Government Accounting Rules (10 Hours)

Provisions of Government Accounting Rules,1990-Chapter 1-Introductory, Chapter 2– General Outlines of the System of Accounts, Chapter 3- Basic Structure of the Form of Accounts; List of Major and Minor Heads of Accounts of Union and States (LMMH).

Module II: Defence Account and Audit (15 Hours)

Budgetary process for Defence Service Expenditure; Manual of Audit Department - Vol I Part B -Chapter 18 –(Accounts Section); Defence Accounts Code; Classification Hand Book of Defence Services Receipts and Charges, Debt and Remittances heads with code numbers.

Module III: Postal Accounts (10 Hours)

Introduction of General system of Accounts; Organization and control; Postal Accounts Workbook and Compilation; Remittance; Annual Accounts of Central Government; Transfer Entries Journal and ledger; Cost Calculation; Capital Accounts; Checking of receipts; Internal check; inspections.

Module IV: Public Finance (12 Hours)

Introduction to Public Finance; Role of Public Finance in Economic Development; Public Revenue: Main Sources of Public Revenue; Classification and canons of Public Expenditure; Effects of Public expenditure on Production, Distribution and Economic Growth.

Module V: Federal Finance, Local Finance, Budgets and Fiscal Policy (13 Hours)

Financial Issues in a Federal set up; Principles of efficient division of financial resources between Central and States; The Finance Commission; NITI Aayog; Local bodies and their Financial responsibilities; Sources of Local Finance; Local Taxation; Classification of Budgets; Budgets and Planning; Budget and National Accounts; Objectives of Fiscal Policy; Deficit Financing.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the various forms of Government Accounting rules.(Remembering)
- CO2:** Contrast the government accounting rules related to service sector.(Understanding)
- CO3:** Identify the various budgetary process of government service.(Applying)
- CO4:** Analyse general system of postal accounts.(Analysing)
- CO5:** Assess the notion of public finance.(Evaluating)
- CO6:** Adapt the concept of federal finance. (Creating)

Suggested Readings

1. Ghosh, A., “Public Finance”, Prentice Hall India Learning Private Limited, New Delhi.
2. Jha, Raghendra,,”Modern Theory of Public Finance”, New Age International Private Limited, New Delhi.
3. Singha, S.K., “Public Finance in Theory & Practice”, S Chand & Company, New Delhi.
4. Government Accounting Rules 1990 published by Controller General of Accounts.
5. Manual of Audit Department.
6. Defence Accounts Code.
7. Classification Hand Book of Defence Services Receipts and Charges.
8. Defence Audit Code (Chapter 18).

SPECIALISATION: FINANCE AND INVESTMENT

CMIB0030: INVESTMENT BANKING

(4 credits – 60 hours)

Objective: The main objective of the course is to provide students with the necessary theoretical and conceptual tools used in investment banking. This course will provide an introduction and general understanding of investment banking activities and the mechanics and financial analysis required to value, negotiate and successfully close transactions.

Module I: Comparable Companies Analysis (15 hours)

Comparable companies analysis steps; Selecting the universe of comparable companies; Identifying key characteristics of target; Spread key statistics, ratios and trading multiples; Benchmarking comparable companies; Valuation implied by EV/EBITDA; Valuation implied by P/E; Pros and cons of comparable analysis.

Module II: Discounted Cash Flow Analysis (15 hours)

Summary of Discounted Cash Flow (DCF) analysis steps; Studying the target and its key performance drivers; Forecasting Free Cash Flow; Calculating Weighted Average Cost of Capital; Determining Terminal Value; Calculating present value; Determination of Valuation; Pros and cons of DCF analysis.

Module III: Leveraged Buyouts (15 hours)

Meaning and objective of Leveraged Buyout (LBO); Key participants; Characteristics of a strong LBO candidate; Economics of LBO; Exit and Monetizing strategies; LBO financing.

Module IV: Mergers and Acquisitions (15 hours)

Introduction to Mergers and Acquisitions (M&A); Auctions; Organization and Preparation; First Round in M&A process; Second Round in M&A process; Negotiations; Closing the deal; Financing the deal; Negotiated Sale.

COURSE/LEARNING OUTCOMES

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

- CO1:** Apply the technique of comparable company analysis for valuation of companies. (Applying)
- CO2:** Build a Discounted Cash Flow model to value a subject company. (Applying)
- CO3:** Explain the basics of a Leveraged Buyout Transaction. (Understanding)
- CO4:** Explain the steps involved in the Mergers and Acquisitions process. (Understanding)
- CO5:** Take part in practical experience in business valuation. (Analysing)

Suggested Readings

1. Rosenbaum and Pearl: Investment Banking, Wiley Finance.
2. E. Soubeiga: Mastering Financial Models, McGraw Hill.
3. J. Tija: Building Financial Models, McGraw Hill.

CMIM0031: INVESTMENT MANAGEMENT**(4 credits – 60 hours)**

Objective: *The objective of the course is to Learn about Financial markets and instruments, investment strategies. Apply standard models of financial economics to problems of portfolio optimization, diversification, immunization, and risk management.*

Module I: Introduction to Investment Management (15 hours)

Meaning and objectives; Portfolio Perspective on Investing: Diversification, Risk Aversion, Composition, Downside Protection, Modern Portfolio Theory; Investment Clients; Steps in Investment Management Process; Pooled Investments: Mutual Funds, Types of Mutual Funds, Other Investment Products.

Case Study analysis I.

Module II: Investment Risk and Return I (15 hours)

Investment Characteristics of Assets: Return; Return measures and their applications, Variance and Covariance of Returns, Historical Risk and Returns, Other Investment Characteristics; Risk Aversion and Portfolio Selection; Portfolio Risk; Efficient frontier; Investor's Optimal Portfolio.

Case Study analysis II.

Module III: Investment Risk and Return II (15 hours)

Capital Market Theory; Pricing of Risk: Systematic Vs Non-systematic Risk, Interpretation and Calculation of Beta; Capital Asset Pricing Model: Assumptions, Security Market Line, Applications, Limitations, Extension.

Case Study analysis III.

Module IV: Investment Planning (15 hours)

Investment Policy Statement (IPS): Components, Gathering Client Information; Capital Market Expectations; Strategic Asset Allocation; Investment Instruments: Equity, Fixed Income, Mutual Funds, Real Estate, Insurance Investments.

COURSE/LEARNING OUTCOMES

- CO1:** At the end of the course students will be able to: Explain the portfolio perspective to investing. (Understanding)
- CO2:** Discuss the steps in the Investment Management process. (Creating)
- CO3:** Evaluate major return measures of an investment. (Evaluating)
- CO4:** Explain the characteristics of the major asset classes that an investor should consider. (Understanding)
- CO5:** Summarize the risk and return objectives and outline how they may be developed for a client. (Understanding)

Suggested Readings

1. Zvi Bodie, Essentials of Investment, McGraw Hill.
2. Reilly and Brown, Analysis of Investments and Management of Portfolios, Cengage.
3. Prasanna Chandra, Investment Analysis and Portfolio Management, McGraw Hill.

CMCF0032: CORPORATE FINANCE

(4 credits – 60 hours)

Objective: *The aim of the course is to give understanding the various areas of corporate finance and also to develop the sources of finance and investment.*

Module I: Introduction to Corporate Finance (15 hours)

Objective of Corporate Finance; Role of finance manager in corporations; types of firms; stock markets; financial institutions; Financial Statement Analysis: Balance Sheet analysis, Income Statement analysis, Cash Flow statement; Case Study - Enron.

Module II: Investment Decisions (10 hours)

Net Present Value (NPV) rule; Payback rule; Internal Rate of Return (IRR) rule; Modified Internal Rate of Return; Choosing between projects; Capital Budgeting process; Forecasting Incremental Earnings; Break even Analysis; Scenario analysis; Options in Capital Budgeting – Delay, Expand, Abandon.

Module III: Risk and Return in Capital Markets (20 hours)

Variance and volatility of returns; Tradeoff between risk and return; Arithmetic Average returns Vs Compound Annual returns; Normal Distribution; Systematic Risk Vs Equity Risk; Measuring Systematic risks; Beta; Capital Asset Pricing Model (CAPM); Cost of Capital: Weighted Average Cost of Capital (WACC), Cost of Debt, Cost of Equity, Using WACC to value a project.

Module IV: Long Term Financing (15 hours)

Equity financing for Private Companies; Initial Public Offerings (IPO); Case Study – Google’s IPO; Debt Financing: Private Debt and Public Debt, Bond Covenants, Repayment Provisions; Capital Structure: Capital Structure Choices, Capital Structure in Perfect Capital Markets, Modigliani and Miller (MM) Model, Debt and Taxes.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain the basic tools and concepts necessary to understand modern financial theory and its application in corporations. (Understanding)
- CO2:** Apply capital budgeting tools for evaluating investments. (Applying)
- CO3:** Analyse the relationship between capital structure, risk and shareholder value, using thr Modigliani Miller Theorems. (Analysing)

Suggested Readings

1. Berk and DeMarzo : Corporate Finance, Pearson.
2. Brealey, Richard/ Myers, Stewart C. / Allen, Franklin :Principles of Corporate Finance, McGraw Hill.
3. Aswath Damodaran : Investment Valuation, John Wiley.

CMFN0033: ADVANCED FINANCIAL MANAGEMENT

(4 credits – 60 hours)

Objective: *To apply advance knowledge and skills in taking various decisions relating to the financial management of an organization.*

Module I: Role of senior financial adviser in the multinational organization (15 Hours)

Financial executive/advisor; financial strategy formulation; Ethical and governance issues; management of international trade and finance; strategic business and financial planning for multinational organizations; dividend policy in multinationals and transfer pricing.

Module II: Advanced Investment Appraisal (15 Hours)

Discounted cash flow techniques; option pricing theory; Impact of financing: investment decisions, adjusted present values; Valuation and the use of free cash flows; International investment and financing decisions.

Module III: Acquisitions and mergers (15 Hours)

Acquisitions and mergers versus other growth strategies; valuation for acquisitions and Mergers; Regulatory framework and processes; Financing acquisitions and mergers; corporate reconstruction and reorganization- financial reconstruction, business reorganisation.

Module IV: Treasury and advanced risk management techniques (15 Hours)

Treasury function in multinationals; hedging using financial derivatives: forex and interest rate risk.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain and evaluate the role and responsibility of the senior financial executive or advisor in multinational organizations in taking financial decisions. (Understanding)
- CO2:** Evaluate potential investment decisions and assessing their financial and strategic consequences. (Evaluating)
- CO3:** Define Merger and Acquisition. (Remembering)
- CO4:** Apply knowledge for valuation of Merger and acquisition in the world of business. (Applying)
- CO5:** Examine how corporate treasury functions. (Analysing)
- CO6:** Elaborate what foreign exchange risk is and how it can be hedged. (Creating)

Suggested Readings

1. Nelson, A., "Advances in Financial Management", McGraw Hill.
2. Kishor, R, M., "Financial Management", Taxmann's.
3. Advance Financial Management, ACCA, Kaplan Publisher.

CMFS0034: FINANCIAL SECURITIES AND DERIVATIVES

(2 credits – 30 hours)

Objectives: This course presents and analyses derivatives, such as forwards, futures, and options. The course defines the main kind of derivatives, shows how they are used to achieve various hedging and speculating objectives, introduces a framework for pricing derivatives, and studies several applications of derivative-pricing techniques outside derivative markets.

Module I: Derivatives Markets (10 hours)

Exchange traded markets; Over the counter markets; Forward contracts; Futures contract; Options; Types of Traders; Hedgers; Speculators; Arbitrageurs; Dangers of Derivative Markets.

Module II: Futures (10 hours)

Specifications of futures contracts; convergence of futures price and spot price; operation of margins; Forward vs Futures contracts; Hedging using futures: Basis risk, cross hedging, stock index futures.

Module III: Options (10 hours)

Types of Options; Option Positions; Underlying Assets; Specification of Stock options; Trading; Commissions; Margins; Options price: Factors, Upper and lower bounds, put- call parity, effect of dividends; Trading strategies using Options.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain the structural differences among options, forwards and futures. (Understanding)
- CO2:** Summarize how the above derivative securities are traded in exchanges and/or over the counter markets. (Understanding)
- CO3:** Illustrate the pricing of each of the above derivative securities with different pricing models and explain model assumptions. (Understanding)

Suggested Readings

1. John C. Hull: Options, Futures and Other Derivatives, Prentice Hall.
2. SL Gupta: Financial Derivatives: Theory, concepts and Problems, PHI Learning.

SPECIALISATION: INTERNATIONAL ACCOUNTING AND FINANCE

CMPT0035: ADVANCED PERFORMANCE MANAGEMENT

(4 credits – 60 hours)

Objective: To apply relevant knowledge, skills and exercise professional judgement in selecting and applying strategic management accounting techniques in different business contexts and to contribute to the evaluation of the performance of an organisation and its strategic and operational development.

Module I: Strategic planning and control (12 Hours)

Strategic management accounting; Impact of external factors on performance

management; Performance hierarchy; Performance management and control of the organisation; Changes in business structure and management accounting; Other environmental and ethical issues; Comparison between planning and control, between the strategic and operational levels within a business entity; changing role of the management accountant in today's business environment.

Module II: Impact of risk and uncertainty on organisational performance (12 Hours)

Impact of risk and uncertainty on performance management; the impact of the different risk appetites of stakeholders on performance management; evaluate how risk and uncertainty play an important role in long term strategic planning and decision making;

apply different risk analysis techniques in assessing business performance.

Module III: Performance measurement systems and design (12 Hours)

Performance management; information systems; Sources of management information; Recording and processing methods; Management reports.; evaluating the compatibility of management accounting objectives and the management accounting information systems; integration of management accounting information within an overall information system, use of enterprise resource planning systems; evaluate the external and internal factors which influence the design and use of a management accounting system. Benchmarking.

Module IV: Strategic Performance Measurement (12 Hours)

Strategic performance measures in the private sector; Divisional performance and transfer pricing issues; Strategic performance measures in not-for-profit organisations; Non-financial performance indicators; The role of quality in management information and performance measurement systems; Performance measurement and strategic human resource management issues; Other behavioural aspects of performance measurement. Labour Productivity.

Module V: Performance evaluation and corporate failure (12 Hours)

Alternative views of performance measurement and management; Strategic performance issues in complex business structures; Predicting and preventing corporate failure; evaluate the 'balanced scorecard' approach as a way in which to improve the range and linkage between performance measures; evaluate the application of activity-based management; application of value-based management approaches to performance management. Human Resource Audit.

COURSE/LEARNING OUTCOMES

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

- CO1:** Evaluate strategic planning and control models to plan and monitor organizational performance.(Evaluating)
- CO2:** Analyse the impact of risk and uncertainty on organisational performance.(Analysing)
- CO3:** Identify and evaluate the design features of effective performance management information and monitoring systems. (Applying)
- CO4:** Explain appropriate strategic performance measurement techniques in evaluating and Improving performance (Understanding)
- CO5:** Discuss with clients and senior management on strategic business performance evaluation and on recognizing vulnerability to corporate failure(Creating)
- CO6:** Define what human resource audit is (Remembering)

Suggested Readings

1. Eoin McGettigan, Advanced Performance Management: An International Perspective, Chartered Accountants Ireland.
2. ACCA P5 Advanced Performance Management: Study Text, Kaplan Publishing.
3. HakanButune, Systematic Strategic Planning: A Comprehensive Framework for Implementation, Control, and Evaluation, Auerbach Publications.

CMAT0036: ADVANCED TAXATION

(4 credits – 60 hours)

Objective: *The major objective of the course to make them aware about the advance tax system of India and how it works along with GST.*

Module I: Advance Direct Tax Laws (15 Hours)

- a) Assessment of income and Computation of tax liability of Various Entities: Individual including non-resident, Company, Trust, Mutual Association, Tax Management, Return.
- b) Tax Management, Return and Assessment Procedure: Return of Income, Assessment Procedure, Interest and fees, Survey, Search, Seizure & Raids, Refund, demand and recovery; Voluntary disclosures & amnesty.

Module II: Business Restructuring & PMLA Act (15 Hours)

- a) Amalgamation; Demerger; Slump sale; Conversion of sole proprietary business to company; Conversion of firm into company; Conversion of private limited company / unlisted public company into LLP.
- b) Black Money Act, 2015: Introduction to Black Money Act; Highlights of Black Money Act. (PMLA Act)

Module III: International Taxation (15 Hours)

Double Taxation and Avoidance Agreements [Sec. 90, 90A and 91]; Transfer Pricing - Transfer Pricing including specified domestic transactions; Application of Generally Accepted Cost Accounting Principles and Techniques for determination of Arm's Length Price.

Module IV: Goods and Services Tax (GST) Laws (15 Hours)

Levy and collection of CGST and IGST, Application of CGST/IGST law; Time and value of supply; Input tax credit; Computation of GST liability; Registration; Tax invoice; Credit and Debit Notes; Electronic way bill; Returns; Payment of tax including reverse charge

COURSE/LEARNING OUTCOMES

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

- CO1:** Name the direct laws.(Remembering)
- CO2:** Compare between the direct tax and indirect tax. (Understanding)
- CO3:** Identify the advance tax system exists in India.(Applying)
- CO4:** Analyse information about the Black Money Act, 2015. [PML Act, 2005](Analysing)
- CO5:** Determine the input tax credit under GST. (Evaluating)
- CO6:** Discuss the thought of CGST, SGST and IGST. (Creating)

Suggested Readings

1. Bangar, V. & Bangar, Y., "Advance Tax Laws and Practice", AadhyaPrakashan.
2. Mundhar, V., "Advance Tax Laws and Practice", Lawpoint Publication.
3. Pandab, S. K., "Advance Tax Laws and Practice", Lawpoint Publication.
4. Gour, M. Jain, N. & Doshi, S., "Advance Tax Laws and Practice: Part B: Indirect Tax Laws", Carvinowledge Press.
5. Haldia, A., "GST: Made Easy", Taxmann's Publication.

CMAU0037: ADVANCE AUDIT AND ASSURANCE

(4 credits-60 hours)

Objective: To understand the objective and concept of audit and auditing and its practical application in the field of business and its management. Also to understand how the frauds and errors are identified and prevented through audit process.

Module I (10 hours)

International regulatory frameworks for audit and assurance services: need for laws, regulations, standards and other guidance relating to audit, assurance and related services; legal and professional framework including: public oversight of audit and assurance practice, the impact of corporate governance, principles on audit and assurance practice, the role of audit committees and impact on audit and assurance practice.

Module II (10 hours)

Money laundering: definition, international methods for combating money laundering; scope of criminal offences of money; ethical guidance in this area; system to prevent and detect money laundering including record keeping and reporting of suspicion to the appropriate regulatory body; reasons, the basic elements of an anti-money laundering program.

Module III (10 hours)

Laws and regulations: Comparison and contrasting the respective responsibilities of management and auditors concerning compliance with laws and regulations in an audit of financial Statements; auditors' considerations of compliance with laws and regulations and plan audit procedures when possible noncompliance is discovered; Code of Ethics for Professional Accountants

Module IV (10 hours)

Fraud and error: Identification and developing an appropriate response to circumstances which indicate a high risk of error, irregularity, fraud or misstatement in the financial statements or a given situation; Comparison of respective responsibilities of management and auditors for fraud and error; procedures to be carried out to investigate actual and/or potential misstatements in a given situation.

Module V (10 hours)

Professional liability: circumstances of legal liability and the criteria for legal; factors of determining auditor is negligent and auditor's potential liability in given situations; compare and contrast liability to client with liability owed to third parties (ie contract vs establishing a duty of care).

Module VI (10 hours)

Practice Management: Quality control: principles and purpose of quality control of audit and other assurance engagements; elements of a system of quality control relevant to a given firm; Selection and justification of quality control procedures that are applicable to a given audit Engagement; Advertising, publicity, obtaining professional work and fees in Recognise situations in which specified advertisements are acceptable; procedures that an audit firm/professional accountant should carry out before accepting a specified new client/engagement or continuing with an existing engagement, including

- a) client acceptance
- b) engagement acceptance
- c) establish whether the preconditions for an d) audit are present
- e) agreeing the terms of engagement.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the generally accepted audit.(Remembering)
- CO2:** Classify the different auditing procedures.(Understanding)
- CO3:** Apply the techniques and skills needed in audit.(Applying)
- CO4:** Analyse how the assurance be given for internal control and accounting system. (Analysing)
- CO5:** Asses the concept of professional liability.(Evaluating)
- CO6:** Adapt the concept of practice management. (Creating)

Suggested Readings

1. Institute of Chartered Accountants of India: "Auditing and Assurance Standards", ICAI, New Delhi.
2. F Gupta, Kamal, and Ashok Arora: "Fundamentals of Auditing," Tata McGraw Hill Publishing Co. Ltd., New Delhi

SPECIALISATION: FINANCE AND INVESTMENT

CMFX0038: COMMODITIES AND FOREX MANAGEMENT

(4 credits – 60 hours)

Objectives: *The objectives of the course are to-*

- *To introduce the students to the concept of Forex management*
- *To make them aware about the risks associated with Foreign exchange*
- *To introduce the students to the concept of commodities management.*

Module I: Forex Management (15 Hours)

- a) Nature, Significance and Scope of Forex Management; Foreign Exchange Market and its Structure
- b) Foreign Exchange Rates and its Determination; Types of Exchange Rates, Spot and Forwards Exchange Rates; Forex Trading;
- c) Currency Futures and Options, Foreign Exchange Risk Exposures and their Management; Exchange Rate Forecasting; Risk in Foreign Exchange Business

Case Study

Module II: Foreign exchange Risk Management (15 Hours)

- a) Conceptual Overview; Nature and Exposure (Economic, Transaction and Translation)
- b) Hedging and Speculation.
- c) Framework of Managing Exposures, Accounting Implications of Forex Transactions

Module III: Derivatives and Exposure Management (15 Hours)

- a) Currency Forwards; Currency Options; Currency Futures; Currency Swaps
- b) Interest Risk Management

Module VI: Commodities Management (15 Hours)

- a) Introduction to commodity derivatives, commodity exchanges and commodity contracts
- b) Pricing commodity Forward, Futures and options
- c) Agricultural Price Risk Management
- d) Crude Oil and Base metal derivatives; Gold and Electricity Price Risk Management; Weather and Carbon Derivatives

Case Study on commodities management

COURSE/LEARNING OUTCOMES

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

CO1: *Define the concept of Forex management. (Remembering)*

CO2: *Understand the economy– sector and industries, stock market basics and money management. (Understanding)*

- CO3:** Develop wealth management and financial planning strategies. (Applying)
CO4: Examine the various kinds of risks associated with Foreign exchange. (Analysing)
CO5: Compare good and bad investment in order to build a good portfolio. (Evaluating)
CO6: Design the world of derivatives and commodities management. (Creating)

Suggested Readings

1. M.Y. Khan & P.K. Jain, Financial Management – Text and Problems, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Prasanna Chandra , Financial Management – Theory & Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi
3. R.P. Rustagi, Strategic Financial Management ,Taxmann Publication Pvt. Ltd
4. Neil C. Schofield, Commodity Derivatives: Markets and Applications
5. PrabinaRajib, Commodity Derivatives and Risk Management

CMPF0039: PORTFOLIO MANAGEMENT

(4 credits – 60 hours)

Objectives: The course objective is to acquaint students with the theoretical foundation of modern portfolio theory, the major groups of investors and their investment objectives and constraints, and to master practical skills in investment management, forming capital market expectations and forecasting markets activity to justify major investment portfolio management strategy for equity and fixed-income instruments.

Module I: Portfolio Management Process (15 hours)

Portfolio Management Process; Steps in Portfolio Management; Investment Objectives and Constraints; Dynamics of the Process; Managing Individual Investor Portfolio: Investor Characteristics, Investment Policy Statement, Asset Allocation concepts; Regulations for Portfolio Management Companies(PMCs).

Module II: Capital Market Expectations and Asset Allocation (15 hours)

Economic Analysis: Business Cycle Analysis, Economic Growth Trends, International Interactions; Asset Allocation: Strategic Asset Allocation in relation to Systematic Risk, Strategic vs Tactical Asset Allocation; Asset Allocation and Investor's Risk and Return objectives; Selection of Asset Classes; Optimisation Approaches; Implementing Strategic Asset Allocation.

Module III: Equity Portfolio Management (15 hours)

Role of Equity Portfolio; Approaches to Equity Investment; Passive Equity Investments; Active Equity Investments; Semi-active Equity Investments; Equity Portfolio Managers: Identifying, Selecting and Contracting; Structuring Equity Research and Security Selection.

Module IV: Fixed Income Portfolio Management (15 hours)

Managing Funds against a Bond Market Index; Managing Funds against liabilities: Dedication Strategies, Cash Flow matching strategies; Other Fixed Income Strategies: Combination strategies, Leverage, Derivatives enabled strategies; International Bond Investing: Active vs Passive Management, Currency Risk, Emerging Market debt.

COURSE/LEARNING OUTCOMES

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

- CO1:** Recall the theoretical foundations of the Portfolio Theory. (Remembering)
CO2: Illustrate the investment process scope and stages. (Understanding)

CO3: Model market expectations and build and Analyse strategic asset allocation. (Applying, Analysing)

CO4: Choose and evaluate the optimal investment strategy. (Creating, Evaluating)

Suggested Readings

1. John L. Maginn, Donald L. Tuttle, Dennis W. McLeavey, Jerald E. Pinto: Managing Investment Portfolios – A dynamic process, John Wiley & Sons.
2. ZviBodie: Essentials of Investment, McGraw Hill.
3. Reilly and Brown: Analysis of Investments and Management of Portfolios, Cengage.

CMAL0040: ALTERNATIVE INVESTMENTS

(4 credits – 60 hours)

Objectives: *The purpose of this course is to explore the world of alternative investments such as investments on hedge funds, private equity, venture capital funds, and commodities, either directly or through funds of funds.*

Module I: Hedge Funds (15 hours)

Hedge Funds: Scope and objectives; Establishing a Hedge Fund Investment Program; Selecting a Hedge Fund Manager; Due Diligence for Hedge Funds; Risk Management in Hedge Funds; Regulations in Hedge Funds.

Module II: Commodity and Managed Futures (15 hours)

Investing in Commodity Futures: Economic Rationale, Commodities and Business Cycle, Event Risk, Commodity Futures as an Asset Class; Commodity Futures Index, Sources of Index Returns; Comparison of Commodity Futures Indices.

Module III: Venture Capital (15 hours)

History of Venture Capital; Role of a venture capitalist; Business Plans; Intellectual Property Rights and issues in Venture Capital; Prior Operating History; Structure of Venture Capital Industry; Sources of Venture Capital Financing; Venture Capital Investment Vehicles; Specialisation in the Venture Capital Industry.

Module IV: Leveraged Buyouts (LBOs) (15 hours)

History of LBOs; Rational for LBOs; Unlocking an Entrepreneurial Mindset; Buy and Build Strategies; LBO Turnaround Strategies; LBO Fund Structures; Risks of LBOs; Corporate Governance and LBOs; Dismantling of conglomerates; Merchant Banking.

COURSE/LEARNING OUTCOMES

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

CO1: Recall and Explain the economic rationale behind alternative investments. (Remebering, Understanding)

CO2: Analyse the risk-return characteristics of alternative investments. (Analysing)

CO3: Discuss and Evaluate the Leveraged Buyout Model. (Evaluating, Creating)

Suggested Readings

1. Mark J. P. Anson: Handbook of Alternative Assets, John Wiley & Sons.
2. John L. Maginn, Donald L. Tuttle, Dennis W. McLeavey, Jerald E. Pinto: Managing Investment Portfolios – A dynamic process, John Wiley & Sons.

CMOT0041: ORGANISATIONAL THEORY AND BEHAVIOUR**(4 credits– 60 hours)**

Objective: *The objective of this paper is to provide the students an insight into the principles of organizational behaviour and its relation to other activities in an organization, and to introduce the students to the techniques of organisational behaviour used as a management tool.*

Module I: Introduction to Organizational Behaviour (8 Hours)

Defining Organisational Behaviour, historical background: the Hawthorne Studies; early development, conceptual development; the nature of people; theoretical frameworks; explaining and predicting behaviour; OB in the global context.

Module II: Cognitive processes of organizational behavior (12 Hours)

Nature and importance of Perception and attribution; perception and individual decision making; values, nature and dimensions of attitudes and job satisfaction; personality; aptitude; interests; learning; intelligence, motivation - theories of motivation.

Module III: Group Dynamics (14 Hours)

- a) Understanding group dynamics, types of groups, group goals, group cohesiveness, group pressure and norms, teamwork; group structure - formal leadership, roles and norms; group member resources - abilities, personality, characteristics, stages in group development.
- b) Leadership Theories - trait, behavioural, contingency, attributional, charismatic, transactional vs. transformational.
- c) Power and politics: Contrasting leadership and power; power in groups; power tactics; politics-power in action.

Module IV: Communication and Decision Making (12 Hours)

Role of communication; Communication media and technology, communication networks - formal vs. informal; barriers to effective communication; communication skills; feedback information; persuasion in communication; active listening; participative decision making techniques; groups vs. the individual; groupthink and group shift; the decision making process

Module V: Organizational culture and Work Stress (14 Hours)

- a) Definition of organizational culture; cultural typologies; organizational culture vs. national culture; functions of culture; formation of cultures; potential sources of stress - environmental factors, organizational factors; individual differences - perception, job experience, social support, locus of control, hostility; Stress – the emergence of stress, causes of stress; stress consequences - physiological symptoms, psychological symptoms, behavioural symptoms, stress management strategies : individual approaches, organizational approaches.
- b) Conflict and negotiation : Definition of conflict; the conflict process; conflict in intergroup relations; creating functional conflicts; bargaining strategies; role of personality traits on negotiation; third party negotiations; intergroup relations and factors affecting intergroup relations.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the concepts of Organisational Behaviour in the global context (Remembering)
- CO2:** Explain the Cognitive processes of organizational behavior and its application in workplace (Understanding)

- CO3:** Develop models of group dynamics, leadership theories, power & politics in terms of its application in workplace (Applying)
- CO4:** Analyse the importance of communication and decision making techniques for improving productivity of employees (Analysing)
- CO5:** Determine and develop models of Organizational culture, work stress and Conflict & negotiation in various workplace settings (Evaluating and Creating)

Suggested Readings

1. Fred Luthans, Organisational Behaviour, 10th Edition, McGraw Hill India, 2005
2. Stephen P Robbins, Organizational Behaviour, 11th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2004
3. Gilmer, Industrial Psychology, McGraw Hill.
4. Ghiselle and Brown, Personnel and Industrial Psychology, McGraw Hill.
5. Keith Davis, Human Relations at Work, Tata McGraw Hill.
6. Leavitt, Managerial Psychology, University of Chicago Press.
7. BM Bass, Leadership Psychology and Organizational Behaviour, Harper International.
8. Litterer, Analysis of Organizations, John Wiley.

CMBD0042: BUSINESS STATISTICS AND DECISIONS

(4 credits-60 hours)

Objective: *The objective of this course is to familiarize students with the applications of statistical techniques in business decisions. This purpose of this course is to provide students with statistical tools needed by managers. The course emphasizes understanding the process associated with statistical decisions, defining and formulating problems, Analysing the data, and using the results in decision making.*

Part A: BUSINESS STATISTICS

Module I: Uni-variate Analysis (15 hours)

Measures of Central Tendency including Arithmetic mean, Geometric mean and Harmonic mean: properties and applications; Mode and Median. Partition values - quartiles, deciles, and percentiles. Measures of Variation: absolute and relative. Range, quartile deviation and mean deviation; Variance and Standard deviation: calculation and properties.

Module II: Bi-variate Analysis (10 hours)

Simple Linear Correlation Analysis: Meaning, and measurement. Karl Pearson's coefficient and Spearman's rank correlation. Simple Linear Regression Analysis: Regression equations and estimation. Relationship between correlation and regression coefficients.

Module III: Time-based Data: Index Numbers and Time Series Analysis(15 hours)

Meaning and uses of index numbers; Construction of index numbers: Aggregative and average of relatives – simple and weighted, Tests of adequacy of index numbers, Construction of consumer price indices.

Components of time series; additive and multiplicative models; Trend analysis: Finding trend by moving average method and Fitting of linear trend line using principle of least squares.

Part B: BUSINESS DECISION**Module IV (10 hours)**

Course introduction. Introduction to Evidence Based Management. Introduction to measurement theory and statistical inference. Simple decision tools; Rational choice, limited rationality and biases; Modern test theory. Rapid evidence assessment. Academic Survey design and testing.

Module V (10 hours)

Multiple-person decision making. Exploratory data analysis; Forecasting; roadmaps Optimisation; Big data, inference and dimension reduction. Forecasting, roadmaps.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Find the techniques for decision-making under uncertainty.(Remembering)
- CO2:** Demonstrate understanding of statistical thinking and data analysis. (Understanding)
- CO3:** Apply methods of Correlation, Regression and also use Time based data. (Applying)
- CO4:** Analyse from theoretical and practical perspectives, decision making concepts and processes in business settings. (Analysing)
- CO5:** Estimate different kinds of Statistical methods like Mean, Median, Mode, Standard Deviation, Index Number. (Evaluating)
- CO6:** Combine research concepts and methods in a business setting. (Creating)

Suggested Readings

1. J. K. Sharma, Business Statistics, Pearson Education.
2. S.C. Gupta, Fundamentals of Statistics, Himalaya Publishing House.
3. S.P. Gupta and Archana Gupta, Elementary Statistics, Sultan Chand and Sons, New Delhi.
4. Richard Levin and David S. Rubin, Statistics for Management, Prentice Hall of India, New Delhi.
5. M.R. Spiegel, Theory and Problems of Statistics, Schaum's Outlines Series, McGraw Hill Publishing

CMFY0043: FINANCIAL STATEMENT ANALYSIS**(4 credits – 60 hours)**

Objective: The course introduces to provide the knowledge of decision makers information about a business enterprise for use in decision-making and to evaluate the economic situation of the firm and predicting its future course based on the financial statements.

Module I: Introduction to Financial Statement Analysis (10 hours)

Scope of Financial Statement Analysis; Financial Statements and other information sources; Financial Statement Analysis Framework; Classification of Business Activities; Financial Reporting Standards; Regulatory Authorities; International Financial Reporting Standards Framework (IFRS); Comparison of IFRS with other Reporting Standards.

Module II: Analysis of Income Statement (15 hours)

Components and format of Income Statement; Revenue Recognition; Expense Recognition; Non-recurring and Non-operating items; Earnings Per Share(EPS) : Simple Vs complex capital structure, Basic EPS, Diluted EPS; Analysis of Income Statement: Common size analysis, Income Statement Ratios.

Case Study I

Module III: Balance Sheet (10 hours)

Components and format of Balance Sheet; Measurement Bases of Assets and Liabilities; Equity: Components, Statement of Changes in Shareholders Equity; Uses and Analysis of Balance Sheet: Common size analysis, Balance Sheet Ratios.

Case Study II

Module IV: Cash Flow Statement (15 hours)

Components and format of Cash Flow Statement; Linkages and Preparation: Cash Flow Statement with Income Statement and Balance Sheet, Preparation of Cash Flow Statement, Conversion from Indirect to Direct method; Cash Flow Statement Analysis: Evaluation of Sources and Uses of Cash, Common size analysis, Free Cash Flow to Firm and Free Cash Flow to Equity, Cash Flow Ratios.

Case Study III

Module V: Financial Statement Analysis Techniques (10 hours)

Financial Analysis Process; Analysis tools and techniques; Common Ratios: Activity Ratios, Liquidity Ratios, Solvency Ratios, Profitability Ratios; Integrated Financial Ratio Analysis.

Case Study IV

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the role of standard setters and regulators in Financial Reporting (Remembering).
- CO2:** Illustrate the information provided by Balance Sheet, Income Statement and Cash Flow Statement (Understanding)
- CO3:** Identify and compare cash flow classifications of operating, investing and financing activities (Applying)
- CO4:** Analysing the link between Income statement, Balance Sheet and Cash Flow Statement (Analysing)
- CO5:** Criticise ratios used to analyse a company's liquidity, profitability, solvency and efficiency (Evaluating)
- CO6:** Build a strong base on financial statement analysis (Creating)

Suggested Readings

1. Thomas R. Robinson and Elaine Henry: International Financial Statement Analysis, Wiley.
2. Charles H. Gibson: Financial Statement Analysis, Cengage.
3. K. R. Subramanyam and John J. Wild: Financial Statement Analysis, McGraw Hill.

CMMG0044: MANAGERIAL ECONOMICS

(4 Credits-60 Hours)

Objective: *The objective of the course is to acquaint students with the basic principles of micro and macroeconomics for developing the understanding of theory of the firm, markets and the macro environment. This will help them in managerial decision making processes.*

Module I: Managerial Economics (10 Hours)

Introduction to Managerial Economics; Economic factors influencing decisions, Functions Role and Responsibilities of Managerial Economist; Principles in Managerial decision analysis; Micro-Macro Economics, Paradox of Micro Economics, Distinction between Micro and Macro Economics.

Module II: Demand Analysis (10 Hours)

Theories in Demand, Derivation of demand, types, Environment influencing demand; Elasticity of Demand; Advertising or promotional Elasticity; Demand forecasting ; Demand forecasting for new products, Demand Estimation for consumer durables and non-consumer durables.

Module III: Production And Cost Analysis (15 Hours)

Production Function; Law of variable proportions, Production with two variable inputs; Cost Analysis: concept, importance, types – Real opportunity, Money, Fixed, variable, Direct, indirect, Explicit, implicit, past, future, controllable and uncontrollable, Escapable, inescapable, urgent, potable cost, Replacement and Historical cost, Total Average and Marginal cost in short Run – and Long Run curve; Revenue - Concepts, definition, types-Total, Average, Marginal and relationship with AR and MR

Module IV: Market Structure (13 Hours)

Concept, meaning and classification of Market; Perfect competition-features and price determination; Monopoly – definition, features, types and price determination; Monopolistic competition-meaning, concept, types, price determination and defects; Pricing - types, cost pulls, going rate, Intuitive, Imitative, Marginal cost, Pioneering, Transfer pricing; Price discrimination – Definition, Concept, meaning, types, conditions, Dumping and socio – economic consideration in pricing; Firm objectives, staff, sales and growth Maximization.

Module V: Business Cycle (13 Hours)

Business cycle–cobweb, Hick’s Samuelson Theories of Trade cycle; Measures to control Business Cycle; Inflation; Deflation; Economic effects on production distribution and employment, remedies demand full v/s cost push Inflation; Monetary and fiscal policies objectives, role and impact on economic development, Concept of sustainable development, consumption and its inclusive growth.

COURSE/LEARNING OUTCOMES

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

- CO1:** Understand the scope of managerial economics. **CO2:** State the difference between demand and supply. **CO3:** Outline the determinants of demand.
- CO2:** Outline the determinants of supply and estimate elasticity of supply.
- CO3:** Summarize the concept of production function and relate it with economies and diseconomies of scale.
- CO4:** Explain the various kinds of production functions. **CO7:** Estimate cost of production of firms.
- CO5:** Summarize and evaluate fiscal policy and monetary policy to control inflation. **CO9:** Describe Balance of Payments and its various components.
- CO6:** Outline various Open macro-economic concepts

Suggested Readings

1. Koutsiyannis, A., Modern Microeconomics, Macmillan Press Ltd.
2. Varian, Micro-Economic Analysis , Norton.

3. Pindyck Robert S., Daniel L. Rubinfeld and Prem L. Mehta, Micro Economics, Pearson Education Asia, New Delhi.
4. Branson William H., Macro Economics Theory and Policy, First East – West Press.
5. Dornbusch, R. and S. Fischer Macro Economics , Publisher Tata McGraw Hill.
6. Oliver Blanchard ,Macro Economics, Pearson Education, LPE.

CMAG0045: COST AND MANAGEMENT ACCOUNTING

(4 credits-60 hours)

Objectives:

- *To understand the different concepts of cost, costing and cost accounting and their practical application in real world scenario.*
- *To provide in-depth knowledge of the detailed procedure and documentation involved in cost ascertainment systems.*

Module I: Introduction to Cost and Management Accounting (10 Hours)

Concepts of Costs; Classifications and Elements of Cost; Cost Centre and Cost Unit; Methods and Techniques of Costing; Installation of a Costing System.

Module II: Management Accounting (10 Hours)

Tools and Techniques of Management Accounting; Relationship of Cost Accounting, Financial Accounting, Management Accounting and Financial Management; Conflicts in Profit Vs Value Maximisation Principle; Role of Management Accountant in Decision Making.

Module III: Material Cost (10 Hours)

Materials Control – Concept and Techniques; Stock Verification; Methods of Pricing of Material: FIFO, LIFO, Simple Average, Weighted Average; Inventory Management: Techniques of fixing of minimum, maximum and reorder levels, Economic Order Quantity, ABC Analysis ; Stock Verification and Perpetual Inventory.

Module IV: Activity Based Costing (Abc) And Cost Records (10 Hours)

ABC Vs Traditional Costing; Uses and Limitations; Cost Ledgers – Integrated Accounts and Non-Integrated Accounts; Reconciliation of Cost and Financial Accounts.

Module V: Costing Systems (20 Hours)

Unit and Output Costing; Job Costing: Job Cost Cards, Collecting Direct Costs; Batch Costing: Features and Applications; Contract Costing: Features, Distinction between Job and Contract Costing, Contract Accounts, Accounting for Material, Accounting for Plant Used in a Contract; Process Costing: Features, Applications and Types of Process Costing; Joint Products, By-Products; Service Costing: Features and Applications; Unit Costing and Multiple Costing.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning of cost, costing and cost accounting. (Remembering)
- CO2:** Illustrate the application of management accounting. (Understanding)
- CO3:** Identify the detailed procedure and documentation involved in cost ascertainment system. (Applying)
- CO4:** Compare profit maximization and wealth maximization as an objective to financial management. (Analysing)

CO5: Interpret the effective techniques for inventory control. (Evaluating)

CO6: Estimate cost of production under different situations. (Creating)

Suggested Readings

1. Arora, M. N., "Cost and Management Accounting", Vikash Publishing House, New Delhi.
2. Zad, N. S., " Cost and Management Accounting", Taxman, New delhi.
3. Aggarwal, P., "Cost and Management Accounting", Bharat Law House, New Delhi.
4. Banarjee, H., "Cost and Management Accounting", Prentice Hall India Pvt, Ltd, New Delhi.

CMRC0046: RESEARCH METHODOLOGY IN COMMERCE

(4 credits-60 Hours)

Objective: This course is designed to provide students with the necessary skills and knowledge to determine the information necessary to address an identified research problem (basic or applied) and, using this understanding, develop and use an actionable research proposal. In this process, the students will gain an understanding of relevant approaches and elements of undertaking a research enquiry specifically to provide insights to solving a relevant problem.

Module I: Introduction to research (10 Hours)

Concept and nature, objectives, criteria of a good research, social science research, business research, approaches to research-qualitative and quantitative research, types of research; case study research, research methodology, difficulties of social science research in India.

Module II: Research design (8 Hours)

features of a good research design; research problem: definition, Components, selection and formulation of research problem; formulation of hypothesis, research design: types, research design for experimental exploratory and descriptive research.

Module III: Sampling design (8 Hours)

Meaning, significance; sampling process; principles of sampling essentials of a good sample, methods of sampling; determination of sample size.

Module IV: Data collection (8 Hours)

Meaning, types, methods; Sources of data-Use of secondary data-Methods of collecting primary data-Observation-Interviews-Questionnaires and Schedules.

Module V: Processing and Analysis of Data (8 Hours)

Processing Operations –Types of Analysis-Presentation and Interpretation of Data- Editing, Classification and Tabulation-Interpretation.

Module VI (8 Hours)

Preparation of a Report-Types of Report-Research Report-Format-Principles of Writing Reports-Documentation-Foot noters and Bibliography.

Module VII (10 Hours)

Quantitative Tools-Measures of Central Tendency-Dispersion-Measures of Correlation- Simple and Multiple Correlation-testing of Hypothesis-Tests based on t-P, Z and Chi square-Time Series Analysis-Trend Measurement-Moving Averages.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define and tell why research and its methodology are important. (Remembering)
- CO2:** Explain the use of methodology in understanding the process of research. (Understanding)
- CO3:** Identify the sources of data and apply various data collecting techniques. (Applying)
- CO4:** Classify, analyse and draw inferences from Data. (Analysing)
- CO5:** Justify the use of various methods in evaluating data. (Evaluating)
- CO6:** Design methodology specific to the study under consideration. (Creating)

Suggested Readings

1. C.R Kothari, Research Methodology: Methods and Techniques, New Age International,
2. Srivastava, S. C. : Foundation of Social Research and Economics Techniques, Himalaya Publishing House, 1990.
3. Sharma H.D. and Mukherji S. P: Research Methods in Economics and Business, New York : The Macmillan Company, 1992.
4. M Saunders, Philip Lewis and Adrian Thornhill, Research Methodology for business students, Pearson Education
5. V.P Michael, Research Methodology in Management, Himalaya Publishing House

CMBE0047: BUSINESS ENVIRONMENT

(3 credits– 45 hours)

Objective: To apply relevant knowledge, skills and exercise professional judgement in understanding the macro environment in which a business organisation operates. The course would also make the students capable of analysing and understanding policies of the government implemented from time to time and assess their impact on business

Module I: Business Environment (9 classes)

Concept, Components and importance; Indian Business Environment; Cultural, social, political, technological, economic and legal environment; scanning techniques of environmental forecasting; SWOT- Internal environment -their impact on policy formulation.

Module II: Economic trends (9 classes)

Economic reforms in India –Liberalization, privatization and globalization; Competitive Strength of Indian industry; Impact of liberalization policy on different sectors; Foreign Investments policy in India.

Module III: Multinational Corporations (8 classes)

Multinational corporations and their participation in India; strategies of multinational corporations; competitive strengths policies and performance.

Module IV: Business Ethics and Social Responsibilities (9 classes)

Business ethics and social responsibilities; relationship between business and society; Corporate power social accountability; Ethical issues and values in business; Corporate Social policies - issues and challenges; Ecological and environmental issues.

Module VI: Economic Development of North Eastern Region (10 classes)

Special package for economic development of north eastern region; DONER and its role in economic development, infrastructure and industry; North East Industrial Policy- promotional measures for cross-border trade, Role of NEC and NEDFI.

Problems and prospects of the industry in Assam, Brief study of the tea industry, paper industry, food processing industry, silk industry and bell metal industry; tourism industry.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define economic systems in depth (Remembering)
- CO2:** Outline how an entity operates in a business environment (Understanding)
- CO3:** Identify the role of Public and Private sector in the business environment (Applying)
- CO4:** Examine the trade environment in details (Analysing)
- CO5:** Explain the impacts of Government policy on the economic environment (Evaluating)
- CO6:** Elaborate the various trade blocs and the role of WTO (Creating)

Suggested Readings

1. Wheelen, Concepts of Strategic Management and Business policy, Pearson Education, New Delhi.
2. Swabera Islam & Kharkongor; Business Environment, Taxman's Publication, New Delhi.
3. S.K. Misra, V.K. Puri; Indian Economy, Himalaya Publishing House, Mumbai.
4. Deepashree, Indian Economy, Tata McGraw Hill, New Delhi.
5. Rnddar Dutta and KPM Sundaram, S. Chand & Co. Ltd., New Delhi.
6. A.N. Agarwal, Indian Economy, New Delhi.
7. Kazhmi Azhar , Business Policy,
8. Gupta, Liberalisation - its impact on Indian Economy, Macmillan.

CMBL0048: BUSINESS LAW

(3 Credits- 45 hours)

Objectives: *The objectives of this course is to enable students have a detailed understanding of the Indian Contract Act, 1872, The Companies Act, The partnership act. The course also aims at giving the students in depth knowledge about the Negotiable Instruments Act 1881.*

Module I: The Indian Contract Act, 1872

- a) Proposal- its communication, acceptance and revocation; Agreement vis-à-vis contract, void agreement & voidable contract
- b) Consideration – essential elements, exception to rule- No consideration no contract; privity of contract and consideration
- c) Capacity to contract; Free consent – coercion, undue influence, misrepresentation, fraud; Mistake – of fact and of law
- d) Legality of object – agreements opposed to public policy and in restraint of marriage, trade & legal proceedings; Contingent contracts
- e) Performance of contract–liability of joint promisor; Consequences of breach of contract–liquidated damages and penalty
- f) Quasi contract; Indemnity and guarantee–surety's liability
- g) Bailment–Duties and liabilities of bailor and bailee, bailment of pledges;
- h) Agency–types of agency, agents duty to principal and vice-versa, ratification and revocation of agent's authority

Module II: The Companies Act, 1956

- a) Meaning, characteristics and kinds; Lifting the corporate veil; Registration and incorporation; Memorandum of Association–alteration therein
- b) Doctrine of Ultra Vires–consequences of ultra vires transaction
- c) Articles of Association–alteration therein, its relation with memorandum of Association; Rule of constructive notice; Doctrine of Indoor Management; Prospectus- liability for misstatement, statement in lieu of prospectus
- d) Shares–statutory restrictions, kinds of share capital; Debentures
- e) Directors- Position, Appointment, Removal, Power & Duties, their responsibility for offence under N.I. Act & I.T.Act,2000
- f) Meetings; Majority Powers and Minority Rights; Prevention of Oppression and Mismanagement
- g) Winding up-liability under N.I.Act, Winding up by order of court and subject to its supervision; Voluntary winding up; Conduct of winding up

Module III: The Partnership Act, 1932

- a) Nature of Partnership; Relation of partners-inter se; Relation of partners to third parties; Incoming and outgoing partners
- b) Dissolution of Firm; Registration of Firms-effect of non-registration c) Offences by Firm-liability under N.I. Act & I.T. Act, 2000

Module IV: The Negotiable Instruments Act, 1881 - As Amended by The Negotiable Instruments(Amendment and Miscellaneous Provisions) Act, 2002

- a) Notes, Bills and Cheques-Promissory notes, Bills of exchange and cheques (Demand drafts, payment orders etc.);Drawer, Drawee, Acceptor, Holder, Holder in due course, payment in due course
- b) Endorsement-Endorsement in blank and endorsement in full, conversion of endorsement in blank into endorsement in full and its effects
- c) Negotiation; Presentment-At sight, on presentment, after sight, presentment for payment; Maturity-Calculating its period; Noting and protest-Protest for better security; Presumption as to negotiable instruments-and estoppel; Cross Cheques- Cheques crossed generally and specially;Of penalties in case of Dishonour of certain cheques for insufficiency of funds etc.; Offences by companies

COURSE/LEARNING OUTCOMES

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

- CO1:** Relate with the legal environment that is influencing business functioning. (Remembering)
- CO2:** Illustrate proper perspective about legal environment for better decision making. (Understanding)
- CO3:** Identify the legal provisions in the formation of a company and partnership. (Applying)
- CO4:** Examine the validity of any contract as per the law. (Analysing)
- CO5:** Interpret the uses and application of the various negotiable instruments. (Evaluating)
- CO6:** Formulate a valid contract with all legal provisions and conditions. (Creating)

Suggested Readings

1. A.K. Majumdar & G.K. Kapoor ,Company Law & Practice, Taxmann Publication
2. Vijay Gupta, K.C. Garg ,Company Law, Kalyani Publishers
3. Auler, Company Law- Singh, Eastern Book Company, Lucknow.

CMFI0049: CORPORATE FINANCE**(4 credits – 60 hours)**

Objectives: *The main objective of the course is to provide the conceptual background for corporate financial analysis from the point of corporate value creation. The course develops theoretical framework for understanding and analysing major financial problems of modern firm in the market environment.*

Module I: Introduction to Corporate Finance (15 hours)

Objective of Corporate Finance; Role of finance manager in corporations; types of firms; stock markets; financial institutions; Financial Statement Analysis: Balance Sheet analysis, Income Statement analysis, Cash Flow statement; Case Study - Enron

Module II: Investment Decisions (10 hours)

Net Present Value (NPV) rule; Payback rule; Internal Rate of Return (IRR) rule; Modified Internal Rate of Return; Choosing between projects; Capital Budgeting process; Forecasting Incremental Earnings; Break even Analysis; Scenario analysis; Options in Capital Budgeting – Delay, Expand, Abandon

Module III: Stock Valuation (20 hours)

Models of Stock Valuation; Dividend Discount Model; Discounted Cash Flow Model; Comparable Companies Analysis; Systematic Risk vs Equity Risk; Measuring Systematic risks; Beta; Capital Asset Pricing Model (CAPM); Cost of Capital: Weighted Average Cost of Capital (WACC), Cost of Debt, Cost of Equity, Using WACC to value a project.

Module IV: Long Term Financing (15 hours)

Equity financing for Private Companies; Initial Public Offerings (IPO); Case Study – Google’s IPO; Debt Financing: Private Debt and Public Debt, Bond Covenants, Repayment Provisions; Capital Structure: Capital Structure Choices, Capital Structure in Perfect Capital Markets, Modigliani and Miller (MM) Model, Debt and Taxes.

COURSE/LEARNING OUTCOMES

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

- CO1:** Explain the basic tools and concepts necessary to understand modern financial theory and its application in corporations. (Understanding)
- CO2:** Apply capital budgeting tools for evaluating investments. (Applying)
- CO3:** Analyse the relationship between capital structure, risk and shareholder value using the Modigliani Miller Theorems. (Analysing)

Suggested Readings

1. Berk and DeMarzo : Corporate Finance, Pearson.
2. Brealey, Richard/ Myers, Stewart C. / Allen, Franklin :Principles of Corporate Finance, McGraw Hill.
3. Aswath Damodaran : Investment Valuation, John Wiley.

CMPG0050: PRINCIPLES OF MARKETING

(4 credits – 60 hours)

***Objective:** To apply relevant knowledge, skills and exercise professional judgement in selecting and applying marketing principles and concepts in different business contexts and to contribute to the evaluation of the performance of an organisation and its strategic and operational development.*

Module I: Introduction to Marketing (12 classes)

Marketing in the Twenty-First Century; The Impact of the New Economy; Change in Customers; Changes in Business Scenario; Marketing Objectives; Marketing Environment; Marketing Mix; Elements of Marketing Mix, Product Mix, Price Mix, Promotion/Communication Mix, Place Mix/ Distribution Mix; Significance of Marketing Mix; Factors Affecting Marketing Mix; Growth & Future of marketing in India.

Module II: Product, and Product Brand Management (12 hours)

Definition, Features, Characteristics and Classification of Product; Product Life Cycle definitions, Stages of the Product Life Cycle; Implications of the Product Life Cycle Concept; Types of New Products; Challenges to New Product Development; Steps in the Development of the New Product; Introduction, Objectives, Problems and Process of Test Marketing; Introduction to Product Brand, Definition of Product Branding, Purpose of Branding, Features of Good Brands, Significance and Importance of Branding, Branding in a new economy.

Module III: Pricing and Promotion Decision (12 Classes)

- a) Pricing Decisions; Concept of Price; Significance of Pricing; Factors Affecting Pricing Decisions; Major Pricing Methods; Pricing Policies and Strategies; Geographical Pricing, Product Line Pricing, Discounts and Rebates.
- b) Meaning and Nature of Promotion, Importance of Promotion, Communication Process, Concept of Integrated Marketing Communication, Meaning of Promotion Mix, Elements of Promotion Mix (Methods of Promotion), Factors Influencing Promotion Mix Decisions, Promotion Mix Strategies, Communication Planning and Control.

Module IV: Distribution and Retailing (12 Classes)

- a) Channels of Distribution: Meaning of a Channel of Distribution, Importance of Channels of Distribution, Types of Distribution Channels, Choice of a Channel of Distribution, Functions of Distribution Middlemen, Distribution Strategies, Wholesaling.
- b) Meaning of Physical Distribution, Importance of Physical Distribution, Elements of Physical Distribution, Marketing Logistics Decisions.
- c) Meaning of Retailing, Functions and Services of Retailers, Types of Retailing; Malls and major markets; FDI in retail market; Management of Retailing Operations: An Overview, Retailing in India – Changing Scenario.

Module IV: Rural Marketing, Consumer Protection and Developments In Marketing (12 Classes)

- a) Growing Importance of Rural Markets, Distinguishing Characteristics of Rural Markets, Understanding Rural Consumer and Rural Markets, Marketing Mix Planning for Rural Markets.
- b) Consumer Protection, Need for Consumer Protection, Measures for Consumer Protection, Consumerism – Evolution, Meaning and Approaches, Laws to Protect Interests of Consumers.

- c) Recent Developments in Marketing, Social Marketing, Direct Marketing, Online Marketing, Relationship Marketing, Green Marketing, Marketing Ethics, Sustainable Marketing, Marketing of Services.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define and explain marketing mix models in workplace and contribute to organisational growth (Remembering and Understanding)
- CO2:** Assess the impact of product and brand management decisions on organizational performance (Applying)
- CO3:** Examine the effectiveness of pricing and promotion decisions (Analysing)
- CO4:** Determine appropriate distribution and retailing strategies in improving organisational performance (Evaluating)
- CO5:** Elaborate the Rural Marketing initiatives and Developments in Marketing (Creating)

Suggested Readings

1. C.B. Gupta, Principles of Marketing, Sultan Chand & Sons.
2. Philip Kotler, Marketing Management, Pearson Education, New Delhi.
3. S. A. Sherlekar, Marketing Management, Himalaya Publishing House, Mumbai.
4. A. Kumar & Meenakshi, Marketing Management, Vikas Publishing House, New Delhi.
5. R. Saxena, Marketing, Himalaya Publishing House, Mumbai.

CMBS0051: INTERNATIONAL BUSINESS

(4 credits – 60 hours)

***Objective:** This course provides an overview of the environment, concepts, and basic differences involved in international business.*

Module I: Introduction to Global Business (15 hours)

Global Business: Scope, Global Linkages today; Culture and Global Business: Elements of culture, Training Challenge; Global Trade and Investment Theory: Mercantilism, Classical Trade Theory, Factor Proportion Theory, International Trade and Product cycle theory, Theory of International Investments; Structure of Indian Foreign Trade: Composition & direction; EXIM Bank; Exit Policy of India; Regulation and Promotion of Foreign Trade.

Module II: Global Financial Markets (15 hours)

Foreign exchange markets; Fixed and Floating Foreign exchange rates; Significant monetary events; Exchange rates, interest rates and economic policy; Economic Integration; Government Trade Policies.

Module III: Global Business Environment (15 hours)

Private International Law; Public International Law; Risk to Global Business; Doctrine of Sovereign Immunity; Doctrine of Eminent Domain; Labour Law Differences; Theoretical foundations of International Business; Balance of Payments; International Liquidity; International Economic; Accounting and Tax differences; Multinational Corporations; Foreign Direct Investment.

Module IV: International Finance (15 hours)

Financing exports and imports; International Capital and Cash Management; Capital Structure: International Dimensions; International Capital Markets; International Banking and Security Markets; IMF; World Bank; IFC; ITA; ADB; WTO.

COURSE/LEARNING OUTCOMES

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

- CO1:** Describe the foundation of international business.
- CO2:** Describe international organizations and multinational corporations.
- CO3:** Define forms of foreign involvement.
- CO4:** Discuss international trade theory.

Suggested Readings

1. Rakesh Mohan Joshi: International Business, Oxford University Press.
2. FRANCIS CHERUNILAM: International Business: Text and Cases, PHI Learning.

CMSH0052: STRATEGIC HUMAN RESOURCE MANAGEMENT

(4 credits – 60 hours)

Objective: *The objective of this course is to develop within the students the understanding of the student with relevant concepts, roles and challenges related to strategic human resource management practices in the workplace and design the requisite skills to be competent contributors in the organization's strategic decision making process and make them competent to for various managerial and administrative positions in different organizations.*

Module I: Introduction to Strategic Human Resource Management (12 hours)

Introduction, Strategy, Hierarchy of Strategy, Corporate Level Strategy, Business Level Strategy, Functional Level Strategy, Strategic HRM, Emergence of Strategic Human Resource Management (SHRM), The Evolutionary Stages of Strategic HRM, Difference Between Traditional HR and Strategic HR, Case study

Module II: Concepts of Strategic Human Resource Management(12 hours)

Introduction, Trends in Strategic Human Resource Management, HR Practitioners Role, Human Resource as Competitive Advantage, Aims of Strategic HRM, Approaches to Strategic HRM, Formulation of HR Strategies, The Classical Sequential Approach, The Empirical Need-based Approach, Achieving Strategic Fit, Problems in Achieving Strategic Fit, Benefits of Strategic HRM, Barriers to Strategic HRM, Case study

Module III: Human Resource Strategies and its Implementation(12 hours)

Introduction, HR Strategies, Types of HR Strategies, Overarching Strategies, Specific HR Strategies, Criteria for an Effective HR Strategy, Developing HR Strategies, Methodology for Formulating HR Strategies, Setting Out the Strategy, Conducting a Strategic Review, Implementing HR Strategies
Barriers to the Implementation of HR Strategies, Overcoming the Barriers, Case study

Module IV: Roles in Strategic Human Resource Management (12 hours)

The Strategic Role of Top Management, The Strategic Role of Front-line Management, The Strategic Role of the HR Director, The Strategic Role of the HR Specialists, The New Mandate for HR, The Specific Strategic Roles of HR, Business Partner, The Innovation Role, The Change Manager Role, The Implementer Role, Case study

Module V: Challenges in Strategic Human Resource Management (12 hours)

Introduction, The Challenges of Workplace Diversity, The Management of Workplace Diversity, Managing Diverse Workforce in an Organisation, Planning a Mentoring Program, Organising Talents Strategically, Retention Strategy, Talent Management Strategy and its components, Approaches to

Human Resource Planning, Managing Executive Information Systems, Challenges for HR Managers, HRM Strategic Challenges, Case study

COURSE/ LEARNING OUTCOMES:

After learning this course, the students will be able to:

- CO1:** Define the hierarchy of strategy, classify between traditional HR and strategic HR. (Remembering)
- CO2:** Explain the factors behind the emergence of strategic human resource management (Understanding)
- CO2:** Choose the aims of strategic HRM, interpret the various approaches to strategic HRM and identify the barriers in implementing HR strategies (Applying)
- CO3:** Analyse the concept of HR strategies, explain the approaches of developing HR strategies and analyse the ways in which HR strategies can be implemented (Analysing)
- CO4:** Analyse the strategic role of the HR director, determine the strategic role of the HR specialists and design the new mandate for HR
- CO5:** Evaluate the various approaches to motivation, develop the retention strategy and flexibility strategy that should be adopted by an organisation (Creating)

Suggested Readings:

1. Deb Tapomoy , Strategic Approach to Human Resource Management Concept, Tools and Application, Atlantic Publishers & Distributors Pvt Ltd.
2. Nayantara Padhi, Strategic Human Resources Management: Theory and Practice, Atlantic Publishers and Distributors Pvt. Ltd; 1 edition
3. Mello Jeffrey A., Strategic Management of Human Resources, Cengage Learning, 3rd edition
4. Sharma A, Khandekar A, Strategic Human Resource Management – An Indian Perspective, SAGE Publications
5. Schuler, R. S., & Jackson, S. E., 2009, Strategic Human Resource Management.2nd ed., Wiley-India
6. Sharma, A and Khandekar, A., 2006, Strategic Human Resource Management: an Indian perspective.1st ed., Response Books.

CMCR0053:CONSUMER BEHAVIOUR

(4 credits – 60 hours)

Objective: *The objective of this course is that the students should be able to understand the different concepts of consumer behaviour, implications of motivation, personality, perception, learning in marketing, role of social and cultural settings on consumer behaviour and consumer buying process and will make them competent for taking responsible positions in the area of marketing in different organizations.*

Module I: Contemporary Dimensions of Consumer Behaviour (12 hours)

Consumer Behaviour, Consumer Decision-Making, Models of Consumer Decision –Making, Types of Consumer Buying Behaviour, Factors influencing Consumer Behaviour, Market Segmentation, Segmentation of Consumer markets, Positioning, Differentiation and Marketing Mix, Marketing Research;Consumer Research Process, Types of Research Methods.

Module II: Marketing implications of Motivation, Personality and Perception (12 hours)

Motivation and its Marketing Implications, Personality and its Marketing Implications, Brand Personality, Personality and self Image, The Concept of Perception, Perception and its Impact on Marketing strategies

Module III: Application of Learning Principles in Marketing (12 hours)

Consumer Learning, Concept of Conditioning, Important Aspects of Information Processing Theory, Split-Brain Theory, Measures of Consumer Learning

Module IV: Implications Social and Cultural Settings on Consumer Behaviour (12 hours)

Influence of culture and Subculture on Consumer Behaviour, Influence of Social Class on Consumer Behaviour, Social Stratification and Marketing Strategy, Group Influence on Consumer Behaviour, Household and Family Influence on Consumer Behaviour, Socialisation of family Members, Family Purchasing Decision-Making and Consumption Related Roles, family Life Cycle.

Module V: Consumer Buying Process (12 hours)

Stages of Consumer Buying Process, Purchase Decision and Post Purchase Behaviour, Traditional and Contemporary Models of Consumer Behaviour; Case study

COURSE/ LEARNING OUTCOMES:

After learning this course, the students will be able to:

- CO1:** Define the consumer behaviour, relate the various marketing implications select the learning principles in marketing, find the influence of culture and subculture on consumer behaviour and define the stages of consumer buying process (Remembering)
- CO2:** Explain the models of consumer decision process, interpret the concepts of motivation, personality and perception with reference to consumer buying behaviour, relate the concept of conditioning in consumer buying (Understanding)
- CO3:** Apply the factors influencing consumer behaviour in developing marketing strategies, identify the impact of personality and perception on marketing strategies, choose the important aspects of information processing theory, make use of social stratification to develop marketing strategy, identify purchase decision and post purchase behaviour in varied marketing situations (Applying)
- CO4:** Analyse market segmentation and segmentation of consumer markets, classify the types of brand personality, analyse the split-brain theory, compare the various types group influence on consumer behaviour and analyse traditional and contemporary models of consumer behaviour (Analysing)
- CO5:** Assess the positioning strategies on buying behaviour, determine the relationship between personality and self image, evaluate the relationship between traditional and contemporary models of consumer behaviour (Evaluating)
- CO6:** Discuss the types of research methods, Elaborate the measures of consumer learning and design strategies for influencing family purchasing decision-making and the consumption related roles (Creating)

Suggested Readings:

1. Blackwell, Roger D, Paul W Miniard and James F Engel, Consumer Behaviour, Thomson Learning Inc., 2002
2. Duhan S.N., GarimaSahni N.K. , Consumer Behaviour, 1st edition, 2016, Kalyani Publishers
3. Loudon, David I., and Albert J. Della Bitta, Consumer Behaviour, Tata McGraw Hill, New Delhi
4. Schiffman, Leon G., and Leslie Kanuk, Consumer Behaviour, Prentice Hall, New Delhi
5. Schiffman, Kanuk L L., S Ramesh Kumar, Consumer Behaviour, 10th edition, Pearson
6. Dheeraj Sinha, Consumer India Inside the Indian Mind and Wallet, 2011, Jain Book Depot

SPECIALISATION: ACCOUNTING AND TAXATION

CMTM0054: CORPORATE TAX MANAGEMENT

(4 Credits-60 Hours)

Objectives:

- To familiarize students with corporate tax planning.
- To cram the process of computation of tax for companies.
- To identify the process of business reorganization in terms of tax planning

Module I: Introduction of Tax Planning and Management: (5 Hours)

Tax planning, tax management, tax evasion and tax avoidance; Nature and scope of tax planning and tax management in the corporate sector.

Module II: Assessment of Companies' Tax Management: (15 Hours)

Residential Status and incidence of tax, Computation of corporate tax: Carry forward and set off of losses in the case of certain companies under Sec. 79 of Income-tax Act, 1961; various deductions available to corporate assess.

Module III: Tax Computation of Companies (15 Hours)

Computation of taxable income of companies; Computation of amount of corporate tax liability; Minimum Alternate Tax; Tax on distributed profits of domestic companies; Tax on income distributed to unit holders.

Module IV: Tax Planninga Specific Tax Management Decisions (10 Hours)

Implications of Tax concessions and incentives for corporate decisions in respect of setting up a new business, location of business and nature of business.

Module V: Business Reorganisation (15 Hours)

Tax Planning in respect of amalgamation or de-merger of companies ,Slump sale, conversion of a firm into a company; Conversion of sole proprietorship into company, Conversion of company into limited liability partnership.

COURSE/LEARNING OUTCOMES:

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

- CO1:** Define the concept of tax management.(Remembering)
- CO2:** Compare between tax planning and tax management.(Understanding)
- CO3:** Identify the tax planning process of companies. (Applying)
- CO4:** Analyse various tax incentive plans for corporate sector.(Analysing)
- CO5:** Measure tax planning in case of amalgamation or de-merger. (Evaluating)
- CO6:** Adapt the concept of limited liability partnership.(Creating)

Suggested Readings:

1. Srinivas, E.A, Corporate Tax Planning, Tata McGraw Hill, New Delhi.
2. Singhanian, Vinod. K, Taxmann's Direct Taxes, Law & Practice, Taxman, New Delhi.
3. Ahuja. Girish & Gupta, Ravi, Bharat's Professional Approach to Direct Taxes, Law & Practice, Bharat Law House Pvt. Ltd., New Delhi.
4. Bhagmati Prasad, Direct Taxes And Laws And Practice, WishwaPrakashan, New Delhi

CMAF0055: ACCOUNTING THEORY AND FINANCIAL REPORTING

(4 Credits-60 Hours)

Objectives:

- *To provide knowledge about the notion of accounting theory.*
- *To enable students to learn the reporting aspect of specific accounting standards.*
- *To identify the key issues in corporate financial reporting.*

Module I: Accounting Theory (15 Hours)

Nature; Classifications of Accounting Theory; Different Approaches to Theory Construction; Factors Influencing Accounting Environment; Measurement in Accounting; Accounting Principles: Generally Accepted Accounting Principles; Indian Accounting Standards.

Module II: Reporting of Explicit Accounting Standards (10 Hours)

AS-1: Disclosure of Accounting Principles; AS-6: Depreciation accounting; AS-9: Revenue Recognition; AS-27: Financial Reporting of Interests in Joint Ventures; AS-29: Provisions, Contingent Liabilities and Contingent Assets.

Module II: Financial Reporting (10 Hours)

Nature, Objectives and Benefits; General purpose and Specific Purpose Report; Qualitative Characteristics of Accounting Information; Conceptual Framework: Financial Accounting Standards Board (FASB) & International Accounting Standards Board (IASB).

Module III: International Financial Reporting Standards (Ifrss) (15 Hours)

Role of International Accounting Standards Board (IASB); Arguments for Global Convergence; Required Disclosure as per International Financial Reporting Standards; Achievements of International Accounting Standards Board (IASB) and Obstacles in Convergence; Difference between International Financial Reporting Standards (IFRSs) and Indian Accounting Standards; US GAAP.

Module IV: Issues in Corporate Financial Reporting (10 Hours)

Accounting for Changing Prices; Segment Reporting; Interim Reporting; Foreign Currency Translation.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the concept of accounting theory. (Remembering)
- CO2:** Compare various accounting standards (AS). (Understanding)
- CO3:** Apply the knowledge of IFRSs. (Applying)
- CO4:** Analyse the FASB and IASB. (Analysing)
- CO5:** Assess the issues in corporate reporting. (Evaluating)
- CO6:** Adapt the thought of segment reporting. (Creating)

Suggested Readings

1. Porwal, L.S, Accounting Theory, McGraw Hill Education (India) Ltd. New Delhi
2. Lal, Jawahar, Accounting Theory and Practice, Himalaya Publishing House, New Delhi.
3. Das, Arjun & Saxena, Vishal, Accounting Theory & Practice, Navyug Publications; 2nd edition, Uttar Pradesh.
4. Evans, Thomas G., Accounting Theory, South-Western, New Delhi.

SPECIALISATION: FINANCE AND INVESTMENT

CMCR0056: ADVANCED CORPORATE FINANCE

(4 credits – 60 hours)

Objectives:

The objective of this course is to equip students with the background to act as finance managers in organizations. This course develops theoretical framework for understanding and Analysing major financial problems of modern firm in the market environment.

Module I: Interest Rates and Valuation of Cash Flows (15 hours)

Introduction to Time Value of Money; Converting cash across time; Timelines; Finding the present value of a stream of cash flows; Finding the future value of a stream of cash flows; Perpetuity; Annuities – Present Value and Future Value; Growing Cash flows – Growing perpetuity and growing annuity; Determinants of Interest rates; Yield curves.

Module II: Bonds (20 hours)

Features of debt securities – Indenture and covenants, Maturity, Par Value; Coupon rates; Embedded options bonds; Risk associated with bonds – Interest rate risk, Yield Curve risk, Call and prepayment risk, Credit risk, Liquidity risk, Sovereign risk; Yield spreads; Valuation of Bonds; Measurement of Interest rate risk.

Module III: Capital Structure and Payout Policy (15 hours)

Capital Structure choices – Across industries and within industries; Leverage and firm value; Effect of leverage on risk and return; Homemade leverage; Leverage and cost of capital; Costs of Bankruptcy and financial distress – Direct and Indirect costs; Tradeoff theory of Optimal Capital Structure; Dividend versus share repurchase in perfect capital markets; Payout versus retention of cash; Signaling with payout policy; Dividends, splits and spinoffs.

Module IV: Mergers and Acquisitions (10 hours)

Background and trends; Rationale of a mergers and acquisition (M&A) deal; Steps in M&A deal; Takeover defences – Poison pills, Staggered Boards, White Knight, Golden Parachutes; Value added in a takeover.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Apply the concept of Time Value of Money for valuation of cash flows. (Applying)
- CO2:** Explain the determinants of interest rates. (Understanding)
- CO3:** Illustrate the features of debt securities. (Understanding)
- CO4:** Build valuation model for bonds. (Applying)
- CO5:** Explain Capital structure choices and its impact on the firm. (Understanding)
- CO6:** Explain the rationale and process of a Mergers and Acquisition deal. (Understanding)

Suggested Readings

1. Berk and DeMarzo: Corporate Finance, Pearson.
2. Brealey, Richard/ Myers, Stewart C. / Allen, Franklin: Principles of Corporate Finance, McGraw Hill.
3. AswathDamodaran: Investment Valuation, John Wiley.
4. Ross, Westerfield, Jordan: Fundamentals of Corporate Finance, McGraw Hill.

CMBK0057: INVESTMENT BANKING

(4 credits – 60 hours)

Objectives: *The objective of this course is to acquaint students with the various models of equity valuation. Students are expected to be proficient in the use of Microsoft excel for conducting a comparable company analysis and discounted cash flow valuation of a publicly traded company.*

Module I: Comparable Companies Analysis(15 hours)

Comparable companies analysis steps; Selecting the universe of comparable companies; Identifying key characteristics of target; Spread key statistics, ratios and trading multiples; Benchmarking comparable companies; Valuation implied by EV/EBITDA; Valuation implied by P/E; Pros and cons of comparable analysis.

Case study I: Valuation of a publicly listed company using comparable company analysis.

Module II: Discounted Cash Flow Analysis I (15 hours)

Summary of Discounted Cash Flow (DCF) analysis steps; Studying the target, Determination of key performance drivers; Financial statement analysis for valuation; Estimation of growth; Models for estimation of Cost of Equity – Capital Asset Pricing Model and Fama-French model.

Case study II: Valuation of a publicly traded company using Discounted Cash Flow model.

Module III: Discounted Cash Flow Analysis II(15 hours)

Estimation of cost of debt; Determination of Weighted Average Cost of Capital; Projection of Free Cash Flow; Determining Terminal Value- Exit Multiple method and Perpetuity growth method; Calculation of present value; Determination of Valuation; Pros and cons of DCF analysis.

Case study II (contd.): Valuation of a publicly traded company using Discounted Cash Flow model.

Module IV: Leveraged Buyouts(15 hours)

Meaning and objective of Leveraged Buyout (LBO); Rationale of LBOs in modern finance; Key participants; Characteristics of a strong LBO candidate; Economics of LBO; Exit and Monetizing strategies; LBO financing.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Explain different valuation models. (Understanding)
- CO2:** Distinguish between Comparable companies analysis model and Discounted cash flow model. (Analysing)
- CO3:** Apply the technique of comparable company analysis for valuation of companies. (Applying)
- CO4:** Build a Discounted Cash Flow model to value a subject company. (Applying)
- CO5:** Make use of Microsoft Excel for building valuation models. (Applying)
- CO6:** Explain the steps involved in the Leveraged Buyout process. (Understanding)

Suggested readings:

1. Rosenbaum and Pearl: Investment Banking, Wiley Finance.
2. E. Soubeiga: Mastering Financial Models, McGraw Hill.
3. J. Tija: Building Financial Models, McGraw Hill.
4. PratapGiri S: Investment Banking, McGraw Hill.

SPECIALIZATION: MANAGEMENT

CMIG0058: INTERNATIONAL MARKETING

(4 Credits – 60 hours)

Objective: To familiarize the students with the concept and issues of international marketing and enable them to be able to analyse the foreign market environment and develop international marketing strategies for a business firm.

Module I: Introduction: Introduction to International Business (14 hours)

An overview; International marketing management process, International marketing information system. International Marketing Environment: Influence of physical, economic, socio - cultural, political and legal environments on international marketing decisions; International marketing information system. International Market Segmentation, Selection and Positioning; International market entry strategies – Exporting, licensing, contract manufacturing, joint venture, setting -up of wholly owned subsidiaries abroad.

Module II: International Product Planning and Pricing decisions (14 hours)

Major Product decisions-product design, labeling, packaging, branding and product support services; Product standardization vs. adaptation; Managing product line; International trade product life cycle; New product development. Pricing decisions for International Markets: Factors affecting international price determination; International pricing process and policies; Delivery terms and currency for export price quotations; Transfer pricing; Counter trade as a pricing tool-types and problems of counter trading.

Module III- International Distribution Decisions (12 hours)

Distribution channel- from traditional to modern channel structures, Intermediaries for international markets-their roles and functions; Alternative middlemen choices, Factors affecting choice of channels; Locating, selecting and motivating channel members; International distribution logistics- Issues and Planning.

Module IV-International Promotion Strategies (12 hours)

Communications across countries-complexities and issues; Country -of-origin effect; Sales promotions in international markets, trade fairs and exhibitions, International public relations, International Advertising decisions, Personal selling and sales management; Developing international promotion campaign.

Module V- Emerging trends in International Marketing (8 hours)

International Marketing through Internet; Ecological concerns and international marketing ethics.

COURSE/ LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Define international marketing (Remembering)
- CO2:** Explain International Product Planning and Pricing decisions (Understanding)
- CO2:** Identify the traditional to modern channel structures, Intermediaries (Applying)
- CO3:** Analyse the international distribution decisions in terms of issues and planning (Analysing)
- CO4:** Evaluate the different aspects of international promotional strategies (Evaluating)
- CO5:** Elaborate the trends associated with international marketing in the present context (Creating)

Suggested Readings

1. Cateora, Philip R, Graham John L and Prashant Salwan, International Marketing, Tata Mc Graw Hill
2. Czinkota, Michael R. and Illka A. Ronkainen, International Marketing, Cengage Learning
3. International Marketing, P K Vasudeva, 4th edition, 2010, Excel Books , New Delhi.
4. Jain, Subash C., International Marketing, South-Western.
5. Keegan, Warran J and Mark C Green, Global Marketing, Pearson
6. Kotabe, Masaaki and Kristiaan Helsen, Global Marketing Management, John Wiley and Sons.
7. Onkvist, Sak and John J.Shaw, International Marketing; Analysis and Strategy, Psychology Press.
8. Rajagopal, International Marketing, Vikas Publishing House.
9. Terpstra, Vern; Foley, James and Ravi Sarathy, International Marketing, Naper Press.

CMBC0059: BUSINESS ETHICS AND CORPORATE GOVERNANCE

(4 Credits-60 Hours)

Objective: This paper aims at providing the students the understanding of ethical issues related to business and good governance necessary for long term survival of business.

Module I: Introduction (9 hours)

Definition & nature of business ethics, characteristics, ethical theories; causes of unethical behavior; ethical abuses; work ethics; code of conduct; public good.

Module II: Ethics Theory and Beyond (13 hours)

Management of ethics - ethics analysis [Hosmer-model]; ethical dilemma; ethics in practice, ethics for managers; role and function of ethical managers- comparative ethical behavior of managers; code of ethics; competitiveness, organizational size, profitability and ethics; cost of ethics in corporate ethics evaluation; business and ecological / environmental issues in the Indian context and case studies.

Module III: Legal Aspects of Ethics (10 hours)

Political – legal environment; provisions of the Indian constitution pertaining to business; political setup – major characteristics and their implications for business; prominent features of MRTP & FERA; social – cultural environment and their impact on business operations, salient features of Indian culture and values.

Module IV: Environmental Ethics (10 hours)

Economic environment; philosophy of economic growth and its implications for business, main features of economic planning with respect to business; industrial policy and framework of government contract over business; role of chamber of commerce and confederation of Indian industries.

Module V: Corporate Social Responsibility and Governance (15 hours)

Definition, evolution and need for CSR; theoretical perspectives; corporate citizenship; business practices; strategies for CSR; challenges and implementation; evolution of corporate governance; governance practices and regulation; structure and development of boards; role of capital market and government; governance ratings; future of governance- innovative practices; case studies with lessons learnt

COURSE/LEARNING OUTCOMES

After learning the course the students will be able to:

- CO1:** Define business ethics. (Remembering)
- CO2:** Distinguish between ethical and unethical behavior at workplace. (Analysing)

- CO3:** Elaborate the various theories on ethics in practice. (Creating)
- CO4:** Evaluate legal and economic aspects of ethics in business. (Evaluating)
- CO5:** Interpret the accountability hierarchy from a corporate governance perspective. (Understanding)
- CO6:** Design issues involved in addressing litigation risks in corporate governance and regulatory contexts. (Creating)
- CO7:** Examine ethical theories and frameworks to Analyse ethical dilemmas in business and resolve practical problems. (Analysing)
- CO8:** Identify different stakeholders and understand why they may hold differing perspectives on ethical issues. (Applying)

Suggested Readings

1. S.A. Sherlekar, Ethics in Management, Himalaya Publishing House.
2. William B. Werther and David B. Chandler, Strategic corporate social responsibility, Sage Publications Inc.
3. Robert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons.
4. W.H. Shaw, Business Ethics, Cengage Learning.
5. Beeslory, Michel and Evens, Corporate Social Responsibility, Taylor and Francis.
6. Philip Kotler and Nancy Lee, Corporate social responsibility: doing the most good for company and your cause, Wiley.
7. Subhabrata Bobby Banerjee, Corporate social responsibility: the good, the bad and the ugly, Edward Elgar Publishing.
8. Satheesh Kumar, Corporate governance, Oxford University, Press.

CMEM0060: ENTREPRENEURSHIP MANAGEMENT AND E-COMMERCE

(4 credits- 60 hours)

Objective: The students develop and can systematically apply an entrepreneurial way of thinking that will allow them to identify and create business opportunities that may be commercialized successfully.

Module I (15 Hours)

- a. Entrepreneurship: Definition, Concept, Growth and role. The Entrepreneur : Types, characteristics, theories of entrepreneurial class, Urges and importance of Entrepreneurship Stimulates; Seed Beds of Entrepreneurship, Influencing Factors; Problems (Operational and Non Operational) and Obstacles. Entrepreneurial Management. Role of socio economic environment.
- b. Skills for a New Class of Entrepreneurs; The Ideal Entrepreneurs; The Entrepreneurship Audit; Identification of opportunities by an Entrepreneur; The steps to identify the project/ventures; Process of converting business opportunities into reality; Feasibility Report and analysis; Process of setting up a small scale industry/unit.

Module II (15 Hours)

Promotion of a venture, External Environment Analysis; Economic, Social, Technological and competition; Legal Framework for establishing and fund raising Venture Capital: Sources and Documents required

Module III (15 Hours)

E-Commerce and Entrepreneurs; Exports and entrepreneurs. Balanced Regional Development and Entrepreneurs, relevant Acts for Entrepreneurs (An overview only); Foreign Exchange and Entrepreneurs; Micro and small enterprises; Recent Initiatives taken by the government to revitalize the Entrepreneurship.

Module IV (15 Hours)

- a. Introduction to E-commerce: Meaning and Concept of E-Commerce; Business Model for E Commerce; Sales and Marketing Cycle; Features of E Commerce; Element of E-Commerce; Benefits and Limitations of E-Commerce; Types of E-Commerce System; B2B, B2C, C2C, C2B, B2G andG2C.
- b. Electronic Payment systems : Features of an ideal electronic payment system; Types of an Electronic Payment System, Credit Cards, Debit Cards, Smart Cards, E-Money, E Check and Electronic fund transfer (EFT). Need of security in E Commerce; Essential security requirements for safe electronic payments; Security Schemes for an Electronic Payment Systems, Encryption, Digital Signature, Security Certificates; internet security Protocol, SSL, HTTP,SET.

COURSE/LEARNING OUTCOMES

- CO1:** Define entrepreneurship, its features and ability to discern distinct entrepreneurial traits (Remembering)
- CO2:** Illustrate the parameters to assess opportunities and constraints for new business ideas (Understanding)
- CO3:** Demonstrate the systematic process to select and screen a business idea (Understanding)
- CO4:** Choose the entrepreneurship as a career objective (Applying)
- CO5:** Analysing the legal framework to set up new ventures (Analysing)
- CO6:** Find the meaning and Concept of E-Commerce; Business Model for E Commerce (Remembering)
- CO7:** Discuss the entrepreneurial prospects in e-commerce (Creative)

SPECIALISATION: ACCOUNTING AND TAXATION

CMMD0061: MODERN ACCOUNTING

(4 Credits-60 Hours)

Objectives:

- *To provide knowledge about the various concept of accounting.*
- *To learn the application of various accounting concept.*
- *To categorize the key areas of modern accounting.*

Module I: Introduction to Modern Accounting (10 Hours)

Various concept of modern accounting: inflation accounting, environmental accounting, social accounting, forensic accounting and behavioural accounting; its application, process and its scope.

Module II: Inflation Accounting (10 Hours)

Meaning; techniques of inflation accounting; determination of value of assets and liabilities under inflation accounting; accounts preparation under inflation accounting.

Module III: Environmental Accounting (10 Hours)

Meaning; functions of environmental accounting; valuation process under environmental accounting, methods of evaluation under environmental accounting; accounts preparation under environmental accounting.

Module IV: Forensic Accounting (10 Hours)

Meaning; branches of forensic accounting; activities under forensic accounting; procedure of forensic accounting; stages of forensic accounting; application and consequences of forensic accounting.

Module V: Behavioural Accounting (10 Hours)

Meaning; process of behavioural accounting; application of behavioural accounting; techniques of behavioural accounting; influence of accounting information on behaviour.

Module VI: Social Accounting (10 Hours)

Meaning; purpose of social accounting; scope & objectives of social accounting; benefits & challenges of social accounting; accounting under social accounting.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the concept of modern accounting. (Remembering)
- CO2:** Compare various system of modern accounting. (Understanding)
- CO3:** Apply the knowledge of environmental accounting. (Applying)
- CO4:** Analyse behavioural accounting. (Analysing)
- CO5:** Assess the challenges in social accounting. (Evaluating)
- CO6:** Adapt the thought of forensic accounting. (Creating)

Suggested Readings:

1. Lal, Jawahar, Accounting Theory and Practice, Himalaya Publishing House, New Delhi
2. Pedneault, Stephen, Forensic Accounting and Fraud Investigation for Non-Experts, John Wiley & Sons; 3rd edition, New Delhi.
3. Pahuja, Shuchi, Environmental Accounting & Reporting: Theory, Law & Empirical Evidence, New Century Publications, New Delhi.
4. Hellmann, Andreas, Behavioural Accounting, Routledge; 1 edition, New Delhi.
5. Rao, P.M., Corporate Social Accounting and Reporting, Deep & Deep Publications Pvt.ltd, Delhi.

CMAV0062: ADVANCED ACCOUNTING

(4 Credits- 60 hours)

Objective: *The objective of this course is to provide advanced knowledge in the field of accounting. It stresses on specialised accounting processes followed in specific organisations. This course also gives insight into various modern concepts of Accounting.*

Module I: Conceptual Framework (10 credits)

Conceptual Framework in the preparation and presentation of Financial Statements: Objectives, Purpose, Constituents of Financial Statements, Underlying assumptions in the preparation of Financial Statements, Qualitative Characteristics and Elements of Financial Statements, Capital Maintenance Adjustments, Recognition of the elements of Financial Statements, Concept of Capital and Capital Maintenance, GAAP and Accounting Standards in India, Compliance Requirements of Accounting Standards in India, Applicability of Accounting Standards

Module II: Accounts of Banking Companies (15 credits)

Accounting of Banking Companies: Nature, Features of Banking Companies, Banking Regulation Act, 1949, Rebate on Bills Discounted, Income recognition, Statutory books to be maintained, special features of Bank book keeping, Preparation and presentation of Financial Statements of Banks, Advances and its classification, provisions to be made against advances.

Module III: Accounts of Insurance Companies and Insurance Claims (15 credits)

Accounting of Insurance Companies: Meaning of Insurance Business, Accounts of Life insurance company – Revenue Account, Profit and Loss Account and Balance Sheet, Ascertainment of profit under Life insurance business, Accounts of general insurance business – Revenue Account, Profit and Loss Account and Balance Sheet.

Insurance Claims: Average clause, indemnity period, procedure of ascertaining loss of stock and loss of profit, Ascertainment of claims against loss of stock and loss of profit.

Module IV: Investment Accounts and Liquidation of a company (15 credits)

Investment Account: Meaning, features, concept of cum-interest, ex-interest, cum-dividend, ex-dividend, Accounting for fixed interest learning securities and variable earning securities, bonus shares and right shares, Intercompany investment.

Winding up of a company: Meaning, winding up by National Company law Tribunal, Modes of Winding up, preferential payments, Preparation of Statement of Affairs, Liquidator's Final statement of Account.

Module V: Inflation and Government Accounting (5 credits)

Inflation Accounting: Meaning, Need, Objectives, Current Purchasing Power Method, Current Cost Accounting; Government Accounting: Meaning, features and Objectives of Government Accounting; difference between commercial accounting and Government Accounting; General Principles of Government Accounting; System of financial administration and financial control in India; Accounts keeping of the government; Classification of Accounts in Government Accounting; Accounting for Human Resources in an Organisation.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the recent concepts of accounting (Remembering)
- CO2:** Explain the conceptual framework in the preparation and presentation of financial statements (Understanding)
- CO3:** Identify the various modes of liquidation of companies (Applying)
- CO4:** Compare the accounting techniques followed under general and special processes. (Analysing)
- CO5:** Determine insurance claims from loss of profit and stock (Evaluating)
- CO6:** Compile financial statements of insurance and banking companies (Creating)

Suggested Readings:

1. JawaharLal, Financial Accounting, S Chand
2. Hanif& Mukherjee, Advanced Accounting, McGraw Hill Education.
3. B. B. Dam, Advanced Accounting, Capital Publishing Company
4. M. Y. Khan, Advanced Accounting M.C. Shukla, Advanced Accounting, S Chand & Co.
5. S. N. Maheshwari, Advanced Accounting, Vikas Publishing.

SPECIALISATION: FINANCE AND INVESTMENT**CMFI0063: FINANCIAL INSTITUTIONS MANAGEMENT****(4 credits – 60 hours)**

Objectives: *The objective of this course is to impart the knowledge of the banking, finance and insurance industry to the students. The student will be able to articulate the operations of each of this industry; understand the various potential conflicts of interests and analyse the regulatory structure of the industry.*

Module I: Banking (15 hours)

Commercial Banking; Capital requirements of Banks; Merchant Banking; Investment Banking; Securities trading; Potential conflicts of Interests in Banking; Large Banks and their implications; Risks in Banking

Case study: 2008 financial crisis

Module II: Insurance companies (15 hours)

Life insurance companies: size, structure, composition of industry, recent trends and regulations; Property-casualty insurance: size, structure, composition of industry, recent trends and regulation; Health insurance; Moral hazard and adverse selection; risks in insurance industry.

Module III: Financial services industry (15 hours)

Mutual funds: size, structure, composition of industry, types, objectives, costs, recent trends and regulations; Hedge funds: types of hedge funds, fees in hedge funds industry, offshore hedge funds, and regulation of hedge funds.

Module IV: Risk and regulation (15 hours)

Interest rate risk; Market risk; Credit risk; Off balance sheet risk; Foreign exchange risk; Sovereign risk; Technology and Operational risk; Liquidity risk; Insolvency risk; Liability and liquidity management; Deposit insurance; Basel norms: rationale, Basel I, Basel II, Basel III; Dodd-Frank Act.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Explain the operations of the banking industry. (Understanding)
- CO2:** Analyse the potential conflicts of interest in the banking industry. (Analysing)
- CO3:** Explain the operations of the Insurance industry. (Understanding)
- CO4:** Explain the operations of the financial services industry. (Understanding)
- CO5:** Outline the risks in the financial industry. (Understanding)
- CO6:** Analyse the regulatory framework in the banking and financial industry. (Analysing)

Suggested Readings

1. John C Hull: Risk Management and Financial Institutions, Wiley Finance Series.
2. Saunders: Financial Institutions Management, McGraw Hill.
3. Kohn: Financial Institutions and Markets, Oxford University Press.
4. Frank J Fabozzi, Franco Modigliani: Capital Markets – Institutions and Instruments, PHI Learning.

CMPN0064: PORTFOLIO MANAGEMENT

(4 credits – 60 hours)

Objective: *The objective of this course is to acquaint students with the portfolio perspective of investing. The student will be able to illustrate various risk and return objectives of investors and understand the justification of diversification in a portfolio.*

Module I: Introduction to Portfolio Management(15 hours)

Meaning and objectives; Portfolio Perspective on Investing: Diversification, Risk Aversion, Composition, Downside Protection, Modern Portfolio Theory; Investment Clients; Steps in Investment Management Process; Pooled Investments: Mutual Funds, Types of Mutual Funds, Other Investment Products.

Module II: Portfolio Risk and Return I (20 hours)

Investment Characteristics of Assets: Return, Return measures and their applications, Variance and Covariance of Returns, Historical Risk and Returns, Other Investment Characteristics; Risk Aversion and Portfolio Selection; Portfolio Risk; Efficient frontier; Investor's Optimal Portfolio; Capital Market Theory; Pricing of Risk: Systematic vs Nonsystematic Risk.

Module III: Capital Market expectations and Asset allocation (15 hours)

Economic Analysis: Business Cycle Analysis, Economic Growth Trends, International Interactions; Asset Allocation: Strategic Asset Allocation in relation to Systematic Risk, Strategic vs Tactical Asset Allocation; Asset Allocation and Investor's Risk and Return objectives; Selection of Asset Classes; Optimization Approaches; Implementing Strategic Asset Allocation.

Module IV: Investment Planning (10 hours)

Investment Policy Statement (IPS): Components, Gathering Client Information; Capital Market Expectations; Strategic Asset Allocation; Investment Instruments: Equity, Fixed Income, Mutual Funds, Real Estate, Insurance Investments.

LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Explain the Portfolio Perspective to Investing. (Understanding)
- CO2:** Analyse major return measures of an investment. (Analysing)
- CO3:** Explain the characteristics of the major asset classes that an investor should consider. (Understanding)
- CO4:** Analyse the risk and return objectives and how they may be developed for a client. (Analysing)
- CO5:** Illustrate the steps in the Investment Management process. (Understanding)

Suggested Readings

1. ZviBodie: Essentials of Investment, McGraw Hill.
2. Reilly and Brown: Analysis of Investments and Management of Portfolios, Cengage.

3. Prasanna Chandra: Investment Analysis and Portfolio Management, McGraw Hill.
4. Ranganatham: Security Analysis and Portfolio Management, Pearson.

SPECIALIZATION: MANAGEMENT

CMIL0065: MANAGEMENT OF INDUSTRIAL LAWS

(4 credits- 60hours)

Objective: *The objective of this course is to make the students aware of the legal aspects of management. Every industrial concern is set to follow certain terms and guidelines and the management has to take due care about it. This course will give a detailed idea about the various industrial laws and its provisions*

Module I: Introduction to Labour Laws (15 credits)

Origin and Development, Objectives and Principles of Labour Laws, Development of Labour Laws in India, Concept of Industrial Relations- Importance, Scope & Aspects of Industrial Relations, Factor Affecting Industrial Relations, Different approaches/perspectives of Industrial Relations, Industrial conflict, unfair labour practices, concept of Labour welfare & activities of labour welfare officer, Political influence on trade unions, Workers Education, Role of trade union in the changed economic scenario.

Module II: Regulatory framework for management of industries (15 credits)

Trade Union Act, 1926, The Industrial Employment (Standing Orders) Act, 1946, Factories Act, 1948, Payment of Bonus Act, 1956, Payment of Wages Act, 1936: scope, objectives and important provisions

Module III: Dispute and settlement (15 credits)

Industrial Disputes Act, 1947: Industrial Disputes, Development of Industrial Disputes Legislations in India, Mechanisms for settlement of Industrial Disputes, Constitutional and Statutory Framework in India, unions and technological changes, Industrial relation system, Instruments of economic coercion, discipline, domestic enquiry grievance procedure and disciplinary action, Principle of natural justice.

Module IV: Prevention and legal regulations regarding labour management (15 credits)

Machinery for prevention of industrial disputes, Welfare Officer works committees, Joint Management Council, Ethical Codes, Methods of setting Industrial Disputes, Arbitration Adjudication, Tripartite and Bipartite Machinery, Collective Bargaining, workers' participation in management, Labour management and cooperation, Industrial relations and related legislations with special reference to industrial disputes Act, 1947, labour welfare and social security, Lok Adalat as a body to conduct mediation.

Case studies

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the terms commonly used in industrial laws (Remembering)
- CO2:** Explain the various provisions of labour laws (Understanding)
- CO3:** Identify the factors essential for management of labour unions (Applying)
- CO4:** Analyse the different theories of Trade Unionism. (Analysing)

CO5: Assess the impact of economic changes upon labour management (Evaluating)

CO6: Develop a model of business management abiding by all industrial laws (*Creating*)

Suggested Readings

1. Dr. G V Goswami, Labour Industrial Laws, Central Law Agency.
2. K M Pillai, Labour and Industrial Law, Allahabad Law Agency
3. S N Mishra, Labour and Industrial Laws, Central Law Publications
4. BD Singh, Labour Law for Managers, Excel Books, New Delhi,
5. GB Pai, Labour Law in India, Butterworth's India, New Delhi
6. SC Srivastava, Industrial Relations and Labour Laws, Vikas Publishing House.

CMSM0066: SUPPLY CHAIN MANAGEMENT AND LOGISTICS

(4 credits – 60 Hours)

Objective: *The objective of this paper is to acquaint the students with the concepts and tools of supply chain management and logistics as relevant for an international firm.*

Module I: Basic Framework (9 hours)

Concept of supply chain management (SCM); SCM and trade Logistics; Business view of SCM; Push and pull of SCM; Decision phases; Impellers and drivers in SCM Process views of SCM, planning and operations; Supply chain modeling; Role of Relationship marketing in SCM; managing relationships with suppliers and customers; Designing strategic distribution network; Factors influencing distribution network.

Module II: Supply Chain and Information Management Systems (13 hours)

Purchasing Process- Strategic role of purchasing in the supply chain and total customer satisfaction; Types of purchases; Purchasing cycle; Supplier selection and evaluation; Vendor development; Importance of information management; Distribution and sharing of information; Information technology as a platform for effective and efficient supply chain management.

Module III: Logistic System (10 hours)

Concept, objectives and scope of logistics; System elements; Inbound and Out bound logistics. Reverse inventory, Value added role of logistics, Logistics interface with manufacturer and marketing, Packing, Marking, Just in time concept; Third party logistic outsourcing—challenges and future directions.

Module IV: Transportation (16 hours)

Importance of effective transportation system; Service choices and their characteristics; inter-modal services; Transport cost characteristics and rate fixation; Carrier selection determinants and decision; Structure of Shipping: World sea borne trade; international shipping - characteristics and structure; Liner and tramp operations; Liner freighting; Chartering-Types, principles and practices; Charter, party agreement; Development in sea transportation-Unitization, containerisation, inter and multimodal transport; CFC and ICD; Indian shipping – growth, policy and problems; Ports and port trust; International Air transport: International set up for air transport: Freight rates; India's exports and imports by air – Problems and prospects; Carriage of Goods by sea, sea and combined transport.

Module V: Warehousing and Inventory Management (12 hours)

Warehousing and marketing strategy; Objectives and functions of warehousing; Warehouse strategies; Material handling equipment and material mobility Warehousing evaluation and requirements.

Inventory management-inventory categories, EOQ, LT, ICC; Inventory levels; Material planning and sourcing of procurement; Methods of cost reduction.

COURSE/LEARNING OUTCOMES

After learning the course the students will be able to:

- CO1:** Define the process of supply chain management. (Remembering)
- CO2:** Demonstrate operational purchasing methods and techniques on supplier management and supply in specific business contexts.(Understanding)
- CO3:** Explain the strategic importance of logistics elements and describe how they affect supply chain management. (Understanding)
- CO4:** Apply sales and operations planning, MRP and lean manufacturing concepts. (Applying)
- CO5:** Analyse the creation of new value in the supply chain for customers, society and the environment. (Analysing)

Suggested Readings

1. Ballau, R.H., *Business Logistics Management*, Prentice Hall, Englewood Cliffs.
2. Bes, J., *Chartering Practices*.
3. Bes, J., *Dictionary of Shipping and chartering Practices*.
4. Christopher, M., *Logistics and Supply Chain Management*, Prentice Hall.
5. *ICAO Journal*, New York., various issues.
6. *Indian Shipping and Transport*, Mumbai, Various issues.
7. Murphy, Paul R. and Donald F. Wood, *Contemporary Logistics*, Prentice Hall.
8. Marks, Daniel, *Shipping Cartels*.
9. Shapiro, R., *Logistics Strategy: Cases and Concepts*, West Publishing, St. Paul.
10. Coughlan, A., Anderson, E. and Louis W. Stern, *Marketing Channels*, Prentice Hall.
11. *The Marine Times*, Mumbai, various issues.
12. Jhon J Coyle, C. Jhon and Langley, Brian J Gibbs, *Logistics approach to Supply Chain Management*, Cengage Learning.
13. Burt, Dobler and Starling, *World Class Supply Management*, Tata McGraw Hill.
14. Bowersor, Donald J and David J Closs, *Logistics management and Integrated Supply Chain Management*, Tata McGraw Hill.

CMFA0067: FINANCIAL ACCOUNTING

(Credits: 6- 75 Hours)(L-T-P:4-2-0)

Objectives: *The objective of this paper is to help students to acquire conceptual knowledge of the financial accounting and to impart skills for recording various kinds of business transactions.*

Module I: (a) Theoretical Framework (3 Hours)

1. Accounting as an information system, the users of financial accounting information and their needs. Qualitative characteristics of accounting, information. Functions, advantages and limitations of accounting. Branches of accounting. Bases of accounting; cash basis and accrual basis.
2. The nature of financial accounting principles–Basic concepts and conventions: entity, money measurement, going concern, cost, realization, accruals, periodicity, consistency, prudence (conservatism), materiality and full disclosures.

3. Financial accounting standards: Concept, benefits, procedure for issuing accounting standards in India. Salient features of First-Time Adoption of Indian Accounting Standard (Ind-AS) 101. International Financial Reporting Standards (IFRS): - Need and procedures.

a) Accounting Process (2 Hours)

From recording of a business transaction to preparation of trial balance including adjustments

b) Computerized Accounting Systems (26 Hours)

Practical Lab Computerized Accounting Systems: Computerized Accounts by using any popular accounting software: Creating a Company; Configure and Features settings; Creating Accounting Ledgers and Groups; Creating Stock Items and Groups; Vouchers Entry; Generating Reports - Cash Book, Ledger Accounts, Trial Balance, Profit and Loss Account, Balance Sheet, Funds Flow Statement, Cash Flow Statement Selecting and shutting a Company; Backup and Restore data of a Company

Module II: (a) Business Income (10 Hours)

1. Measurement of business income-Net income: the accounting period, the continuity doctrine and matching concept. Objectives of measurement.
2. Revenue recognition: Recognition of expenses.
3. The nature of depreciation. The accounting concept of depreciation. Factors in the measurement of depreciation. Methods of computing depreciation: straightline method and diminishing balance method; Disposal of depreciable assets-change of method.
4. Inventories: Meaning. Significance of inventory valuation.
5. Inventory Record Systems: periodic and perpetual. Methods : FIFO, LIFO and Weighted Average Salient features of Indian Accounting Standard (Ind-AS):2

(b) Final Accounts (7 Hours)

Capital and revenue expenditures and receipts: general introduction only. Preparation of financial statements of non-corporate business entities

Module III: Accounting for Hire Purchase and Installment Systems (10 Hours)

Calculation of interest, partial and full repossession, Hire purchase trading (total cash price basis), stock and debtors system; Concepts of operating and financial lease (theory only)

Module IV: Accounting for Inland Branches (10 Hours)

Concept of dependent branches; accounting aspects; debtors system, stock and debtors system, branch final accounts system and whole sale basis system. Independent branches: concept-accounting treatment: important adjustment entries and preparation of consolidated profit and loss account and balance sheet.

Module V: Accounting For Dissolution of the Partnership Firm (10 Hours)

Accounting of Dissolution of the Partnership Firm Including Insolvency of partners, sale to a limited company and piecemeal distribution

Note:

1. The relevant Indian Accounting Standards in line with the IFRS for all the above topics should be covered.

2. Any revision of relevant Indian Accounting Standard would become applicable immediately.
3. There shall be 4 Credit hrs. for Hours plus one Credit hr. (Two Practical Periods per week per batch) for Practical Lab plus one credit Hr for Tutorials (per group)
4. Examination Scheme for Computerized Accounting Systems–Practical for 20marks.The practical examination will be for 1hour.
5. Theory Exam shall carry 80 marks

LEARNING/COURSE OUTCOMES

After learning this course, the students will be able to:

- CO1:** Define the theoretical framework and accounting process (Remembering)
- CO2:** Explain the accounting process (Understanding)
- CO3:** Identify the important constituents of business income (Applying)
- CO4:** Analyse the final accounts (Analysing)
- CO5:** Evaluate the accounting for inland branches (Evaluating)
- CO6:** Elaborate the accounting system for dissolution of the partnership firm (Creating)

Suggested Readings

1. Robert N Anthony, David Hawkins, Kenneth A. Merchant, *Accounting: Text and Cases*. McGraw-Hill Education, 13th Ed.2013.
2. Charles T. Horngren and Donna Philbrick, *Introduction to Financial Accounting*, Pearson Education.
3. J.R. Monga, *Financial Accounting: Concepts and Applications*. Mayur Paper Backs, New Delhi.
4. M.C.Shukla, T.S. Grewal and S.C.Gupta. *Advanced Accounts. Vol.-I*. S. Chand & Co., New Delhi.
5. S.N. Maheshwari, and. S. K. Maheshwari. *Financial Accounting*. Vikas Publishing House, NewDelhi.
6. Deepak Sehgal. *Financial Accounting*. Vikas Publishing House, New Delhi.
7. Bhushan Kumar Goyal and H.N. Tiwari, *Financial Accounting*, International Book House
8. Goldwin, Alderman and Sanyal, *Financial Accounting*, Cengage Learning.
9. Tulsian, P.C. *Financial Accounting*, Pearson Education.
10. *Compendium of Statements and Standards of Accounting*. The Institute of Chartered Accountants of India, New Delhi

Note: Latest edition of the text books should be used

CMBL0068: BUSINESS LAW

(Credits: 6- 75 Hours)(L-T-P:4-2-0)

Objective: *The objective of the course is to impart basic knowledge of the important business legislation along with relevant case law.*

Module I: The Indian Contract Act, 1872: General Principle of Law of Contract (13 Hours)

Contract – meaning, characteristics and kinds

Essentials of a valid contract - Offer and acceptance, consideration, contractual capacity, free consent, legality of objects.

Void agreements

Discharge of a contract–modes of discharge, breach and remedies against breach of contract.

Contingent contracts

Quasi -contracts

Module II: The Indian Contract Act, 1872: Specific Contract (13 Hours)

Contract of Indemnity and Guarantee

Contract of Bailment

Contract of Agency

Module III: The Sale of Goods Act, 1930 (13 Hours)

Contract of sale, meaning and difference between sale and agreement to sell.

Conditions and warranties

Transfer of ownership in goods including sale by a non-owner

Performance of contract of sale

Unpaid seller—meaning, rights of an unpaid seller against the goods and the buyer.

Module IV: Partnership Laws (13 Hours)

The Partnership Act, 1932

Nature and Characteristics of Partnership

Registration of a Partnership Firm

Types of Partners

Rights and Duties of Partners

Implied Authority of a Partner

Incoming and outgoing Partners

Mode of Dissolution of Partnership

The Limited Liability Partnership Act, 2008

Salient Features of LLP

Differences between LLP and Partnership, LLP and Company

LLP Agreement,

Partners and Designated Partners

Incorporation Document

Incorporation by Registration

Partners and their Relationship

Module V: The Negotiable Instruments Act 1881 (13 Hours)

Meaning, Characteristics, and Types of Negotiable Instruments: Promissory Note, Bill of Exchange, Cheque

Holder and Holder in Due Course, Privileges of Holder in Due Course.

Negotiation: Types of Endorsements

Crossing of Cheque

Bouncing of Cheque

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Define the Indian Contract Act, 1872: General Principle of Law of Contract (Remembering)
- CO2:** Explain the Indian Contract Act, 1872: Specific Contract (Understanding)
- CO3:** Identify the important constituents of partnership laws (Applying)
- CO4:** Analyse the Negotiable Instruments Act 1881 (Analysing)
- CO5:** Evaluate the important business legislation along with relevant case law. (Evaluating)
- CO6:** Elaborate the accounting system for dissolution of the partnership firm (Creating)

Suggested Readings

1. M.C.Kuchhal, and Vivek Kuchhal, *Business Law*, Vikas Publishing House New Delhi.
2. Avtar Singh, *Business Law*, Eastern Book Company, Lucknow.
3. Ravinder Kumar, *Legal Aspects of Business*, Cengage Learning
4. S.N. Maheshwari and S.K. Maheshwari, *Business Law*, National Publishing House, New Delhi.
5. Aggarwal S.K, *Business Law*, Galgotia Publishers Company, New Delhi.
6. Bhushan Kumar Goyal and Jain Kinneri, *Business Laws*, International Book House
7. Sushma Arora, *Business Laws*, Taxmann Publications.
8. Akhileshwar Pathak, *Legal Aspects of Business*, McGraw Hill Education
9. P.C. Tulsian and Bharat Tulsian, *Business Law*, McGraw Hill Education
10. Sharma, J.P. and Sunaina Kanojia, *Business Laws*, Ane Books Pvt .Ltd., New Delhi

Note: Latest edition of text books may be used

CMME0069: MICRO ECONOMICS

(Credits: 6- 75 Hours)(L-T-P:4-2-0)

Objective: *The objective of the course is to acquaint the students with the concepts of microeconomics dealing with consumer behavior. The course also makes the student understand the supply side of the market through the production and cost behavior of firms.*

Module I: Demand and Consumer Behavior (13 hours)

Concepts of revenue: marginal and Average: Revenue under conditions of Perfect and imperfect competition Elasticity of demand: price, income and cross.

Consumer Behavior: Indifference curve analysis of consumer behavior; Consumer's equilibrium (necessary and sufficient conditions). Price elasticity and price consumption curve, income consumption curve and Engel curve, price change and income and substitution effects. Indifference curves as an analytical tool (cash subsidy v/s. kind subsidy). Revealed Preference Theory.

Module II: Production and Cost (13 hours)

Production isoquants, marginal rate of technical substitution, economic region of production, optimal combination of resources, the expansion path, isoclines, returns to scale using isoquants.

Cost of Production: Social and private costs of production, long run and short run costs of production. Economies and diseconomies of scale and the shape to the long run average cost. Learning curve and economies of scope.

Module III: Perfect Competition (13 hours)

Perfect competition: Assumptions. Equilibrium of the firm and the industry in the short and the long runs, including industry's long run supply curve. Measuring producer surplus under perfect competition. Stability Analysis – Walrasian and Marshallian. Demand - supply analysis including impact of taxes and subsidy.

Module IV: Monopoly (10 hours)

Monopoly: Monopoly short run and long run equilibrium. Shifts in demand curve and the absence of the supply curve. Measurement of monopoly power and the rule of thumb for pricing. Horizontal and vertical integration of firms. The social costs of monopoly power including deadweight loss. Degrees of price discrimination.

Module V: Imperfect Competition (16 hours)

Monopolistic Competition and Oligopoly: Monopolistic competition price and output decision-equilibrium. Monopolistic Competition and economic efficiency Oligopoly and Interdependence – Cournot's duopoly model, Stackelberg model, Kinked demand model. Prisoner's dilemma, collusive oligopoly – price- leadership model – dominant firm, cartels, sales maximization, Contestable markets theory. Pricing Public Utilities.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Define the concepts of revenue (Remembering)
- CO2:** Explain the concepts related to production and cost (Understanding)
- CO3:** Identify the assumptions of perfect competition (Applying)
- CO4:** Analyse the Monopoly short run and long run equilibrium (Analysing)
- CO5:** Evaluate the Monopolistic Competition and Oligopoly (Evaluating)
- CO6:** Elaborate the supply side of the market through production and cost behavior of firms (Creating)

Suggested Readings

1. Pindyck, R.S., D.L. Rubinfeld and P.L. Mehta; *Microeconomics*, Pearson Education.
2. N. Gregory Mankiw, *Principles of Micro Economics*, Cengage Learning
3. Maddala G.S. and E. Miller; *Microeconomics: Theory and Applications*, McGraw-Hill Education.
4. Salvatore, D. *Schaum's Outline: Microeconomic Theory*, McGraw-Hill, Education.
5. Case and Fair, *Principles of Micro Economics*, Pearson Education
6. Koutsiyannis, *Modern Micro Economic Theory*.
7. C Snyder, *Microeconomic Theory: Basic Principles and Extensions*, Cengage Learning
8. Bilas, Richard A., *Microeconomics Theory: A Graphical Analysis*, McGraw-Hill Education.
9. Paul A Samuelson, William D Nordhaus, *Microeconomics*, McGraw-Hill Education.
10. Amit Sachdeva, *Micro Economics*, KusumLata Publishers

Note: Latest edition of text books shall be used

CMBC0072: BUSINESS COMMUNICATION

(2 Credits- 30 Hours) (L-T-P:2-0-0)

Objective: To equip students of the B.Com (Hons.) course 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 the 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,
7. *Business Communication: Connecting in a Digital World (SIE)*, McGraw Hill Education

Note: Latest edition of text books may be used.

CMCA0070: CORPORATE ACCOUNTING

(Credits: 6- 75 Hours)(L-T-P:4-2-0)

Objectives: To help the students to acquire the conceptual knowledge of the corporate accounting and to learn the techniques of preparing the financial statements.

Module I: Accounting for Share Capital & Debentures (12 Hours)

Issue, forfeiture and reissue of forfeited shares: concept & process of book building; Issue of rights and bonus shares; Buy back of shares; Redemption of preference shares; Issue and Redemption of Debentures

Module II: Final Accounts (9 Hours)

Preparation of profit and loss account and balance sheet of corporate entities, excluding calculation of managerial remuneration, Disposal of company profits

Module III: Valuation of Goodwill and Valuation of Shares (6 Hours)

Concepts and calculation: simple problem only

Module IV: Amalgamation of Companies (12 Hours)

Concepts and accounting treatment as per Accounting Standard: 14 (ICAI) (excluding inter-company holdings). Internal reconstruction: concepts and accounting treatment excluding scheme of reconstruction.

Module V: Accounts of Holding Companies/Parent Companies (12 Hours)

Preparation of consolidated balance sheet with one subsidiary company. Relevant provisions of Accounting Standard: 21 (ICAI).

Module VI: Banking Companies (7 Hours)

Difference between balance sheet of banking and non banking company; prudential norms. Asset structure of a commercial bank. Non-performing assets (NPA).

Module VII: Cash Flow Statement (7 Hours)

Concepts of funds. Preparation of cash flow statement as per Indian Accounting Standard (Ind- AS): 7

Note:

1. The relevant Indian Accounting Standards in line with the IFRS for all the above topics should be covered.
2. Any revision of relevant Indian Accounting Standard would become applicable immediately.

COURSE/LEARNING OUTCOMES

- CO1:** Define the meaning and types of shares.(Remembering)
- CO2:** Illustrate the procedure of forfeiture and re-issue of company's shares.(Understanding)
- CO3:** Construct the redemption of company's debenture accounts.(Applying)
- CO4:** Analyse the valuation of goodwill and shares of a company.(Analysing)
- CO5:** Determine the alteration and reduction of company's share capital.(Evaluating)
- CO6:** Adapt the accounting problems related to amalgamation of companies.(Creating)

Suggested Readings

1. J.R. Monga, *Fundamentals of Corporate Accounting*. Mayur Paper Backs, New Delhi.
2. M.C. Shukla, T.S. Grewal, and S.C. Gupta. *Advanced Accounts* .Vol.- II. S. Chand & Co., New Delhi.
3. S.N. Maheshwari, and S. K. Maheshwari. *Corporate Accounting*. Vikas Publishing House, New Delhi.
4. Ashok Sehgal , *Fundamentals of Corporate Accounting*. Taxman Publication, New Delhi.
5. V.K. Goyal and Ruchi Goyal, *Corporate Accounting*. PHI Learning.
6. Jain, S.P. and K.L. Narang. *Corporate Accounting*. Kalyani Publishers, New Delhi.
7. Bhushan Kumar Goyal, *Fundamentals of Corporate Accounting*, International Book House

8. P. C. Tulsian and Bharat Tulsian, Corporate Accounting, S. Chand
9. Amitabha Mukherjee, Mohammed Hanif, Corporate Accounting, McGraw Hill Education
10. Compendium of Statements and Standards of Accounting. The Institute of Chartered Accountants of India, New Delhi.

Note: Latest edition of text books may be used.

CMCL0071: CORPORATE LAWS

(Credits: 6- 75 Hours)(L-T-P:4-2-0)

Objective: *The objective of the course is to impart basic knowledge of the provisions of the Companies Act 2013 and the Depositories Act, 1996. Case studies involving issues in corporate laws are required to be discussed.*

Module I: Introduction (15 Hours)

Administration of Company Law [including National Company Law Tribunal (NCLT), National Company Law Appellate Tribunal (NCLAT), Special Courts]; Characteristics of a company; lifting of corporate veil; types of companies including one person company, small company, and dormant company; association not for profit; illegal association; formation of company, on-line filing of documents, promoters, their legal position ,pre-incorporation contract; on-line registration of a company.

Module II: Documents (15 Hours)

Memorandum of association, Articles of association, Doctrine of constructive notice and indoor management, prospector-shelf and red herring prospectus, misstatement in prospectus, GDR; book-building; issue, allotment and forfeiture of share, transmission of shares, buyback and provisions regarding buyback; issue of bonus shares.

Module III: Management (15 Hours)

Classification of directors, women directors, independent director, small shareholder's director; disqualifications, director identity number (DIN); appointment; Legal positions, powers and duties; removal of directors; Key managerial personnel, managing director, manager;

Meetings: Meetings of shareholders and board of directors; Types of meetings, Convening and conduct of meetings, Requisites of a valid meeting, postal ballot, meeting through video conferencing, e-voting.

Committees of Board of Directors- Audit Committee, Nomination and Remuneration Committee, Stakeholders Relationship Committee, Corporate Social Responsibility Committee

Module IV: Dividends, Accounts, Audit 15 Hours

Provisions relating to payment of Dividend, Provisions relating to Books of Account, Provisions relating to Audit, Auditors' Appointment, Rotation of Auditors, Auditors' Report, Secretarial Audit.

Winding Up: Concept and modes of Winding Up.

Insider Trading, Whistle Blowing: Insider Trading; meaning & legal provisions; Whistle- blowing : Concept and Mechanism.

Module V: Depositories Law 5 Hours

The Depositories Act 1996 – Definitions; rights and obligations of depositories; participants issuers and beneficial owners; inquiry and inspections, penalty.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Explain what a company is and how it is formed. (Understanding)
- CO2:** Define the concepts related to various essential documents relating to a company. (Remembering)
- CO3:** Develop the knowledge regarding management of a company. (Applying)
- CO4:** Analyse the various provisions relating to dividends, accounts and audit of a company. (Analysing)
- CO5:** Explain the various concepts regarding winding up of companies, insider trading and whistle blowing (Evaluating)
- CO6:** Elaborate the meaning, definition, rights, obligations, etc. under The Depositories Act, 1996 (Creating)

Suggested Readings

1. MC Kuchhal, *Modern Indian Company Law*, Shri Mahavir Book Depot (Publishers), Delhi.
2. GK Kapoor and Sanjay Dhamija, *Company Law*, Bharat Law House, Delhi.
3. Anil Kumar, *Corporate Laws*, Indian Book House, Delhi
4. Reena Chadha and Sumant Chadha, *Corporate Laws*, Scholar Tech Press, Delhi.
5. Avtar Singh, *Introduction to Company Law*, Eastern Book Company
6. Ramaiya, *A Guide to Companies Act*, LexisNexis, Wadhwa and Buttersworth.
7. *Manual of Companies Act, Corporate Laws and SEBI Guideline*, Bharat Law House, New Delhi.
8. *A Compendium of Companies Act 2013, along with Rules*, by Taxmann Publications.
9. Gower and Davies, *Principles of Modern Company Law*, Sweet & Maxwell
10. Sharma, J.P. *An Easy Approach to Corporate Laws*, Ane Books Pvt. Ltd., New Delhi

Note: Latest edition of text books may be used.

CMMC0072: MACRO ECONOMICS

(Credits: 6- 75 Hours)(L-T-P:4-2-0)

Objectives: *The course aims at providing the student with knowledge of basic concepts of the macro economics. The modern tools of macro-economic analysis are discussed and the policy framework is elaborated, including the open economy.*

Module I: Introduction 5 Hours

concepts and variables of macroeconomics, income, expenditure and the circular flow, components of expenditure. Static macroeconomic analysis short and the long run – determination of supply, determination of demand, and conditions of equilibrium

Module II: Economy in the short run (20 Hours)

IS–LM framework, fiscal and monetary policy, determination of aggregate demand, shifts in aggregate demand, aggregate supply in the short and long run, and aggregate demand- aggregate supply analysis.

Module III: Inflation, Unemployment and Labour market (20 Hours)

Inflation: Causes of rising and falling inflation, inflation and interest rates, social costs of inflation; Unemployment–natural rate of unemployment, frictional and wait unemployment. Labour market and its interaction with production system; Phillips curve, the trade-off between inflation and unemployment, sacrifice ratio, role of expectations adaptive and rational

Module IV: Open economy (13 Hours)

Open economy– flows of goods and capital, saving and investment in a small and a large open economy, exchange rates, Mundell – Fleming model with fixed and flexible prices in a small open economy with fixed and with flexible exchange rates , Interest-rate differentials case of a large economy.

Module V (7 Hours)

Behavioral Foundations- Investment– determinants of business fixed investment ,effect of tax, determinants of residential investment and inventory investment. Demand for Money – Portfolio and transactions theories of demand for real balances, interest and income elasticities of demand for real balances. Supply of money

COURSE/LEARNING OUTCOMES

After learning this course, the students are able to:

- CO1:** Explain how money is circulated in an economy.(Understanding)
- CO2:** Outline the different concepts of National Income.(Understanding)
- CO3:** Estimate National Income Accounting.(Evaluating)
- CO4:** Explain Keynesian National Income Determination by using Aggregate Demand and Aggregate Supply concept.(Understanding)
- CO5:** Summarize Consumption Function and determinants of propensity to consume. (Understanding)
- CO6:** Determine Investment Function and investment multiplier.(Evaluating)
- CO7:** Relate the concept of money and money supply with economic development. (Remembering)
- CO8:** Estimate deposit multiplier and money multiplier.(Evaluating)
- CO9:** Explain the functioning of the banking system and categorizing the banking system in India.(Understanding)
- CO10:** Illustrate the various theories of Interest.(Understanding)
- CO11:** Summarize and evaluate fiscal policy and monetary policy to control inflation. (Understanding)
- CO12:** Explain Balance of Payments and its various components.(Understanding)
- CO13:** Outline various Open macro-economic concepts like foreign exchange system, foreign investment, functioning of GATT, WTO, and FTA. (Understanding)

Suggested Readings

1. Mankiw, N. Gregory. *Principles of Macroeconomics*. Cengage Learning
2. Robert J Gordon, *Macro economics*, Pearson Education
3. Branson, William H. *Macro economic Theory and Policy*. Harper Collins India Pvt. Ltd.
4. Rudiger Dornbusch and Stanley Fischer, *Macro economics*. McGraw-Hill Education.
5. Rudiger Dornbusch, Stanley Fischer, and Richard Startz ,*Macro economics*. McGraw-Hill Education

6. Oliver J. Blanchard, *Macro economics*, Pearson Education
7. G. S. Gupta, *Macro economics: Theory and Applications*, McGraw-Hill Education
8. Shapiro, *Macro economic Analysis*,
9. Paul A Samuelson, William D Nordhaus, and Sudip Chaudhuri, *Macro economic*,
10. McGraw-Hill Education

Note: Latest edition of text books may be used.

CMAS6002: ACCOUNTING SOFTWARE LAB

(3 credits)

Objectives: *To give an opportunity to the undergraduate student to get acquainted with Tally accounting software and, the learning outcome is enabling students to learn the practical application of Tally.ERP9 and apply those in the practical field in the business organisation*

Module I Introduction to Tally (5 hours)

Accounting Package: Why Tally, Leadership, Various versions of tally

Module II Tally.ERP9 (15 hours)

Tally.ERP9: meaning, salient features, shut company, select company, company features and company configuration; Introducing the Tally.ERP 9 software, creation of company, various reports (accounts and inventory), Backup and restore.

Creation of Chart of accounts: creation of groups and subgroups, creation, alteration and deletion of ledgers, backup and restore; report: Balance Sheet , Trial Balance

Module III Bill Allocation and report (8 hours)

Opening bill allocation; accounting entry with online creation; party payment/ receipt with advance payment/receipt; Report: Day book with zooming, cash/bank book

Module IV Cost centre, cost category and vouchers (8 hours)

Cost centre and cost category, predefined cost centre, BRS, asset purchase, sale of assets with depreciation Vouchers class, non-accounting vouchers, budgeting and control Project on Tally Accounting

Module V Goods and Service Tax (GST) (10 hours)

GST: Meaning, benefits, registration process, GST components, input tax credit, payment of GST, Return filing, consequences of non- compliances in GST GST Activation, Master creation-GST related, purchase and sale of goods (local), purchase and sale of goods (Interstate), Project on GS

COURSE/LEARNING OUTCOMES

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

- CO1:** Define various version of Tally (Remembering)
- CO2:** Illustrate the process of making group of ledgers in Tally, other salient features etc. (Understanding)
- CO3:** Application of rules in Tally while entering data in the software of Tally (Applying)
- CO4:** Analysing the various meaning of cost centers, BRS, assets etc. (Analysing)
- CO5:** Choose and Explain the GST rules, registration process and various components (Evaluating)
- CO6:** Discuss the process of entering data in erp using Tally software (Creating)

CMPJ6003: PROJECT PHASE 1**(1 Credit)****CMPJ6005: PROJECT PHASE 2****(2 Credits)****Objective:**

The students need to go through a project work which is divided into two phases covering 5th and 6th semester. The basic objective of the project work is to give students an idea of research . In which they need to undertake field survey for collecting data. Further they need to analyse the data and present a report on the topic in which they have conducted reseerach. The evaluation is done on the basis of the project report, presentation and viva-voce examination.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the various chapters of a project report (*Remembering*)
- CO2:** Explain how to prepare the outline of a project report. (*Understanding*)
- CO3:** Develop questionnaire and interview schedule for conducting filed survey (*Applying*)
- CO4:** Analyse the data with the help of various statistical tools (*Analysing*)
- CO5:** Explain the findings of the research with facts and figures (*Evaluating*)
- CO6:** Improve the presentation skills in both written and oral. (*Creating*)

GUIDELINES RELATED TO PROJECT:

The entire project will be carried out in two phases

Phase 1: It includes Introduction and Review of Literature part, which will carry a weightage of 100 marks (1 Credit). The viva voce of phase 1 will be held before the 5th semester final examination.

Phase 2: It includes Research Methodology, Data Analysis and Interpretation and Findings, suggestions and conclusion part, which will again carry a weightage of 100 marks (Credit 2). The Final Viva Voce along with presentation of the project work will be held before the 6th semester final examination.

CMIN6004: INTERNSHIP**(2 Credits)****Objectives:**

The students are required to undergo an internship in work related to Commerce and Management during the semester break at the end of fourth Semester or fifth Semester. The purpose of this internship is to expose the students to real-life industry work situations. This is an opportunity for the students to learn the application of knowledge that they have acquired from the classes, in an on-the-job situation. After the internship the students have to present their experiences in the form of reports and seminar presentations at a specified date towards the end of the sixth semester. Students will be evaluated on the basis of the report, seminar presentation and viva-voce examination.

INSTRUCTION AND GUIDELINES FOR STUDENTS

The students should follow the following instruction and guidelines during the course of internship:

1. The internship should be for a minimum duration of 80hours which can be extended up to any limit depending upon the convenience and requirement of the student and the organisation respectively.
2. The students have to undergo the internship during the Summer Break at the end of 4th Semester Examination or Winter Break at the end of 5th Semester Examination. Any students willing to undergo internship during the semester classes will not be encouraged and would be completely on his/her own cost of attendance and classes. Further, in such a case, the Department holds full right to reject the internship of such student.
3. The students can undergo internship at any organisation which is recognised or registered, as applicable, of their choice but the work must be related to commerce and management.
4. After the completion of the internship, the students must submit the Internship Report which should include of the Internship Diary as an Annexure to the Report. The format of the Internship Report and Internship Diary should be in accordance with the one prescribed by the Department.
5. There would be a Seminar Presentation (PPT) and Viva-Voce Examination towards the end of the 6th Semester based on which the students would be evaluated for the internship. The Internship report would also be a part of evaluation.

STRUCTURE OF INTERNSHIP

1. The Internship Report must comprise of the following:
 - a) Recommendation Letter from the Department.
 - b) Completion Certificate from the Organisation where the student has worked as intern.
 - c) Internship Diary as per the prescribed format.
 - d) Organisation details (Address, E-mail, Contact Number) including name, contact number and e-mail of the supervisor is mandatory. This should be included as a part of the Internship Diary according to the prescribed format.
 - e) The Contents of the Report must include:
 - (i) Introduction.
 - (ii) Objectives of the Internship.
 - (iii) About the Organisation (Sector, Activities, Operations).
 - (iv) Description of the work.
 - (v) Learning Outcomes.
2. The Assessment for the internship must have the following components:
 - a) Internship Report : 20marks
 - b) Internship Diary : 20marks
 - c) Seminar Presentation : 30marks
 - d) Viva-Voce Examination : 30marks

COURSE/ LEARNING OUTCOMES

At the end of the internship students will be able to:

- CO1:** Relate with the working in the corporate sector. (Remembering)
- CO2:** Interpret the situations and real life problems in business management and operations. (Understanding)
- CO3:** Organise and work on projects under a supervisor and deal with situations. (Applying)
- CO4:** Analyse and understand group cohesion. (Analysing)
- CO5:** Justify any action on the part of management for greater efficiency (Evaluating)
- CO6:** Develop a corporate personality with improved communication skills, presentation and other soft skills. (Creating)

CMDS6006: DISSERTATION-I (RESEARCH SOFTWARE)

(4 credits- 60 hours)

Objective: *The objective of the course would be to educate the students about the various dimensions of a research based project work. The students will also be taught about the application of statistical tools through SPSS.*

This phase of the Dissertation will comprise of the following:

1. **Synopsis:** Submission of a write up on a specific area/topic of study (10hours)
2. **Review of Literature:** Submission of a specified number of reviews to respective guide (15 hours)
3. **Research Methodology:** Lecture based on the topic of study. (10 hours)
4. **Referencing Style:** Lecture on referencing style to be followed while submitting report (5 hours)
5. **Training on application of Statistical software used in research** (20hours)
6. **Submission of Progress Report after completion of Phase I:** Report should comprise of Introduction, Review of Literature, Research Methodology and References.

EVALUATION:

A diary will be maintained by every student to keep record of meeting with his/her guide. A format of the diary will be circulated at the beginning with the semester. Evaluation at Phase I will be done by the respective guide based on timely submission of part-work and quality of work as follows:

Synopsis (30marks)

Review of Literature (30marks)

Research Methodology (30marks)

Referencing (10marks)

CMDS6007: DISSERTATION-II

(6 credits- 75 hours)

Objective: *The objective of the course would be to develop analytical skills among the students for solving any research queries. The students will also be taught about the preparation of a project report.*

This phase of the Dissertation will comprise of the following:

1. **Field Work:** Collection of data and validation with the respective guide (30 hours)
2. **Analysis of Data:** Analysis and presentation of the data collected through application of various statistical tools through SPSS and other statistical software packages. **(10 hours)**
3. **Test of Plagiarism.**
4. **Submission of Project Report:** Submission of the complete report in continuation from Phase I.
5. **Presentation of work using PPT and Viva Voce Examination.**

EVALUATION:

Evaluation at Phase II will be done by a panel comprising of an external and internal expert along with the respective guide based on quality of work as follows:

Report (50marks)

Presentation (30marks)

Viva-Voce (10marks)

DEPARTMENT OF ECONOMICS

ENME0001: MICRO-ECONOMICS I

(6 Credits – 75 Hours) (L-T-P: 5-1-0)

Objective: This course introduces economic analysis of individual, business, and industry choices in the market economy. Students will learn how markets establish price, production, wage and employment levels, and the likely consequences of government attempts to alter market outcomes.

Module I: Basic Concepts (25 hours)

Scarcity and Choice; Production possibility frontier, Positive and normative economics; constructing a model, scientific method; concepts of opportunity cost, rate of growth, and of total, average and marginal functions.

Demand and Supply: Market demand, elasticity, shifts and movements, Applications of Demand, Supply and elasticity, Revenue and Expenditure, elasticity and marginal revenue; income elasticity of demand; consumer surplus

Module II: Consumer Choice (30 hours)

Cardinal theory, derivation of demand in case of one or more goods; Ordinal theory:

Budget sets and Preferences under different situations. Indifference curves: the rate and elasticity of substitution. Consumer equilibrium; effects of change in prices and income; Engels curve, Derivation of demand curve. Income and substitution effects: Hicks and Slutsky, Applications of indifference curves to other economic problems, Revealed preference theory of demand.

Module III: Production (15 hours)

Production functions: single variable - average and marginal product, variable proportions, stages of production. Two variables - isoquants, returns to scale and to a factor; factor prices; cost minimization and output maximization; Elasticity of substitution. Expansion path and the cost function.

Module IV: Cost (10 hours)

Concept of economic cost; Short run and long run cost curves; increasing and decreasing cost industries; envelope curve; L-shaped cost curves; economies of scale. Prices as parameters: Firm equilibrium and profit; short and long-run supply function; taxes and subsidies.

COURSE/LEARNING OUTCOMES

On completion of the course the students will be able to:

- CO1:** Define the concepts of demand & supply and its determinants. (Remembering)
- CO2:** Explain the concept of budget set, indifference curve. (Understanding)
- CO3:** Apply the concept of production function and relate it with economies and diseconomies of scale. (Applying)
- CO4:** Analyse the various concepts of cost. (Analysing)
- CO5:** Determine consumer's equilibrium and explain the effects of changes in consumer's equilibrium with respect to changes in income and prices. (Evaluating)
- CO6:** Estimate elasticity of demand and estimate elasticity of supply. (Creating)

Suggested Readings

1. Dr. Robert E. Hall and Dr. Marc Lieberman, Microeconomics- Principles and applications
2. Joseph E. Stiglitz and Carl E. Walsh: Principles of Microeconomics
3. Arthur O'Sullivan and Steven M. Sheffrin, Microeconomics- Principles, Applications and Tools (for Application Purposes)
4. Varian, Hal R., Intermediate Microeconomics
5. Mankiw, Gregory N., Principles of Economics
6. Pindyck, Robert S. &Rubinfeld, Daniel L., Microeconomics, PHI
7. Browning, Edgar K. &Zupan, Microeconomic Theory and Applications

ENQM0002: QUANTITATIVE METHODS IN ECONOMICS I

(6 Credits-75 Hours) (L-T-P: 5-1-0)

Objective: *The objective of this course is to accustom the students with the concepts of mathematical techniques and their applications which are used to elucidate the problems of economic theory and help in better choices.*

Module I: Basic Concepts (17 Hours)

Variables, Sets, Functions, Limit and Continuity of a Function, Equations, Identities, Systems of simultaneous equations, Homogeneous function

Module II: Matrix And Determinants (17 Hours)

Various types of matrices, Matrix operations-addition, subtraction and multiplication,

Scalar Multiplication, transpose of a matrix, Rank of a matrix, Determinants, Matrix inversion, Solution of Simultaneous equation system, Cramer's rule, Application to partial equilibrium market model, simple national income model.

Module III: Differential Calculus (25 Hours)

Differentiation of a Function, Basic rules of differentiation, derivatives of higher order, maximum and minimum values of a function, order condition for maximum-minimum values, partial and total differentiation, chain rule of differentiation.

Module IV: Applications Of Simple Derivatives (16 Hours)

Differential coefficient, elasticity of demand, total, average and marginal cost curves – minimum average cost, cost function in cubic form, maximum total revenue, conditions for profit maximization, effects of taxation and subsidy on monopoly, Relation between AC and MC, Application to Comparative static analysis of Market Model and National Income Model.

COURSE/LEARNING OUTCOMES

On completion of the course the students will be able to:

- CO1:** Define the basic concepts of mathematics like set, function, matrix algebra etc. used in Economic Analysis. (Remembering)
- CO2:** Explain the usage of the basic concepts of mathematics in Economics. (Understanding)
- CO3:** Apply the mathematical techniques to elucidate the problems of economic theory. (Applying)
- CO4:** Analyse the economic theory and draw inferences in context of mathematical techniques. (Analysing)
- CO5:** Explain the need of mathematical techniques in economic theory. (Evaluating)
- CO6:** Solve numerical problems in economic theory. (Creating)

Suggested Readings

1. Chiang, A.C & Wainwright, K., Fundamental Methods of Mathematical Economics, McGraw Hill Education.
2. J.M. Henderson and R.E. Quandt, Micro – Economic Theory – A Mathematical Treatment, McGraw Hill.
3. R.G.D. Allen, Mathematical Economics for Economists, Biblio Bazaar.
4. Sydsaeter, Knut & Hammond, Peter J., Mathematics for Economic Analysis, Pearson Education.

ENMB0003: MONEY, BANKING AND FINANCE**(6 Credits-75 Hours) (L-T-P: 5-1-0)**

Objectives: This course exposes students to the theory and functioning of the monetary sectors of the economy. Banking sector reforms and monetary policy with special reference to India are also covered. This course also introduces the students to Financial Economics.

Module I: Money (10 Hours)

Nature and Functions of money, Concept, measurement; Demand for money and

Keynes' Liquidity preference theory of interest

Module II: Money and Prices (18 Hours)

Value of money and price level, Fisher's transactions approach, quantity theory of money, Fisher's equation of exchange, Cambridge Cash-balance approach, Other monetarist's view; Keynes' Monetary theory; Friedman's Modern Quantity Theory of Money.

Module III: Banking System (17 Hours)

- a) Balance sheet and portfolio management, credit and commercial banking; Indian banking system: Changing role and structure; banking sector reforms
- b) Functions, goals, targets, indicators and instruments of monetary control; monetary management in an open economy; current monetary policy of India.

Module IV: Deterministic cash-flow streams (20 Hours)

- a) Interest Rates determination; sources of interest rate differentials; theories of term structure of interest rates; interest rates in India.
- b) Basic theory of interest; discounting and present value; internal rate of return; evaluation criteria; fixed-income securities; bond prices and yields; interest rate sensitivity and duration; immunisation; the term structure of interest rates; yield curves; spot rates and forward rates.

Module V: Capital Asset Pricing Model (CAPM) (10 Hours)

The capital market line; the capital asset pricing model; the beta of an asset and of a portfolio; security market line; use of the CAPM model in investment analysis and as a pricing formula.

COURSE/LEARNING OUTCOMES

On completion of the course the students will be able to:

- CO1:** Define various concepts and functions of money. (Remembering)
- CO2:** Compare money market and capital market. (Understanding)
- CO3:** Construct interest rate determination. (Applying)
- CO4:** Examine the role of monetary policy in an economy. (Analysing)
- CO5:** Judge the theories of demand for money from various perspectives. (Evaluating)
- CO6:** Discuss the concept of cash flow and how it is determined. (Creating)

Suggested Readings

1. F. S. Mishkin and S. G. Eakins, Financial Markets and Institutions, Pearson Education,
2. F. J. Fabozzi, F. Modigliani, F. J. Jones, M. G. Ferri, Foundations of Financial Markets and Institutions, Pearson Education
3. L. M. Bhole and J. Mahukud, Financial Institutions and Markets, Tata McGraw Hill.
4. M. Y. Khan, Indian Financial System, Tata McGraw Hill
5. Various latest issues of R.B.I. Bulletins, Annual Reports, Reports on Currency and Finance and Reports of the Working Group, IMF Staff Papers.
6. David G. Luenberger, Investment Science, Oxford University Press.
7. Richard A. Brealey and Stewart C. Myers, Principles of Corporate Finance.

ENMC0007: MACRO -ECONOMICS I

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective:

This course gives an understanding on how an economy behaves at the aggregate level. Upon successful completion of the course a student will be able to:

- *Understand the basics of national income accounting.*
- *Understand why household, business and government determine the aggregate demand.*

Module I: Introduction to Macroeconomics and National Income Accounting (20 Hours)

Basic issues studied in macroeconomics; Meaning of National Income; Circular flow of Income: two sector economy, three sector economy; Concepts of National Income and related aggregates; Approaches to measuring National Income; Components of National Income; National Income and Economic Welfare.

Module II: Consumption Function (18 Hours)

Keynesian Consumption Function; Technical attributes of Consumption Function; limitations of Keynesian Consumption Function, Factors affecting consumption function; Post Keynesian theories of Consumption: Fisher's theory of optimal inter-temporal choice; life-cycle and permanent income hypotheses; rational expectations.

Module III: Investment Function (17 Hours)

Meaning of Investment, Determinants of Investment; Marginal Efficiency of Capital, Marginal Efficiency of Investment, Relation between MEC and MEI; Theory of Investment Multiplier; Accelerator Theory of investment.

Module IV: Theories of Output and Employment (20 Hours)

Classical Theory; Keynes' objections to classical theory; Keynesian Theory: Aggregate Demand, Aggregate Supply; Derivation of aggregate demand and aggregate and supply curves; interaction of aggregate demand and supply; Theory of Effective Demand; Simple Keynesian model of Income Determination; Unemployment and Full Employment: Meaning, Types, Keynes' view on involuntary unemployment.

COURSE/LEARNING OUTCOMES

After learning this course, the students are able to:

- CO1:** Define the basic concepts of macro- economics. (Remembering)
- CO2:** Explain the different concepts of National Income. (Understanding)

- CO3:** Apply the different concepts of National Income Accounting in understanding how an economy works. (Applying)
- CO4:** Examine the Keynesian National Income Determination by using Aggregate Demand and Aggregate Supply concept. (Analysing)
- CO5:** Explain the concepts of Consumption Function and determinants of propensity to consume. (Evaluating)
- CO6:** Discuss the Investment Function and investment multiplier. (Creating)

Suggested Readings

1. D'Souza, E. (2008), Macroeconomics, Pearson Education: New Delhi.
2. Blanchard, O. (2006), Macroeconomics, Pearson Education, New Delhi.
3. N. Gregory Mankiw (2006), Macroeconomics, Worth Publishers
4. Dornbusch Rudiger, Fischer Stanley and Startz Richard (2004), Tata McGraw-Hill
5. Froyen (2013): Macroeconomics, Theories and Policies Pearson, New Delhi
6. Government of India (GOI) (Latest Year), Economic Survey||, Ministry of Finance: New Delhi

ENIM0008: INDIAN MONETARY SYSTEM

(6 Credits-75 Hours) (L-T-P: 5-1-0)

Objective: *The course intends to give an extensive exposure to the students to the concept of money and money supply and distinguish the different forms of money markets in India. The course also gives a theoretical perspective on determination of money supply through the various theories of demand.*

Module I: Introduction to Money (15 Hours)

Meaning, components of supply of money, measures of money supply; features of a developed money and capital market; functions of commercial banks and pre-requisites of a sound commercial banking system; brief review of the measures taken in India to liberalize the financial system.

Module II: Theories on Money (12 Hours)

Theories of demand for money –Post Keynesian Theories of Demand for money; the H theory of money supply; Money multiplier process, determinants of money multiplier; income theory of money.

Module III: Financial Institutions in India (23 Hours)

Functions & growth of financial institutions in India; Functions and objectives of central bank; instruments of credit control; role of non-banking financial institutions in India – mutual funds, LIC, Investment companies, venture capital; role of regulatory authorities – SEBI and IRDA.

Module IV: Money Market (15 Hours)

The structure of financial markets – call money, treasury bills and commercial bills; the stock market and market for gilt edged securities; unregulated credit markets; financial sector reforms in India.

Module V: Foreign exchange market (15 Hours)

Foreign exchange; foreign exchange rate, foreign exchange market – concept of spot exchange rate and forward exchange rates; determination of exchange rates under fixed & flexible exchange rate regime and role of hedging in the determination of exchange rates; Euro-Dollar market – its role & significance.

COURSE/LEARNING OUTCOMES

At the end of the course the students would be able to:

- CO1:** Define the various components of Indian Monetary System. (Remembering)
- CO2:** Explain the various concepts related to the Financial Institutions in India. (Understanding)
- CO3:** Identify the various financial institutions in India and their working pattern. (Applying)
- CO4:** Compare the various components of the monetary system and draw conclusions. (Analysing)
- CO5:** Explain the importance of various components of Indian Monetary System. (Evaluating)

Suggested Readings

1. Gupta, S.B., Monetary Economics, S. Chand & Company, New Delhi
2. Mitra, S., Money & Banking, Random House, New York
3. Chandler, L.V. & S.M. Goldfield, The Economics of Money and Banking, Harper & Row, New York
4. Sayers, R.S. Modern Banking, Oxford University Press, New Delhi
5. Smith, P.F., Economics of Financial Institutions & Markets, Prentice Hall
6. Gupta, S.B., Monetary planning for India, S. Chand & Company, New Delhi
7. Grabble, J.O., International Financial Markets, Elsevier, New York

ENSM0009: STATISTICAL METHODS FOR ECONOMICS-I

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objectives:

This course introduces the students to the basics of statistics. It will help the students to classify data, identify the different sources of data, techniques of collecting data and analysedata using various statistical tools. This course mostly focuses to accustom the students on the use of descriptive statistics, correlation & regression and time-series.

Module I: Introduction to Statistics (10 Hours)

Statistics: Meaning, Scope, Importance; Information and data: Processing information and use of statistical procedures; Frequency Distribution; Data Grouping: Discrete and Continuous; Introduction to Graphs and Diagrams

Module II: Measures of Central Tendency (20 Hours)

Measures of Central Tendency: Arithmetic Mean, Median, Mode, Geometric Mean, harmonic Mean, Quartiles; Properties and Applications of the Measures of Central Tendency.

Module III: Measures of Dispersion and Asymmetry (20 Hours)

- a. Measures of Dispersion: Range, Co-efficient of Range, Inter-quartile Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation, Properties and Applications of the Measures of Dispersion.
- b. Measures of Asymmetry: Skewness- Absolute and Relative Measures, Co-efficient of Skewness; Kurtosis; Moments and Moments based on Skewness and Kurtosis.

Module IV: Correlation and Regression (15 Hours)

- a. Correlation: Meaning Types, methods of studying correlation: Scatter Diagram, Karl Pearson's Coefficient of Correlation; Properties of Correlation Coefficient; Interpretation of Correlation; Coefficient of Determination; Rank Correlation

- b. Regression: Meaning, Linear and Non-Linear regression; Uses of Regression; Regression Lines, Regression Coefficients; Properties of Regression Coefficients; Estimation of Regression lines in a bi-variate distribution: Least squares method.

Module V: Time Series Analysis (10 Hours)

Time Series: Meaning, Components: Additive and Multiplicative Models, Uses, Fitting of Trend: Moving Average Method and Least Square Method

COURSE/LEARNING OUTCOMES

At the end of the course the students would be able to:

- CO1:** Recall basic concepts of Statistics. (Remembering)
- CO2:** Classify the various data types and the methods of Analysing data. (Understanding)
- CO3:** Apply various Statistical Tools Analysing data. (Applying)
- CO4:** Draw Inferences from data. (Analysing)
- CO5:** Interpret the inferences drawn from data. (Evaluating)
- CO6:** Predict trends from data. (Creating)

Suggested Readings

1. Jay L. Devore, Probability and Statistics for Engineers, Cengage Learning, 2010.
2. John E. Freund, Mathematical Statistics, Prentice Hall, 1992.
3. Richard J. Larsen and Morris L. Marx, An Introduction to Mathematical Statistics and its Applications, Prentice Hall, 2011.
4. William G. Cochran, Sampling Techniques, John Wiley, 2007.

ENMS0010: MICRO ECONOMICS II

(6 Credits – 75 Hours) (L-T-P: 5-1-0)

Objective: The objective of the course will be on giving conceptual clarity to the student coupled with the use of mathematical tools and reasoning. It covers general equilibrium and welfare, imperfect markets conditions for business firms.

Module I: Forms of Market (22 Hours)

Perfect competition - Equilibrium of the market, price determination in the short-run and long-run, Applications - effects of taxes and subsidies.

Monopoly - Equilibrium; price determination in the short-run and long run; monopoly power; deadweight loss; price discrimination; bundling; Monopolistic Competition - Product differentiation; equilibrium of the firm in the industry - with entry of new firms and with price competition, Comparison with pure competition.

Module II: Oligopoly and Game Theory (20 Hours)

- a) Cournot model and reaction curves; Stackelberg's model, Bertrand model; quantity leadership; price leadership; Non collusive stable equilibrium; collusion; cartels
- b) Concepts of Game Theory - Dominant strategies and Nash Equilibrium; Mixed strategies; Prisoner's Dilemma, Specification of oligopoly models in game theoretic terms.

Module III: Factor Markets (18 Hours)

Factor pricing in the case of single and many variable factors; demand for labor in a product market with perfect competition and monopoly, Monopsony, bilateral monopoly and role of labour unions; Economic rent and quasi rent; theory of interest; theory of profits.

Module IV: General Equilibrium (15 Hours)

Edgeworth box - 2 good, 2 factor, 2 consumer analysis and Pareto optimality conditions; market trade; Walras Law; Relative prices; Equilibrium and efficiency; Grand Utility possibility frontier; Implication of first and second welfare theorem

Module V: Welfare (8 Hours)

Social welfare function - welfare maximization; Fair allocation; Envy and equity; Arrow's Impossibility Theorem.

COURSE/LEARNING OUTCOMES

On completion of the course the students will be able to:

- CO1:** Relate the various market forms and determine prices under these market forms. (Remembering)
- CO2:** Explain the theories of welfare economics. (Understanding)
- CO3:** Apply the concepts of oligopoly and game theory. (Applying)
- CO4:** Distinguish between general and partial equilibrium analysis. (Analysing)
- CO5:** Assess the various theories of distribution in terms of determination of wages, rent, interest and profits. (Evaluating)
- CO6:** Adapt the concept of Factor market. (Creating)

Suggested Readings

1. Dr. Robert E. Hall and Dr. Marc Lieberman, Microeconomics- Principles and applications
2. Joseph E. Stiglitz and Carl E. Walsh, Principles of Microeconomics
3. Arthur O' Sullivan and Steven M. Sheffrin, Microeconomics - Principles, Applications and Tools
4. Varian, Hal R., Intermediate Microeconomics (Sixth edition)
5. Mankiw, Gregory N., Principles of Economics (Sixth edition)
6. Pindyck, Robert S. &Rubinfeld, Daniel L.: Microeconomics Sixth Edition [PHI]
7. Browning, Edgar K. &Zupan, Microeconomic Theory and Applications

ENQS0011: QUANTITATIVE METHODS IN ECONOMICS II

(6 Credits – 75 Hours) (L-T-P: 5-1-0)

Objective: The objective of this course is to accustom the students with the concepts of mathematical techniques and their applications which are used to elucidate the problems of economic theory and help in better choices.

Module I: Integral Calculus (14 hours)

Integration of a function - basic rules of integration Methods of Integration, derivation of total function, definite integrals – application in case of consumer's surplus and producer's surplus.

Module II: Differential Equations (17 Hours)

- a) Kinds of differential equations, order, degree, first order and first degree differential equations, linear homogeneous differential equations, exact differential equations, differential equations of second degree.
- b) Applications of differential equations – market price functions, dynamic multiplier, Harrod-Domar Model, Neo-Classical Model.

Module III: Difference Equations (17 Hours)

- a) Difference Equations; first-order difference equations – iterative method, general method; geometrical representation of the solution of first-order difference equations.
- a) Applications of difference equations – The Cobweb model, dynamic multiplier, multiplier-accelerator model.

Module IV: Input-Output Analysis (15 Hours)

- a) Input-output Analysis – assumptions, the technological coefficient matrix, closed and open input-output model, The Hawkins-Simon conditions, The Leontief Matrix.
- b) Consumption Function Analysis – The Leontief Production Function, Dynamic input-output model.

Module V: Elements of Linear Programming (12 Hours)

Inequality Constraints and formulation of Linear Programming: General Formulation of Production Problem and Diet Problem, Graphical Solution of Production and Diet Problem, Simplex Method of Solution of Production and Diet Problem

COURSE/LEARNING OUTCOMES

- CO1:** Relate to the basic concepts of mathematical techniques in economic theory. (Remembering)
- CO2:** Extend the further usage of the concepts of mathematical techniques. (Understanding)
- CO3:** Identify the areas in economic theory where mathematical techniques can be used. (Applying)
- CO4:** Analyse and examine the mathematical techniques. (Analysing)
- CO5:** Interpret the results drawn from the use mathematical techniques in economics. (Evaluating)
- CO6:** Test the theories of economics in terms of mathematical techniques. (Creating)

Suggested Readings

1. Chiang, A.C & Wainwright, K., Fundamental Methods of Mathematical Economics, McGraw Hill Education.
2. J.M. Henderson and R.E. Quandt, Micro – Economic Theory – A Mathematical Treatment, McGraw Hill.
3. R.G.D. Allen, Mathematical Economics for Economists, Biblio Bazaar.
4. Sydsaeter, Knut & Hammond, Peter J., Mathematics for Economic Analysis, Pearson Education.
5. J.K. Sharma, Operations Research: Theory and Applications, Trinity Press.

ENDE0012:DEVELOPMENT ECONOMICS-I

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objectives:

This course introduces the students to the basics terminologies of growth and development. It also explains difference between growth and development. This course further introduces the students to various growth theories which are crucial for the understanding of various aspects of development and its related concepts.

Module I: Development: Principles and concepts (10 Hours)

Development Meaning: Traditional View, The New Economic View; Core Values of Development; Objectives of Development; Nature of Development Economics; Role of values in Development Economics

Module II: Economic Growth and Economic development(20 Hours)

Economic Growth: Meaning; Sources of Growth: Capital Accumulation, Population & Labour Growth and Technological Progress; the Notion of Capital-Output ratio; Economic Development: Meaning; Differences between growth and development; Characteristics of an Underdevelopment; Causes of Underdevelopment; Development gap.

Module III: Economic Growth Theories (25 Hours)

Growth models and their relevance to the UDCs; Theories of Economic Growth-Classical approach to economic growth- Smith& Ricardo, Marx and Schumpeter; Harrod- Domar model; Solow's neoclassical model; Endogenous Growth Model; Kaldor's Model.

Module IV: Measurement of economic development (20 hours)

Measurement of economic development - National Income/ GDP and PCI as indicators of development and HDI; Human Development report 2018 (latest report); Structural Changes in the Development Process (Kuznets);

COURSE/LEARNING OUTCOMES

At the end of the course the students would be able to:

- CO1:** Define the various concepts of growth and development. (Remembering)
- CO2:** Compare and explain the difference between growth and development. (Understanding)
- CO3:** Identify the various growth theories. (Applying)
- CO4:** Analyse the aspects of measuring development. (Analysing)
- CO5:** Justify the use of HDI over other measures of development. (Evaluating)
- CO6:** Improve the understanding of development process. (Creating)

Suggested Readings

1. 1. Todaro and Smith, *Economic Development*, Pearson Education
2. 2. A P. Thirlwall, *Growth and Development*, Macmillan Press Ltd
3. 3. M. L. Taneja and R. M. Myer, *Economics of Development and Planning*, Vishal Publishing Company
4. 4. Mishra and Puri, *Growth and Development*, Himalaya Publishing House
5. 5. Debraj Ray, *Development Economics*, Princeton University Press

ENIC0013: INTRODUCTION TO COMPUTER APPLICATIONS

(1 Credit – 15 Hours, 1 credit Lab- 30 hours)

Objectives:

- *To learn the basic computer applications required in the field of commerce.*
 - *To learn and do basic calculations required in Commerce using a spreadsheet application.*
- The lab course shall be closely associated with the theory course and shall familiarize the students with the application of all the aspects of the syllabus outlined below.*

Module I: Introduction to Computers and WordProcessing (7 hours)

- a) Introduction to Computers: Characteristics of computers, The computer system, parts of a computer; Computer hardware setup, configuration, networking, wireless networking; Operating System-Introduction to operating systems, an overview of various types of operating systems and their applications (UNIX / Linux, DOS, Windows, Android, windows mobile, iOS etc.)
- b) Wordprocessor: meaning, features, advantages; structure of a wordprocessor window; creating a document, saving opening and printing, find and replace, inserting images, charts; creating and formatting a table; protection of documents-password for documents.

Module II: Presentation Package (8 hours)

Creating presentations in a presentation package, text, tables, charts, animation, running a slide show and setting timing, saving the slides, and printing presentations and notes. Hyperlink to other document/presentation or media file.

Module III: SpreadSheet (15 hours)

Creating a workbook ,Rearranging Worksheet, Cell, rows and columns; Range, Creating, saving opening and printing a spreadsheet, creating tables, charts and graphs. Mail merge- main document, data source and merging

Ranges, functions and formulae: mathematical, statistical functions; formula editing, sorting and filtering; Data Analysis: Consolidate data in multiple worksheets, Statistical Analysis; Data Validation and Protection: Create a drop-down list from a range of cells, apply data validation to cells, copy data validation settings, remove data validation, find cells that have data validation; protect cell data, using password to protect sheet and workbook, use validation to create dependent list; pivot table reports and pivot chart reports. Using spreadsheet for data analysis and reporting; using spreadsheet for following purposes and making reports:

- Graphical representation of data
- Frequency distribution and its statistical parameters
- Correlation and Regression

COURSE/LEARNING OUTCOMES

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

- CO1:** Distinguish between Operating Systems software and Application Systems software. (Analysing)
- CO2:** Define the commonly used operating systems. (Remembering)
- CO3:** Illustrate the primary functions of an Operating System. (Understanding)
- CO4:** Elaborate the “boot” process. (Creating)
- CO5:** Identify Desktop and Windows features. (Applying)
- CO6:** Utilize Utility programs. (Applying)
- CO7:** Compare three major operating systems. (Creating)

Suggested Readings

1. Rajaraman, V. Introduction to Information Technology, Second Edition. PHI.
2. <http://phindia.com/bookdetails/introduction-to-information-technology-rajaraman-v-isbn-978-81-203-4731-1>
3. Sinha, Pradeep K. and Preeti Sinha. Foundation of Computing, First Edition. BPB Publication.
4. <http://www.bpbonline.com/foundation-of-computing.html> ISBN-10:8176566636

5. Rajaraman, V. Analysis and design of information Systems. Third Edition, PHI.
6. <http://phindia.com/bookdetails/analysis-and-design-of-information-systems-rajaraman-v--isbn-978-81-203-4384-9>
7. Sadagopan, S. Management Information Systems. Second Edition, PHI.
8. <http://phindia.com/bookdetails/management-information-systems-sadagopan-s--isbn-978-81-203-4892-9>

ENBE0014:BUSINESS ENVIRONMENT

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective:

To apply relevant knowledge, skills and exercise professional judgment in understanding the business environment in which a business organization operates. The course would also make the students capable of Analysing and understanding policies of the government implemented from time to time and assess their impact on business.

Module I: Business Environment (12hours)

Concept, Components and importance; Nature of Environment of business, Types of Business Environment, Economic Environment of Business, Non-Economic Environment of Business, Techniques of environmental forecasting; Impact of Business Environment on Business Decisions.

Module II: Indian Economic Environment(18 hours)

Profile of Indian Economy, EconomicreformsinIndia–Liberalization,privatizationandglobalization and its impact on Indian Economy, Factors in Economic Development

Module III: Business and Government – Indian Perspective(15 hours)

Role of the State and Central Government in the Economic Development of India, Fiscal and Monetary Policies, Industrial Policy, Foreign Trade Policy, Export Import Policy

Module IV: Business Ethics and Social Responsibilities(18 hours)

Business ethics and social responsibilities; relationship between business and society; social accountability; Ethical issues and values in business; Corporate Social policies- issues and challenges; Ecological and environmental issues.

Module V: International Organizations and Arrangements (12 hours)

WTO- Its objectives, principles and functioning; WTO and India; Forms of Economic Integration; Effects of Economic Integration; Major Regional Trade Blocs.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the various concepts of business environment. (Remembering)
- CO2:** Explain the impacts of Government policy on the economic environment (Evaluating)
- CO3:** Elaborate the role of WTO and Economic Integration. (Creating)
- CO4:** Examine the impact of Economic Reforms in India (Analysing)
- CO5:** Outline the importance of business ethics, social responsibilities and ethical values in business. (Understanding)
- CO6:** Identify the role of government in the economic development of India. (Applying)

Suggested Readings

1. Fernando, A.C., Business Environment, Pearson Education India
2. Aswathappa, K., Essentials of Business Environment, Himalaya Publishing House
3. Britton, C. & Worthington, I., The Business Environment, Pearson
4. Cherunilam, F., Business Environment, Himalaya Publishing House
5. Misra, S. K. & Puri, V.K., Economic Environment of Business, Himalaya Publishing House
6. SwaberalIslam&Kharkongor; Business Environment, Taxman's Publication, New Delhi.
7. A. N. Agarwal, Indian Economy, New Delhi.
8. Gupta, Liberalization- its impact on Indian Economy, Macmillan.

ENSE0015: STATISTICAL METHODS FOR ECONOMICS-II**(6 credits-75 Hours) (L-T-P: 5-1-0)****Objectives:**

This course introduces the students to the basics and terminologies of sampling and inference. It develops the notion of random variables and probability distributions of discrete and continuous random variables. This course also focuses to introduce and accustom the students on the use of index numbers and vital statistics.

Module I: Introduction to sampling (10 hours)

Concepts of sampling: populations and samples; population parameters and sample statistics; estimators; Difference between sample survey and complete enumeration: Types of sampling; Principal steps in a sample survey

Module II: Elementary Probability Theory (13 hours)

Sample spaces and events; probability axioms and properties; counting techniques; conditional probability and Bayes' rule independence.

Module III: Random Variables and Probability Distributions (25 Hours)

Defining random variables; probability distributions; expected values of random variables and of functions of random variables; properties of commonly used discrete and continuous distributions: Binomial, Poisson, Normal.

Module IV: Index Numbers (15 Hours)

Index Numbers: Definition, Uses, Problems in the construction of Index Numbers; Methods of Construction of Index Numbers: Simple Aggregative Method, Simple Average of Price Relative Method, Weighted Index Numbers, Laspeyre's Method, Paasche's Method, Dorbish and Bowley's Method, Fisher's Index; Tests of Adequacy of Index Numbers, Construction of Consumer price Indices

Module V: Vital Statistics (12 Hours)

Concepts and Measurement of fertility-crude birth rate, general fertility rate, age specific fertility rate, total fertility rate, Net reproduction rate, gross reproduction rate, Measurement of Mortality: crude death rate, specific death rate, standardized death rate, Life Table (Basic features)

COURSE/LEARNING OUTCOMES

At the end of the course the students would be able to:

- CO1:** Define the various concepts of sampling, Index Number and Vital Statistics. (Remembering)

- C02:** Explain the use of probability in sampling. (Understanding)
- C03:** Apply various techniques of probability distribution in Analysing data. (Applying)
- C04:** Draw Inferences from data. (Analysing)
- C05:** Explain the use of Index number. (Evaluating)
- C06:** Discuss the various key aspects of Vital Statistics. (Creating)

Suggested Readings

1. Jay L. Devore, Probability and Statistics for Engineers, Cengage Learning, 2010.
2. John E. Freund, Mathematical Statistics, Prentice Hall, 1992.
3. Richard J. Larsen and Morris L. Marx, An Introduction to Mathematical Statistics and its Applications, Prentice Hall, 2011.
4. William G. Cochran, Sampling Techniques, John Wiley, 2007.

ENMS0016:MACRO -ECONOMICS II

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective:

This course introduces the students to the banking system and the role of macro-economic policies in the context of economic growth of nation. It also introduces the students to various theoretical issues related to an open economy.

Module I: Schools of Macroeconomic Thoughts (7 Hours)

Classical; Keynesians; New- Classical and New-Keynesians.

Module II: Goods and Money Market Equilibrium (8 Hours)

Liquidity Preference and the rate of interest: Interaction between the rate of interest and income: the IS-LM framework, Policy implications in IS-LM framework.

Module III: Macro-Economic Policies: Fiscal and Monetary Policy (15 Hours)

Macro–Economic Policies- Inflation Targeting, The Design of Monetary Policy: objectives and targets; The Government Budget Constraint - Government debt and Ricardian Equivalence; Fiscal Policy, Issues in Fiscal Policy.

Module IV: Inflation, Unemployment and Expectations (20 Hours)

Meaning, Types and Impact; hyperinflation; Theories of Inflation- Demand pull (Keynesian and Monetarist), Cost Push; Structural Theories of Inflation-Inflation in developing countries; Inflation and its social costs; Inflation and Unemployment – Philips Curve ; adaptive and rational expectations; policy ineffectiveness debate.

Module V: Business Cycle (10 Hours)

Meaning, Phases, Characteristics; Theories of Business Cycle –Hawtrey’s Monetary Theory, Hicks’s Multiplier –Accelerator Interaction Theory;

Module VI: Open Economy (15 Hours)

Balance of Payments: Balance of Trade; Capital Account and Current Account; Trade Balance and Exchange Rates: Nominal Exchange Rate and Real Exchange Rate; Short-run open economy models; Mundell-Fleming model; exchange rate determination; The effectiveness of Fiscal Policy and Monetary Policy in under different exchange rate regimes; Monetary approach to balance of payments; Purchasing Power Parity - Absolute and Relative Purchasing Power Parity; Devaluation and Revaluation; Policy mix as optimal tool for internal and external balance under perfect capital mobility.

COURSE/LEARNING OUTCOMES

After learning this course, the students will be able to:

- CO1:** Define different schools of Macroeconomic Thoughts. (Remembering)
- CO2:** Explain the concepts of Goods and Money Market Equilibrium. (Understanding)
- CO3:** Apply the different concepts of Macro-Economic Policies like Fiscal and Monetary Policy. (Applying).
- CO4:** Examine the concepts of Inflation, and its relation between Unemployment and Expectations. (Analysing)
- CO5:** Explain the concepts of Business Cycle (Evaluating)
- CO6:** Discuss the meaning and other concepts related to Open Economy. (Creating)

Suggested Readings

1. D'Souza, E. (2008), Macroeconomics||, Pearson Education, New Delhi.
2. Blanchard, O. (2006), Macroeconomics, (IVth Edition), Pearson Education, New Delhi
3. N. Gregory Mankiw (2005), Macroeconomics, Vth Edition, Worth Publishers
4. Dornbusch Rudiger, Fischer Stanley and Startz Richard, Macroeconomics.
5. Charles Jones, Introduction to Economic Growth, (Latest Edition).
6. Froyen (2013): Macroeconomics - Theories and Policies, Pearson, New Delhi

ENDS0017: DEVELOPMENT ECONOMICS-II

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objectives:

This course introduces the students to the basics of sectoral development. It also explains the role of various factors like population and environment in development process. This course further introduces the students to various development theories and its applicability.

Module I: Sectoral Development (15 Hours)

Role of Agriculture in Economic Development; Role of Industry in economic development: Large Scale v/s Small Scale Industries; Trade and Development; Choice of Techniques: Labour Intensive v/s Capital Intensive; Obstacles to Development

Module II: Role of other Factors (10 Hours)

Poverty, Income inequality and Development; Population Growth and Economic Development; Role of Human Capital in Development; Environment and development, Concept of Sustainable development.

Module III: Development Theories (25 Hours)

Theories of Persistence of Underdevelopment: Vicious Circle of Poverty; Cumulative Causation (Myrdal); Strategies for Development: Balanced Growth Strategy, Unbalanced Growth Strategy, Big push theory; Critical Minimum Effort Thesis, The stages of growth-Rostow.

Module IV: More on Development Theories (25 Hours)

Kuznets' Inverted- U Hypothesis; Structural Change Models: Lewis Unlimited Supply of Labour; International Dependence Models: Neo-colonial Dependence Model, The False Paradigm Model; Prebisch- Singer Thesis on Trade and Development; Dual Gap Analysis

COURSE/LEARNING OUTCOMES

At the end of the course the students would be able to:

- CO1:** Define the key aspects of sectoral development. (Remembering)
- CO2:** Explain the role of various factors in development. (Understanding)
- CO3:** Identify the various development theories. (Applying)
- CO4:** Analyse the uses of various development theories. (Analysing)
- CO5:** Explain the importance of development theories. (Evaluating)
- CO6:** Discuss the various key aspects of measuring development and its applicability. (Creating)

Suggested Readings

1. Todaro and Smith, *Economic Development*, Pearson Education
2. A P. Thirlwall, *Growth and Development*, Macmillan Press Ltd
3. M. L. Taneja and R. M. Myer, *Economics of Development and Planning*, Vishal Publishing Company
4. Mishra and Puri, *Growth and Development*, Himalaya Publishing House
5. Debraj Ray, *Development Economics*, Princeton University Press

ENOB0018: ORGANISATIONAL BEHAVIOUR

(2 credits-30 Hours)(L-T-P:2-0-0)

Objectives:

This course is designed to give students the basic knowledge of human behavior needed to provide a more effective organizational environment. The basic elements of the course will be the behavior of individuals in organizations, group behaviour in organizations, and how these behavior affect the overall performance of organizations. Particular emphasis is placed on individual difference, attitude, motivation, job satisfaction, communication, leadership, stress, change and organizational culture.

Module I (5 hours)

The concept of Organizational Behaviour (OB): Nature, Definition, Nature, and Significance, Challenges of OB; Models in OB, New Challenges in OB, Concept and Theories of Learning. Case Analysis

Module II (7 hours)

Foundations of Individual Behaviour: Personality– Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB. Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation–Nature and Importance, Hertzberg’s Two Factor Theory, Maslow’s Need Hierarchy Theory . Case Analysis

Module III (10hours)

- a) Organizational Behaviour Process: Communication–Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Inter-personal Effectiveness. Groups in Organizations-Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision making, Team Building.
- b) Leadership- Leadership and Management, Theories of Leadership–Trait theory, Leader Behaviour theory, Contingency Theory, How to be an effective Leader. Conflict–Nature of Conflict and Conflict Resolution strategies. Case Analysis

Module IV (8 hours)

Organization: Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Organizational Change–Importance of Change, Planned Change; Impact of Change on Individual and Interpersonal Behaviour. Case Analysis

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning of organization behaviour. (Remembering)
- CO2:** Explain the models and the theory of learning and the foundations of individual behaviour. (Understanding)
- CO3:** Develop the relationship between the various theories of motivation and workplace behaviour. (Applying)
- CO4:** Distinguish between leadership and management and the different leadership theories. (Analysing)
- CO5:** Evaluate the various human resource management functions. (Evaluating)
- CO6:** Formulate different types of leadership strategies. (Creating)

Suggested Readings

1. V. S. P.Rao, Organizational Behaviour, Excel Books.
2. Stephen P Robbins, Organizational Behaviour, PHI Learning, New Delhi
3. J. W. Newstorm and K. Davis, Organizational Behaviour: Human Behaviour at Work, MGH, New Delhi
4. K. Aswathappa, Organizational Behaviour, Himalaya Publishing House, New Delhi
5. P. N. Khandawalla, Organizational Behaviour, McGrawHill, New Delhi.

ENFA0019: FUNDAMENTALS OF ACCOUNTING

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objectives:

- *To give basic concepts of accounting, its characteristics, rules of accounting, the practical knowledge of accounting.*
- *To give basic concepts underlying the accounting practices and its techniques with special reference to Sole Proprietorship.*
- *To identify the process of preparing financial statement for the organizations.*
- *To provide theoretical and practical knowledge of partnership firms.*
- *To provide the theoretical and practical knowledge of company accounts.*

Module I (15 hours)

- a) Introduction to Financial Accounting: Introduction, Meaning of Book Keeping, Accounting and Accountancy, Distinction between Book Keeping and Accounting, Accounting Process, Objectives of Accounting, Various users of Accounting Information, Limitations of Accounting, Accounting Terminologies
- b) Accounting Concepts, Principles and Conventions: Introduction, Meaning of Accounting Concepts, Principles, Conventions, Types of Accounting Concepts, Types of Accounting Principles, Types of Accounting Conventions, Accounting standards, International Financial Reporting Standards [IFRS], Accounting Standards.

Module II (10 hours)

Recording of Transactions: Introduction, Meaning of Assets, Liabilities, Equity, Accounting Equation and Effects of Financial Transaction on Accounting Equation, Classification of Accounts under Modern Approach Method, Double Entry System and Rules of Debit and Credit Entries, journal entry, ledger preparation, and preparation of Trial Balance.

Module III (15 Hours)

Final Accounts: Introduction, Meaning, Trading Account, Profit and Loss Account, Balance Sheet, Treatment of Adjustments, Practical Problems

Module IV (10 Hours)

Bank Reconciliation Statement: Introduction, Meaning of Bank Reconciliation Statement, Importance of Bank Reconciliation Statement, Reasons for Difference, Procedure for Reconciliation

Module V (15 Hours)

Partnership Accounts – Admission of a Partner: Introduction, Partnership - Meaning and Features, Partnership Deed and Contents, Admission of a Partner, Goodwill-Meaning, Accounting treatment for partnership firms.

Module VI (10 Hours)

Introduction to Company Accounts: Introduction, Kinds of Companies, Formation of Companies, Share Capital, Issue of Shares-Introduction, Forfeiture of Shares, Reissue of Shares.

COURSE/LEARNING OUTCOMES

- CO1:** Definition and concept of accounting, its characteristics, concepts, rules of accounting (Remembering)
- CO2:** Illustrate the recording process in the books of accounts (Understanding)
- CO3:** Apply those basic concepts underlying the accounting practices and its techniques with special reference to Sole Proprietorship. (Applying)
- CO4:** Explain the process of preparing financial statement for the organizations. (Evaluating)
- CO5:** Solve the problems related to partnership firms and company accounts. (Creating)
- CO6:** Classify expenses and income in the nature of revenue and capital. (Analysing)

Suggested Readings

1. Maheshwari S. N., K Maheshwari Suneel K., K. Maheshwari Sharad, Financial Accounting for BBA, Paperback
2. Jawahar Lal, Seema Srivastava, Financial Accounting –Principles of practices, S Chand
3. Dam B B, Financial Accounting.
4. Goel D.K, Goel Rajesh, Goel Shelly. Fundamentals of Financial Accounting, Paperback

DEPARTMENT OF MANAGEMENT

MTOB0001: ORGANIZATIONAL BEHAVIOUR

(4 credits– 60 hours)

Objective: *The objective of this paper is to provide the students an insight into the principles of organizational behaviour and its relation to other activities in an organization, and to introduce the student to the techniques of organisational behaviour used as a management tool.*

Module I: Introduction to Organizational Behaviour (8 Hours)

Defining Organisational Behaviour, historical background: the Hawthorne Studies; early development, conceptual development; the nature of people; theoretical frameworks; explaining and predicting behaviour; OB in the global context.

Module II: Cognitive processes of organizational behavior (12 Hours)

Nature and importance of Perception and attribution; perception and individual decision making; values, nature and dimensions of attitudes and job satisfaction; personality; aptitude; interests; learning; intelligence, motivation - theories of motivation.

Module III: Group Dynamics (14 Hours)

- a) Understanding group dynamics, types of groups, group goals, group cohesiveness, group pressure and norms, teamwork; group structure - formal leadership, roles and norms; group member resources - abilities, personality, characteristics, stages in group development.
- b) Leadership : Theories - trait, behavioural, contingency, attributional, charismatic, transactional vs. transformational.
- c) Power and politics: Contrasting leadership and power; power in groups; power tactics; politics-power in action.

Module IV: Communication and Decision Making (12 Hours)

Role of communication; Communication media and technology, communication networks - formal vs. informal; barriers to effective communication; communication skills; feedback information; persuasion in communication; active listening; participative decision making techniques; group vs. the individual; group think and group shift; the decision making process

Module V: Organizational culture and Work Stress (14 Hours)

- a) Definition of organizational culture; cultural typologies; organizational culture vs. national culture; functions of culture; formation of cultures; potential sources of stress - environmental factors, organizational factors; individual differences - perception, job experience, social support, locus of control, hostility; Stress – the emergence of stress, causes of stress; stress consequences - physiological symptoms, psychological symptoms, behavioural symptoms, stress management strategies - individual approaches, organizational approaches.
- b) Conflict and negotiation : Definition of conflict; the conflict process; conflict in intergroup relations; creating functional conflicts; bargaining strategies; role of personality traits in negotiation; third party negotiations; intergroup relations and factors affecting intergroup relations.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning of organization behavior. (Knowledge)
- CO2:** Explain the models and the theory of learning and the foundations of individual behaviour. (Comprehension)
- CO3:** Establish the relationship between the various theories of motivation and workplace behaviour. (Application)
- CO4:** Differentiate between leadership and management and the different leadership theories. (Analysis)
- CO5:** Formulate different types of leadership strategies. (Synthesis) **CO6:** Evaluate the various conflict resolution strategies. (Evaluation)
- CO7:** Describe various ways of managing stress at workplace. (Comprehension)

Suggested Readings

1. Fred Luthans, Organisational Behaviour, 10th Edition, McGraw Hill India
2. Stephen P Robbins, Organizational Behaviour, 11th Edition, Prentice Hall of India Pvt. Ltd., New Delhi
3. Gilmer, Industrial Psychology, McGraw Hill.
4. Ghiselle and Brown, Personnel and Industrial Psychology, McGraw Hill.
5. Keith Davis, Human Relations at Work, Tata McGraw Hill.
6. Leavitt, Managerial Psychology, University of Chicago Press.
7. BM Bass, Leadership Psychology and Organizational Behaviour, Harper International.
8. Litterer, Analysis of Organizations, John Wiley.

MTAF0002: ACCOUNTING AND FINANCIAL MANAGEMENT

(4 credits-60 hours)

Objective: The objective of this paper is to make the students familiar with the basic accounting and financial management concepts. This takes into account the knowledge of accounting that a student may require when faced with the task of developing or maintaining any package for any business/financial institutions as well as for non-profit organisations

Module I: Introduction to Accounting (14 Hours)

Utility of Accounting in business enterprises, Double entry system of accounting, accounting equation, accounting principle concepts and conventions, journal, ledger, trial balance, cash book (single, double and triple column).

Module II: Final Accounts and Statements (16 Hours)

- a) Distinction between capital and revenue expenditure, construction of trading, profit and loss accounts and balance sheet of sole proprietorship concerns with adjustments, manufacturing account, simple problems on final accounts of companies.
- b) Preparation of Income and Expenditure account and balance sheet (from receipts and payments account) with common adjustments for non trading institutions.

Module III: Techniques of costing (10 Hours)

Definition of costing and cost accounting, classification of cost, Marginal costing – Basic concepts, break-even analysis, construction of break-even chart, problems on marginal costing, application of marginal costing in decision-making.

Module IV: Financial management (12 Hours)

Financial Statement Analysis- Ratio Analysis – Meaning, Advantages, limitations and types of ratios and their usefulness, simple problems on current ratio, liquid ratio, debt- equity ratio, inventory turnover ratio, gross profit ratio, net profit ratio, earnings per share, return on investment. Fund Flow Analysis- preparation of statement of changes in working capital, preparation of fund flow statement.

Module V: Budget (8 Hours)

Budget: Different types of budget, Theoretical concept, preparation of flexible budgets and cash budgets.

COURSE/LEARNING OUTCOMES

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

- CO1:** Describe the term financial management (Comprehension)
- CO2:** State the different tools and techniques of financial management (Knowledge)
- CO3:** Describe in detail about budget and budgeting (Comprehension)
- CO4:** Not only explain what capital budgeting is but also the types of capital budgeting methods (Comprehension)
- CO5:** Define Internal Rate of Return. (Comprehension)
- CO6:** Illustrate investment analysis. (Knowledge)
- CO7:** illustrate with example the concept of cost and its type (Application)
- CO8:** Define marginal cost. (Knowledge)
- CO9:** Estimate marginal cost. (Application)
- CO10:** Define cost analysis for marginal decision (Knowledge)
- CO11:** Estimate break-even point and explain what is break even analysis (*Application*)
- CO12:** Estimate margin of safety (Application)
- CO13:** Prepare journals, ledger, Trial Balance (Synthesis)
- CO14:** Prepare and evaluate financial statement. (Synthesis, Evaluation)

Suggested Readings

1. Dr. Jawahar Lal, Accounting for Management, Himalaya Publishing House, Mumbai.
2. C. Mohan Juneja, R.C. Chawla, K.K.Saksena, Double Entry Book Keeping, Kalyani Publishers, Ludhiana.
3. S.P .Jain, K.L. Narang, Cost Accounting, Kalayani Publishers, Ludhiana.
4. Shukla, Grewal, Gupta, Advanced Accounts, S Chand & Sons, Delhi.
5. Jain, Narang, Advanced Accountancy, Kalyani Publishers, Ludhiana.

MTOB0069: INTRODUCTION TO ORGANISATIONAL BEHAVIOUR

(2 credits – 30 hours) (L-T-P:2-0-0)

Objective: *This course is designed to give students the basic knowledge of human behavior needed to provide a more effective organizational environment. The basic elements of the course will be the behavior of individuals in organizations, group behavior in organizations, and how these behaviors affect the overall performance of organizations. Particular emphasis is placed on individual difference, attitude, motivation, job satisfaction, communication, leadership, stress, change, and organizational culture.*

Module I (5 hours)

The Study of Organizational Behaviour (OB): Learning objectives, Definition and Meaning, Why Study OB, Models in OB, New Challenges for OB Manager. Learning – Nature of Learning, How Learning occurs, Learning and OB. Case Analysis

Module II (7 hours)

Foundations of Individual Behaviour: Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB. Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation– Nature and Importance, Herzberg’s Two Factor Theory, Maslow’s Need Hierarchy Theory, Alderfer’s ERG Theory, Evaluations. Case Analysis

Module III (10 hours)

- a) Organizational Behaviour Process: Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness. Groups in Organizations - Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision making Managerial Implications, Effective Team Building.
- b) Leadership – Leadership and Management, Theories of Leadership – Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Followership, How to be an effective Leader. Conflict – Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA). Case Analysis

Module IV (8 hours)

Organization: Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management – Selection, Orientation, Training and Development, Performance Appraisal, Incentives; Organizational Change – Importance of Change, Planned Change and OB techniques. International Organizational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective. Case Analysis

Suggested Readings

1. VSP Rao, Organizational Behaviour, Excel Books.
2. Stephen P Robbins, Organizational Behaviour, PHI Learning, New Delhi
3. JW Newstorm and K. Davis, Organizational Behaviour: Human Behaviour at Work, MGH, New Delhi
4. K. Aswathappa, Organizational Behaviour, Himalaya Publishing House, New Delhi
5. PN Khandawalla, Organizational Behaviour, McGraw Hill, New Delhi.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning of organization behavior (Knowledge)
- CO2:** Explain the models and the theory of learning and the foundations of individual behavior. (Comprehension)
- CO3:** Establish the relationship between the various theories of motivation and workplace behavior. (Application)
- CO4:** Differentiate between leadership and management and the different leadership theories. (Analysis)
- CO5:** Formulate different types of leadership strategies. (Synthesis)
- CO6:** Evaluate the various human resource management functions. (Evaluation)

MTFP0070: FUNCTIONAL PRINCIPLES OF MANAGEMENT**(2 credits – 30 hours)**

Objective: This course aims at imparting the students with relevant knowledge, principles, and practices of management so as to groom them as competent contributors in the workforce, ready to occupy managerial and administrative positions in various organizations.

Module I: General Principles and Practices of Management (6 hours)

- a) Theories of Management: Contribution of Management Thinkers – Taylor, Fayol, Elton Mayo, different schools of management thought- classical, scientific, contingency.
- b) Functions of Management: Planning, Organizing, Staffing, Leading and Controlling.

Module II: Marketing Management (8 hours)

- a) Introduction to Marketing: Concepts, Nature, Importance, Marketing Mix. b) Capturing Customer insights: Marketing Research, Customer Behavior, and Market Segmentation.
- c) Building Brand Loyalty: Product Strategies, Branding Strategies, Pricing Strategies. d) Promotional Mix: Advertising and Distribution Strategies.

Module III: Strategic Management (8 hours)

- a) Concepts of Strategic Management: Defining Strategy, Strategic Management Process – Formulation, Implementation and Evaluation.
- b) Strategic Analysis: Core Competence, Corporate-level strategy, Business-unit level strategy, generic level strategy.
- c) Current Strategies in Business Management: Knowledge Management, Corporate Governance, E-commerce- virtual value chain, Technology Management.

Module IV: Quantitative Techniques for Managerial Decisions (8 hours)

- a) Introduction: Methods of Data Collection and Sampling Fundamentals.
- b) Simulation Techniques: Markov Analysis, Monte Carlo Simulation.
- c) Decision Theory: Decision tree, Decision making under Risk (EMV criteria) and Uncertainty.

COURSE/LEARNING OUTCOMES

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

- CO1:** Enumerate the general principles and practices of management. (Knowledge)
- CO2:** Explain the concepts of marketing management. (Comprehension)
- CO3:** Determine the strategic management process. (Application)
- CO4:** Analyse the various levels of strategy and current strategies in business management. (Analysis)
- CO5:** Formulate methods of data collection (Synthesis)
- CO6:** Evaluate simulation techniques and decision theory for business decision making. (Evaluation)

Suggested Readings

1. Harold Koontz & Heinz Weihrich, Essentials of Management, Tata Mc Graw Hill.
2. Stoner, Freeman, Gilbert Jr., General Management, Prentice Hall.
3. Philip Kotler & Gary Armstrong, Principles of Marketing, 15th edition, Prentice Hall.
4. Kotler, Keller, Koshi and Jha, Marketing Management – A South Asian Perspective, 13e, Pearson.
5. V. S. Ramaswamy & S. Namakumari, Marketing Management, Macmillan.

6. Wheeler, T.L. Hunger, J.D., and Rangarajan K., Concepts in Strategic Management & Business Policy, 11th edition, Pearson Education.
7. Ranjan Das, Crafting the Strategy: Concepts & Cases in Strategic Management, Tata Mc Graw Hill.
8. J. K. Sharma, Operations Research Theory & Applications, MacMillan.
9. Srivastava, Sharma & Shenoy, Quantitative Techniques for Managerial Decision Making, Sultan Chand & Co.
10. N. D. Vohra, Quantitative Techniques in Management, Tata Mc Graw Hill.
11. Pradip Kr. Sinha & Sanchari Sinha, Current Trends in Management, Nirali Prakashan.

MTOM0071: PRODUCTION AND OPERATIONS MANAGEMENT

(2 credits – 30 hours)

Objective: *This course aims at acquainting the students with the functions of production and operations management and basic issues and tools of managing production and operation functions of an organization. The course also intends to provide the students a system theoretic view on project management and helps develop an understanding on why today's organizations are cultivating a formal project management process to gain competitive advantage. The syllabus has an in-depth coverage of the most critical topics found in PMBOK (Project Management Body of Knowledge) Guide.*

Module I: Introduction and Work Study (7 hours)

- a) Introduction to Production and operations management
- b) Meaning and scope, subdivisions of work study – Method/Motion study and Work Measurement
- c) Method/ Motion study- its meaning and scope, steps in method/motion study, Tools and techniques of method/motion study, Principles of motion economy
- d) Micro-motion study – Meaning and scope, therbligs, use of motion camera in micro-motion study
- e) Work measurement – concept of observed time, rating/leveling factor, average worker and standard time for jobs. Use of stop watch and work sampling techniques in the determination of standard time.

Module II: Plant Location and layout (7 hours)

- a) Objectives, Locational factors, Economics of plant location
- b) Meaning, objectives and types of plant layout and their relevance to mass, batch and job-order production systems.
- c) Systematic Layout Planning (SLP) procedure d) Use of computers for layout design
- e) Group Technology (GT), Flexible manufacturing systems (FMS) and Computer integrated manufacturing (CIM)
- f) Assembly Line Balancing (ALB) - meaning and objective, Heuristic methods for solution of ALB problems.

Module III: Product design and Development and PPC (10 hours)

- a) Meaning of product, Product life cycle (PLC) and Product mix b) Decisions to be taken during product development and design c) Procedure for product development and design

- d) Value of a product – its meaning, Value Analysis (VA) – its objectives, procedure and example, Simplification and Standardization.
- e) Meaning and Objectives of PPC, Effects of types of production
- f) Steps in PPC primarily stressing the needs of marketing research, Demand forecasting, process planning/routing, scheduling of flow-shop and job-shop productions, Use of Gantt chart, Machine loading, Make/Buy decision and Break-even analysis, Master production schedule, MRP and MRP-II, Capacity planning, Inventory management.
- g) Production control – monitoring, expediting and re-planning, Planning and control of batch production. TOC, Use of L.P in Production Management, Product and service Reliability.

Module IV: Project Management (6 hours)

- a) Project management framework, Scope management.
- b) Project management processes, Cost and Time management, Project integration management, Project risk management, Project Quality management, Project communication management.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define a production system. (Knowledge)
- CO2:** Distinguish between production and operations. (Comprehension)
- CO3:** Use the tools and techniques to measure work study, motion study. (Application)
- CO4:** Apply the concepts of work sampling techniques in the determination of standard time. (Application)
- CO5:** Comprehend the significance of plant location and prepare systematic layout planning procedure. (Synthesis)
- CO6:** Explain product life cycle and product mix. (Comprehension)
- CO7:** Demonstrate the procedure for product development and design. (Application)
- CO8:** Compare between make or buy decision. (Analysis)
- CO9:** Apply various tools of demand forecasting. (Application)
- CO10:** Determine inventory and inventory control techniques. (Application)
- CO11:** Synthesize project management framework. (Synthesis)
- CO12:** Compute project completion time and Analyse and evaluate project risk management techniques. (Application, Analysis & Evaluation)

Suggested Reading

1. M. Telsang, Industrial Engineering, S. Chand & Company Ltd.
2. Kanishka Bedi, Production and Operations Management, Oxford University Press.
3. O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai & Sons.
4. M. Mahajan, Industrial engineering, Dhanpat Rai & Company.
5. L. Krajewski, L. Ritzman and M. Malhotra, Operations Management, Pearson Education.
6. Adam, Ebert, Production and Operations Management, PHI.
7. R. Panneerselvam, Production and Operations Management, PHI.
8. K. Aswathappa & K. Shridhara Bhat, Production and Operations Management, Himalaya Publishing

MTQM0072: QUALITY MANAGEMENT SYSTEMS

(2 credits – 30 hours)

Objective: *This course is introduced with the objective of Analysing the relevance of total quality management in the engineering profession in the light of its increased involvement in company practices. It provides an insight on the various techniques of quality control and presents a broad picture of TQM and explains why it is considered as a major thrust for future competitiveness.*

Module I: Introduction (5 hours)

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

Module II: TQM Principles (6 hours)

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDCA Cycle, 5S, JIT, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

Module III: Statistical Process Control (SPC) (8 hours)

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, DMAIC, Lean Six sigma.

Module IV: TQM Tools (6 hours)

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

Module V: Quality Systems (5 hours)

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing and Reviewing, CMMI, ISO 14000 – Concept, ITIL, CMMI Services, TL9000, ISO 20000 Requirements and Benefits.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define quality and its various dimensions. (Knowledge)
- CO2:** State the various principles of TQM. (Comprehension)
- CO3:** Apply the seven tools of quality control and statistical process control. (Application)
- CO4:** Determine control charts for variables and attributes. (Application)
- CO5:** Describe benchmarking process. (Comprehension)
- CO6:** Illustrate Quality Function Deployment (QFD). (Application)
- CO7:** Explain Six Sigma Concept in TQM. (Comprehension)
- CO8:** Compare and contrast between various quality systems. (Analysis)

Suggested Readings

1. Rajaram, Total Quality Management, Wiley India.
2. Montgomery, Introduction to Statistical Quality Control, 4th Ed, Wiley India.
3. Dale H. Besterfield, et al., Total Quality Management, Pearson Education, Inc. 2003.
4. Amitava Mitra, Fundamentals of Quality Control and Improvement, Pearson Education.
5. Shailendra Nigam, Total Quality Management an integrated approach, Excel books.
6. G Nagalingappa and Manjunath V S, Total Quality Management Text and Cases, Excel Books.
7. James R. Evans and William M. Lindsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002
8. Feigenbaum. A.V., Total Quality Management, McGraw Hill.
9. Oakland J.S., Total Quality Management Butterworth – Heinemann Ltd., Oxford.
10. Narayana V. and Sreenivasan N.S., Quality Management – Concepts and Tasks, New Age International.

MTFC0073: FINANCIAL MANAGEMENT AND ACCOUNTING**(3 credits - 45 hours)**

Objective: *The objective of the course is to provide a broad exposure to the basic terminology, tools, and techniques of financial management and accounting which will enable the students to understand accounting issues as they arise in either the financial press or in the workplace. The knowledge gained through this subject can also be helpful in operational and strategic decision making.*

Module I (8 hours)

- a) Introduction: Financial Management, Financial Planning and Capitalization- definitions, objectives, changing roles and functions, Financial Decision.
- b) Capital Budgeting: Nature of Investment decision, Importance of Capital Budgeting, The Capital. Budgeting Process - Investment criterion, Pay-back period, Accounting, ROR (Rate of Return) Method, Discounting Cash flow method, Net - present value method, IRR (Internal Rate of Return) method, The benefit-Cost Ratio method.

Module II (10 hours)

- a) Management of Working Capital: Various concepts, Elements, Classification, Financing and importance of working capital, Investment analysis, Cash flow determination, cost of capital, capital budgeting methods.
- b) Budgeting Control Technique: Concepts of Budget, budgeting and budgetary control, Objectives, Functions, Uses, Advantages, Limitations; Master Budget and Report.

Module III (8 hours)

Cost - Volume - Profit Analysis: Classification of costs, Allocation, apportionment and absorption, Cost centers, different costing systems, Cost analysis for managerial decisions, Meaning of Linear CVP analysis, Objectives, Assumptions, Break - Even analysis, determining the Break-Even point profit, Volume graph profit, Volume ratios margin of Safety.

Module IV (9 hours)

- a) Introduction to Accounting: basic accounting concepts, important definitions, uses, limitations, advantages; types of accounting, financial statements, introduction to journal accounting; different types of vouchers, double entry bookkeeping, different types of transactions related to financial accounting.

- b) Financial Control: An Introduction to cash book, Posting of Ledgers and preparation of trial balance, preparation of balance sheet and profit and loss accounts, controlling other departments by financial accounting.

COURSE/LEARNING OUTCOMES

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

- CO1:** Describe the term financial management (Comprehension)
- CO2:** State the different tools and techniques of financial management. (Knowledge)
- CO3:** Describe in detail about budget and budgeting. (Comprehension)
- CO4:** Not only explain what capital budgeting is but also the types of capital budgeting methods (Comprehension)
- CO5:** Define Internal Rate of Return (Knowledge)
- CO6:** Illustrate investment analysis (Application)
- CO7:** Illustrate with example the concept of cost and its type (Application)
- CO8:** Define marginal cost (Knowledge)
- CO9:** Estimate marginal cost (Application)
- CO10:** Define cost analysis for marginal decision (Knowledge)
- CO11:** Estimate break-even point and explain what break even analysis is. (Application)
- CO12:** Estimate margin of safety (Application)
- CO13:** Prepare journals, ledger, Trial Balance (Synthesis)
- CO14:** Prepare and assess financial statement (Synthesis, Evaluation)

Suggested Readings

1. P.K. Jain, Financial Management and Accounting, S. Chand and Co.
2. R.K. Sharma and S.K. Gupta, Management and Accounting: Principles and Practice, Kalyani Publishers.
3. R.S. Kaplan and A.A. Atkinson, Advanced Management Accounting, PHI.
4. Van Horne, Fundamentals of Financial Management, Pearson

MTEC0074: ECONOMICS FOR ENGINEERS

(2 credits – 30 hours)(L-T-P:2-0-0)

Objective: *The objective of this course is to make the students of engineering aware of the basic concepts in Economics, introduce them to the preliminary techniques of quantitative analysis in Economics and finally to certain relevant concepts of the stock market. The purpose of this course is to increase the all round knowledge of the engineer and enhance his/her professional competence in the work field.*

Module I (9 hours)

- a) Definition of Economics: Subject matter, scope, principal division of Economics – Microeconomics and Macroeconomics.
- b) Theory of Demand: Meaning of Demand and Supply, The law of demand, meaning of utility, marginal utility and total utility, law of diminishing marginal utility, Indifference curve approach, Consumer's Equilibrium, elasticity of demand- determinants, types and measurement, exceptions to the law of demand.
- c) Theory of Production: Meaning of Production function, production function with one variable input – Law of Variable Proportions, production function with two variable inputs

– Law of Returns to Scale, Cobb-Douglas production function. Economic concept of cost-short-run and long-run.

- d) Market Structure: Market Classification- perfect competition, monopoly, monopolistic competition. Concepts of Revenue - Average Revenue, Marginal Revenue and Total Revenue. The firm- objectives and constraints, Equilibrium of the firm- TR-TC approach, MR-MC approach.

Module II (10 hours)

- a) Macroeconomic concepts and aggregates: Circular flow of income, National Income- GDP, GNP, Meaning and relation between: consumption, saving, investment. Aggregate demand and aggregate supply - Saving and Investment functions, Multiplier Mechanism.
- b) Money: Definition of money, functions of money, Money Supply- M1M2M3M4, Inflation- meaning, types, control of inflation- monetary policy, fiscal policy. c) Banking: Central Banks, Commercial Banks, creation of credit.
- d) Trade Cycles: Meaning of Trade Cycle, Various phases of Trade Cycle.
- e) International Trade: Balance of Payments, Devaluation, Exchange Rate, Special Drawing Rights (SDR), IMF, WTO, concept of Globalization, Role of MNCs, Regional Economic Integration.

Module III (6 hours)

- a) Quantitative Analysis in Economics: Profit Maximization problems, break-even analysis, demand estimation.
- b) Introduction to Statistics: Data, diagram, Data Interpretation problems, Measures of Central Tendency, Measures of Dispersion, dispersion, Index numbers.

Module IV (5 hours)

- a) Introduction to Stock Market: Stock Markets - Meaning, NSE, BSE, NYSE, Stock Market Indices - SENSEX, NIFTY, DOW. Bull Market and Bear Market, Role of SEBI in stock market, FDIs and FIIs, Role of FIIs in stock market.
- b) Basic terms related to stock market: Shares, equity shares, bonus shares, preference shares, buyback shares, splitting of shares, trading - intraday trading, commodity trading, futures, hedging, arbitrage.
- c) Mutual Funds: Meaning of Mutual funds, Types of Mutual Fund.

COURSE/LEARNING OUTCOMES

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

- CO1:** Describe the subject matter of Economics. (Comprehension)
- CO2:** Define and comprehend the meaning of demand and supply. (Knowledge & Comprehension)
- CO3:** Describe the factors of production (Comprehension)
- CO4:** Distinguish between different market forms (Knowledge)
- CO5:** Compute cost, revenue and profit of firms (Comprehension)
- CO6:** Explain how money is circulated in an economy. (Comprehension)
- CO7:** Outline the different concepts of national income. (Analysis)
- CO8:** Describe the banking system of an economy. (Comprehension)
- CO9:** Apply the statistical concepts to interpret different forms of data. (Application)

CO10: Construct price index. (*Synthesis*)

CO11: Interpret and evaluate the functioning of stock market. (*Evaluation*)

Suggested Readings

1. H.L. Ahuja, Modern Economics, S. Chand & Co. Ltd., New Delhi
2. Dr. K.K Dewett and M.H. Navalur, Modern Economic Theory, S. Chand & Co. Ltd., New Delhi
3. Manab Adhikary, Business Economics, Excel Books.
4. Madhu Vij, International Financial Management, Excel Books.
5. Koutsoyiannis, Modern Microeconomics, Palgrave MacMillan, 2003, 2nd Revised edition
6. Dominik Salvatore, Microeconomic Theory, Schaum's Outline series, TMH.
7. Bradley Schiller, Essentials of Economics, Tata Mcgraw Hill.
8. Atmanand, Managerial Economics, Excel Books.
9. M S Loganathan and B Nandhakumar, Dictionary for Economics, Excel Books.
10. Sheetal Thomas, Dictionary of Finance, Excel Books.

MTOB0086: ORGANISATIONAL BEHAVIOUR

(3 credits – 30 hours) (L-T-P:3-0-0)

Objective: *This course is designed to give students the basic knowledge of human behavior needed to provide a more effective organizational environment. The basic elements of the course will be the behavior of individuals in organizations, group behavior in organizations, and how these behaviors affect the overall performance of organizations. Particular emphasis is placed on individual difference, attitude, motivation, job satisfaction, communication, leadership, stress, change, and organizational culture.*

Module I (5 hours)

The Study of Organizational Behaviour (OB): Learning objectives, Definition and

Meaning, Why Study OB, Models in OB, New Challenges for OB Manager. Learning – Nature of Learning, How Learning occurs, Learning and OB. Case Analysis

Module II (7 hours)

Foundations of Individual Behaviour: Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB. Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation– Nature and Importance, Hertzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations. Case Analysis

Module III (10 hours)

- a) Organizational Behaviour Process: Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness. Groups in Organizations - Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision making Managerial Implications, Effective Team Building.
- b) Leadership – Leadership and Management, Theories of Leadership – Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Followership, How to be an effective Leader. Conflict – Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA). Case Analysis

Module IV (8 hours)

Organization: Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management – Selection, Orientation, Training

and Development, Performance Appraisal, Incentives; Organizational Change – Importance of Change, Planned Change and OB techniques. International Organizational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective. Case Analysis

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the meaning of organization behavior (Knowledge)
- CO2:** Explain the models and the theory of learning and the foundations of individual behavior. (Comprehension)
- CO3:** Establish the relationship between the various theories of motivation and workplace behavior. (Application)
- CO4:** Differentiate between leadership and management and the different leadership theories. (Analysis)
- CO5:** Formulate different types of leadership strategies. (Synthesis)
- CO6:** Evaluate the various human resource management functions. (Evaluation)

Suggested Readings

1. VSP Rao, Organizational Behaviour, Excel Books.
2. Stephen P Robbins, Organizational Behaviour, PHI Learning, New Delhi
3. JW Newstorm and K. Davis, Organizational Behaviour: Human Behaviour at Work, MGH, New Delhi
4. K. Aswathappa, Organizational Behaviour, Himalaya Publishing House, New Delhi
5. PN Khandawalla, Organizational Behaviour, McGraw Hill, New Delhi.

MTPM0087: FUNCTIONAL PRINCIPLES OF MANAGEMENT

(3 credits –45 hours)(L-T-P:3-0-0)

Objective: *This course aims at imparting the students with relevant knowledge, principles, and practices of management so as to groom them as competent contributors in the workforce, ready to occupy managerial and administrative positions in various organizations.*

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Module I: General Principles and Practices of Management (10 hours)

- a) Theories of Management: Contribution of Management Thinkers – Taylor, Fayol, Elton Mayo, different schools of management thought- classical, scientific, contingency.
- b) Functions of Management: Planning, Organizing, Staffing, Leading and Controlling.

Module II: Marketing Management (13 hours)

- a) Introduction to Marketing: Concepts, Nature, Importance, Marketing Mix.
- b) Capturing Customer insights: Marketing Research, Customer Behavior, and Market Segmentation.
- c) Building Brand Loyalty: Product Strategies, Branding Strategies, Pricing Strategies. d) Promotional Mix: Advertising and Distribution Strategies.

Module III: Strategic Management (12 hours)

- a) Concepts of Strategic Management: Defining Strategy, Strategic Management Process – Formulation, Implementation and Evaluation.
- b) Strategic Analysis: Core Competence, Corporate-level strategy, Business-unit level strategy, generic level strategy.
- c) Current Strategies in Business Management: Knowledge Management, Corporate Governance, E-commerce- virtual value chain, Technology Management.

Module IV: Quantitative Techniques for Managerial Decisions (10 hours)

- a) Introduction: Methods of Data Collection and Sampling Fundamentals.
- b) Simulation Techniques: Markov Analysis, Monte Carlo Simulation.
- c) Decision Theory: Decision tree, Decision making under Risk (EMV criteria) and Uncertainty.

COURSE/LEARNING OUTCOMES

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

- CO1:** Enumerate the general principles and practices of management. (Knowledge)
- CO2:** Explain the concepts of marketing management. (Comprehension)
- CO3:** Determine the strategic management process. (Application)
- CO4:** Analyse the various levels of strategy and current strategies in business management. (Analysis)
- CO5:** Formulate methods of data collection (Synthesis)
- CO6:** Evaluate simulation techniques and decision theory for business decision making. (Evaluation)

Suggested Readings

1. Harold Koontz & Heinz Weihrich, Essentials of Management, Tata Mc Graw Hill.
2. Stoner, Freeman, Gilbert Jr., General Management, Prentice Hall.
3. Philip Kotler & Gary Armstrong, Principles of Marketing, 15th edition, Prentice Hall.
4. Kotler, Keller, Koshi and Jha, Marketing Management – A South Asian Perspective, 13e, Pearson.
5. V. S. Ramaswamy & S. Namakumari, Marketing Management, Macmillan.
6. Wheeler, T.L. Hunger, J.D., and Rangarajan K., Concepts in Strategic Management & Business Policy, 11th edition, Pearson Education.
7. Ranjan Das, Crafting the Strategy: Concepts & Cases in Strategic Management, Tata Mc Graw Hill.
8. J. K. Sharma, Operations Research Theory & Applications, MacMillan.
9. Srivastava, Sharma & Shenoy, Quantitative Techniques for Managerial Decision Making, Sultan Chand & Co.
10. N. D. Vohra, Quantitative Techniques in Management, Tata Mc Graw Hill.
11. Pradip Kr. Sinha & Sanchari Sinha, Current Trends in Management, Nirali Prakashan

MTAA0088: FINANCIAL ACCOUNTING AND ANALYSIS

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective: To familiarize students with the mechanics of preparation of financial statements, understanding corporate financial statements, their analysis and interpretation.

Module I

Introduction to Financial Accounting: Accounting as an Information System, Importance and Scope, Limitations; Users of accounting information, Concepts, Principles and Conventions

– Generally Accepted Accounting Principles; The Accounting Equation; Nature of Accounts, Types of books (Primary and Secondary) and Rules of Debit and Credit; Recording Transactions in Journal; Preparation of Ledger Accounts; Opening and Closing Entries; Preparation of Trial Balance.

Module II

Preparation of Financial Statements: Trading Account, Profit & Loss Account and Balance Sheet, Adjustment Entries, Understanding contents of financial statements of a joint stock company as per the Companies Act 2013; Understanding the contents of annual report of a company, Preparation of cash flow statement as per AS-3 (revised).

Module III

Indian Accounting Standards (Ind-AS): Concept, benefits, procedure for issuing Ind-AS in India, salient features of Ind-AS issued by ICAI; International Financial Reporting Standards(IFRS): Main features, uses and objectives of IFRS, IFRS issued by IASB and concept of harmonization and convergence, obstacle in harmonization and convergence, suggestions for increased convergence and harmonization.

Module IV

Financial Statement Analysis: Objective of financial statement analysis, sources of information; Techniques of financial statement analysis: Horizontal analysis, Vertical analysis and Ratio Analysis; Financial Ratios: Meaning and Usefulness of Financial Ratios. Analysis of ratios from the perspective of Stakeholders like Investors, Lenders, and Short- term Creditors. Liquidity Ratios, Solvency Ratios, Profitability Ratios, and Turnover Ratios; Limitation of ratio. Analysing the power of ratios in forecasting business failures using Altman Z-score, multiple discriminant analysis and decision-treanalysis.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the commonly used accounting terminology (Remembering)
- CO2:** Classify the users of accounting information and their respective requirements (Understanding)
- CO3:** Understand the process of recording and classifying the business transactions and events (Understanding)
- CO4:** Solve practical problems on accounting like the financial statements, viz., Profit and Loss Account, Balance Sheet, and cash flow statement. (Applying)
- CO5:** Interpret the financial statements from different the perspective of different stakeholders. (Evaluating)
- CO6:** Explain the financial crisis of a business concern. (Creating)

Suggested Readings

1. Monga, J.R., Financial Accounting: Concepts and Applications, Mayur Paperbacks
2. Tulsian, P.C., Financial Accounting, Pearson
3. Maheshwari, S.N. & Maheshwari, S.K. , Financial Accounting for B. Com., CA, CS, & ICWA (Foundation) Courses, Vikas Publishing House Pvt. Ltd.
4. Ghosh, T.P., Financial Accounting for Managers, Taxmann Allied Services (P) Ltd.
5. Balwani, Nitin, Accounting and Finance for Managers
6. Gupta, Ambrish: Financial Accounting for Management

7. Bhattacharyya, Asish K., Financial Accounting for Business Managers
8. Jain, S.P. & Narang, K.L., Advanced Accountancy.
8. Charles T. Horngren, Galt L. Sundem, John A. Elliot and Donna R. Philbrick, Introduction to Financial Accounting, Pearson.

MTMG0089: MANAGERIAL ECONOMICS

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objectives: *The purpose of this course is to apply micro economic concepts and techniques in evaluating business decisions taken by firms. The emphasis is on explaining how tools of standard price theory can be employed to formulate a decision problem, evaluate alternative courses of action and finally choose among alternatives. Simple geometry and basic concepts of mathematics will be used in the course of teaching.*

Module I

Demand, Supply and Market equilibrium: individual demand, market demand, individual supply, market supply, market equilibrium; Elasticities of demand and supply : Price elasticity of demand, income elasticity of demand, cross price elasticity of demand, elasticity of supply;

Theory of consumer behavior : cardinal utility theory, ordinal utility theory (indifference curves, budget line, consumer choice, price effect, substitution effect, income effect for normal, inferior and giffen goods), revealed preference theory.

Module II

Producer and optimal production choice: optimizing behavior in short run (geometry of product curves, law of diminishing margin productivity, three stages of production), optimizing behavior in long run (isoquants, isocost line, optimal combination of resources) Costs and scale : traditional theory of cost (short run and long run, geometry of cost curves, envelope curves), modern theory of cost (short run and long run), economies of scale, economies of scope.

Module III

Theory of firm and market organization : perfect competition (basic features, short run equilibrium of firm/industry, long run equilibrium of firm/industry, effect of changes in demand, cost and imposition of taxes) ; monopoly (basic features, short run equilibrium, long run equilibrium, effect of changes in demand, cost and imposition of taxes, comparison with perfect competition, welfare cost of monopoly), price discrimination, multiplant monopoly ; monopolistic competition (basic features, demand and cost, short run equilibrium, long run equilibrium, excess capacity) ; oligopoly (Cournot's model, kinked demand curve model, dominant price leadership model, prisoner's dilemma

Module IV

Factor Market: demand for a factor by a firm under marginal productivity theory (perfect competition in the product market, monopoly in the product market), market demand for a factor, supply of labour, market supply of labour, factor market equilibrium.

COURSE/LEARNING OUTCOME

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

- CO1:** Fine the mechanics of supply and demand in allocating goods and services and resources (Remembering)

- CO2:** Illustrate how changes in demand and supply affect markets (Understanding)
CO3: Apply the choices made by a rational consumer (Applying)
CO4: Interpret the relationships between production and costs (Evaluating)
CO5: Discuss key characteristics and consequences of different forms of markets (Creating)

Suggested Readings

1. Dominick Salvatore (2009). Principles of Microeconomics(5th ed.) Oxford University Press
2. Lipsey and Chrystal. (2008). Economics. (11th ed.) Oxford University Press
3. Koutosyannis (1979). Modern Micro Economics. PalgraveMacmillan
4. Pindyck, Rubinfeld and Mehta. (2009). Micro Economics. (7th ed.). Pearson.

MTED0090: ENTREPRENEURSHIP DEVELOPMENT

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective: This course provides students with a solid introduction to the entrepreneurial process of creating new businesses, role of Creativity and innovation in Entrepreneurial start-ups, manage family-owned companies, context of social innovation and social entrepreneurship and issues and practices of financing entrepreneurial businesses.

Module I: Entrepreneurial Management

The evolution of the concept of entrepreneurship, John Kao's Model on Entrepreneurship, Idea Generation, Identifying opportunities and Evaluation; Building the Team / Leadership; Strategic planning for business; Steps in strategic planning, Forms of ownership – Sole proprietorship; partnership; limited liability partnership and corporation form of ownership; advantages/disadvantages, Franchising; advantages/disadvantages of franchising; types of franchise arrangements; franchise contracts; franchise evaluation checklist, Financing entrepreneurial ventures; Managing growth; Valuation of a new company; Harvesting and Exit Strategies; Corporate Entrepreneurship

Module II: Entrepreneurship, Creativity And Innovation

Stimulating Creativity; Organisational actions that enhance/hinder creativity, Managerial responsibilities, Creative Teams; Sources of Innovation in Business; Managing Organizations for Innovation and Positive Creativity.

Module III: Social Entrepreneurship

Introduction to Social Entrepreneurship; Characteristics and Role of Social Entrepreneurs; Innovation and Entrepreneurship in a Social Context; Start-Up and Early Stage Venture Issues in creating and Sustaining a Non-profits Organization; Financing and Risks; Business Strategies and Scaling up.

Module IV Family Business And Entrepreneurship

The Entrepreneur; Role and personality; Family Business: Concept, structure and kinds of family firms ; Culture and evolution of family firm; Managing Business, family and shareholder relationships ; Conflict and conflict resolution in family firms ; Managing Leadership, succession and continuity ; women's issues in the family business ; Encouraging change in the family business system.

Module V Financing The Entrepreneurial Business

Arrangement of funds; Traditional sources of financing, Loan syndication, Consortium finance, role played by commercial banks, appraisal of loan applications by financial institutions, Venture capital.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define the role of entrepreneurship and explore the recent trends emerging in this field (Remembering)
- CO2:** Classify the various forms, functions and stages of entrepreneurship prevalent in today's world. (Understanding)
- CO3:** Analyse the multi-faceted role of entrepreneur and intricacies involved in arranging finance (Analysing)
- CO4:** Design entrepreneurial model and its implementation through case study (Creating)

Suggested Readings

1. Burns, P. (2001). Entrepreneurship and small business. New Jersey:Palgrave.
2. Drucker, P. F. (2006). Innovation and entrepreneurship: Practice and principles. USA: Elsevier.
3. Gersick, K. E., Davis, J. A., Hampton, M. M., & Lansberg, I. (1997). Generation to generation: Life cycles of the family business. Boston: Harvard Business School Press.
4. Hisrich, R., & Peters, M. (2002). Entrepreneurship. New Delhi: Tata McGraw Hill.
5. Holt, D. H. (2004). Entrepreneurship new venture creation. New Delhi: Prentice Hall of India.
6. John Kao, Creativity & Entrepreneurship
7. Kaplan, J. (2004). Patterns of entrepreneurship. Wiley.
8. Khandwalla, P. (2003). Corporate creativity. New Delhi: Tata Mc.Graw Hill.
9. Mullins, J. (2004). New business road test. New Delhi: Prentice Hall.
10. Nicholls, A. (Ed.). (2006). Social entrepreneurship new models of sustainable social change. Oxford University Press.
11. Prahalad, C. K. (2006). Fortune at the bottom of the pyramid ,eradicating poverty through profits. Wharton school Publishing.
12. Scarborough & Zimmerer, Effective Small Business Management
13. Stevenson, H. (Ed.). (2007). Perspective on entrepreneurship. Boston:Harvard Business Press.

MTSB0091: STATISTICS FOR BUSINESS DECISIONS

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective: To familiarize the students with various Statistical Data Analysis tools that can be used for effective decision making. Emphasis will be on the application of the concepts learnt.

Module I

Measures of Central Value: Meaning, Need for measuring central value. Characteristics of an ideal measure of central value. Types of averages - mean, median, mode, harmonic mean and geometric mean. Merits, Limitations and Suitability of averages. Relationship between averages. Measures of Dispersion: Meaning and Significance. Absolute and Relative measures of dispersion - Range, Quartile Deviation, Mean Deviation, Standard Deviation, Moments, Skewness, Kurtosis

Module II

Probability: Meaning and need. Theorems of addition and multiplication. Conditional probability. Bayes' theorem, Random Variable- discrete and continuous. Probability Distribution: Meaning, characteristics (Expectation and variance) of Binomial, Poisson, and Normal distribution. Correlation Analysis: Meaning and significance. Types of correlation. Methods of studying simple correlation - Karl Pearson's coefficient of correlation, Spearman's Rank correlation coefficient

Module III

Regression Analysis: Meaning and significance, Regression vs. Correlation. Linear Regression, Regression lines (X on Y, Y on X) and Standard error of estimate. Analysis of Time Series: Meaning and significance. Utility, Components of time series, Models (Additive and Multiplicative), Measurement of trend: Method of least squares, parabolic trend and logarithmic trend.

Module IV

Introduction to testing of Hypothesis: Concept; Level of Significance; Process of testing; Test of hypothesis concerning Mean; Test of hypothesis concerning Proportion. Z test, t – test for single mean and difference of means and ANNOVA – one way and two way. Non parametric tests: One-Sample Wilcoxon Signed Rank Test, Paired-Sample Wilcoxon Signed Rank Test, Paired Sample Sign Test, Two-Sample Kolmogorov-Smirnov Test, Mann-Whitney Test, Kruskal-Wallis ANOVA

COURSE/LEARNING OUTCOMES

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

- CO1:** Summarize data sets using descriptive statistics (Understanding)
- CO2:** Analyse the relationship between two variables (Analysing)
- CO3:** Determine trend and seasonality in a time series data (Evaluating)
- CO4:** Propose conclusion about a population using testing of hypothesis (Creating)

Suggested Readings

- S.P. Gupta (S.P.) : Statistical Methods, Sultan Chand & Sons, 34th Edition
- Richard Levin & David Rubin : Statistics for management, Prentice Hall

MTCM0092: COST AND MANAGEMENT ACCOUNTING

(6 credits-75 Hours) (L-T-P: 5-1-0)

Objective: This paper will acquaint the students with cost and management accounting concepts and its application for decision making.

Module I

Cost concepts: Meaning, Scope, Objectives, and Importance of Cost Accounting, Cost, Costing, Cost Control, and Cost Reduction. Elements of Cost, Components of total Cost, Cost sheet.

Classification of costs: Fixed, Variable, Semi-variable, and Step costs; Product, and Period costs; Direct, and Indirect costs; Relevant, and Irrelevant costs; Shut-down, and Sunk costs; Controllable, and Uncontrollable costs; Avoidable, and Unavoidable costs; Imputed / Hypothetical costs; Out-of-pocket costs; OpportModuley costs; Expired, and Unexpired costs; Conversion cost.

Cost Ascertainment: Cost Module, Cost Center, Profit Center, Cost Allocation and Cost Apportionment; Cost Reduction and Cost Control.

Module II

Cost-Volume-Profit Analysis: Contribution, PV Ratio, Margin of safety, Break- even-point, cost break-even-point, cash break-even-point, Composite break-even-point, Key Factor, Break-even Analysis. Relevant Costs and Decision Making: Pricing, Product Profitability, Make or Buy, Exploring new markets, Shut down or continue, Acceptance of an export order.

Process costing. Process losses and wastage, Abnormal effectives, Work-in-progress - computation of equivalent Modules (FIFO method), Joint and By-products.

Module III

Budgets and Budgetary Control: Meaning, Types of Budgets (sales, production, purchase raw material consumption, cash budget. Steps in Budgetary Control, Fixed and Flexible Budgeting, Responsibility Accounting.

Module IV

Standard Costing and Variance Analysis: Material, Labour & Overhead variances. Activity based costing, Target costing, Life cycle costing, Quality costing (only theoretical knowledge)

COURSE/LEARNING OUTCOMES

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

- CO1:** Define cost and management accounting. (Remembering)
- CO2:** Construct decision making in an organisation will be more effective with this knowledge (Applying)
- CO3:** Analyse Break Even Point and the practical sum (Analysing)

Suggested Readings

1. Maheshwari, S.N., and Mittal, S.N. Cost Accounting: Theory and Problems, Shree Mahavir Book Depot (Publishers), Delhi.
2. M.N.Arora, Management Accounting, Theory, Problems and Solutions, Himalaya Publishing House
3. Horngren, C.T., Foster, G, and Datar, S.M., Cost Accounting: A Managerial Emphasis,
4. Prentice Hall of India Pvt. Ltd., New Delhi.
5. Henke, E.O., and Spoede, C.W., Cost Accounting: Managerial Use of Accounting Data, PWS-KENT Publishing Company, Boston.

MTOG0093: ORGANIZATIONAL BEHAVIOR

(3 credits –45 hours)(L-T-P:3-0-0)

Objective: To acquaint the students with the fundamentals of managing business and to understand individual and group behavior at work place so as to improve the effectiveness of an organization.

Module I

Basic forms of Business Ownership: Sole proprietorship, Partnerships, Corporations/Company, Cooperatives: Advantages and Disadvantages; An Introduction to Special forms of ownership: Franchising, Licensing, Leasing; Choosing a form of Business ownership; Corporate Expansion: A brief introduction to mergers and acquisitions, diversification, forward and backward integration, joint ventures, Strategic alliance.

Evolution of Management Theory: Classical, Behavioural, Systems and Contingency approaches to Management. Managerial functions and Roles (Henry Mintzberg).

Module II

Overview of Planning: Types of Plans, The planning process, Making plans effective, MBO as a tool for planning; Decision making: Process, Types and Techniques. Control: Function, Process and types of Control; Principles of organizing: Common organisational structures- Functional product, Division, Customer, Geographic / Regional, Matrix, Hybrid, Networking organisational structures; Delegation & Decentralization: Factors affecting the extent of decentralization, Process and Principles of delegation.

Module III

Conceptual Foundations and Importance of organizational Behaviour. Perception and Attribution: Concept, Nature, Process, Personality: Concept, Types and Theories of Personality: Learning: Concept and Theories of Learning, reinforcement, , Emotional Intelligence. Motivation: Concepts and their application, Need (Maslow and Herzberg), Content & Process theories, Expectancy theory, Equity theory, goal Setting theory. Leadership: Leaders and Leadership Process: Traits, Behavior, and Situational theories, Blake & Mouton's: Managerial grid, Hersey & Blanchard's situational Leadership Model, Likert's 4 system model, Fiedler's Leadership contingency theory, House's Path-goal theory, Contemporary Leadership issues: Charismatic, Transformational Leadership.

Module IV

Groups and Teams: Definition, Difference between Groups and teams; Stages of Group Development, Group Cohesiveness, Types of teams. Analysis of Interpersonal Relationship: Transactional Analysis, Johari Window

Organisational Power and Politics: Concept, Sources of Power, Tactics to gain power in Organizations. Nature of organisational politics. Conflict: Concept, Sources, Types, Stages of conflict, Management of conflict, Organisational Change: Concept, Resistance to change, Managing resistance to change, Implementing Change, Kurt Lewin Theory of Change.

COURSE/LEARNING OUTCOMES

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

- CO1:** Define different approaches to designing organizational structures. (Remembering)
- CO2:** Explain the role of personality, learning and emotions at work. (Understanding)
- CO3:** Examine the concept of motivation, leadership, power and conflict. (Analysing)
- CO4:** Criticize the foundations of group behaviour and the framework for organizational change and development. (Evaluating)

Suggested Readings

1. Koontz & Heinz Wehrich: Essential of management McGraw Hill (1999)
2. Kaul, Vijay kumar, Management- Text & Cases, Vikas Publishing, New Delhi, 2015 3. Stoner & Wankel: Management
3. Stephen P. Robbins and Mary Coulter: Management, Pearson
4. Y.K. Bhushan: Fundamentals of Business Organisation & Management X Edition
5. Principles of Management, Gilbert, McGraw Hill
6. Richard L. Daft, Principles Of Management, Cengage Learning, India
7. Robbins Stephen P. : Organisational Behaviour, Pearson Education, 12th Edition

8. LuthansFred :OrganisationalBehaviour, Tata McGraw Hill
9. Newstrom John W.: OrganisationalBehaviour, Tata McGraw Hill, 12th Edition
10. Mc Shane L. Steven, Glinow Mary Ann Von & Sharma Radha R. - Organisational Behaviour; Tata McGraw Hill, 3rd Edition
11. Greenberg Jerald and Baron Robert A.: Behaviour in Organisations: Understanding and Managing The Human Side of Work, Prentice Hall of India
12. Gregory Moorhead, Ricky. W. Griffin (Biztantra 7th Edition)
13. OrganisationalBehaviour by Kavita Singh, Pears

SCHOOL OF FUNDAMENTAL AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS

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:** Analyse methods to obtain the solution. (Analysing)
- 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:** Analyse every problem, be it theoretical or computational in terms of its corresponding mathematical formulation. (Analysing)
- 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

- a) B.S. Grewal, “Elementary Engineering Mathematics”, 34th Ed., 1998. b) Shanti Narayan , “Integral Calculus”, S. Chand and Company, 1999
- c) H.K. Dass, “Advanced Engineering Mathematics”, S. Chand and Company, 9th Revised Edition, 2001.
- d) 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:** Analyse how to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions. (Analysing)
- 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.

MACL0012: 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 Analyse certain problems which are not solvable initially whereupon suggesting possible conditions for the solution of the same. (Analysing)
- 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 Analyse the type of problems that does not possess any analytical solution whereby solving those problems through some other method like numerical method etc. (Analysing)
- 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.

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, 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. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010
6. B.S.Grewal, Higher Engineering Mathematics , Khanna publishers, 35th Edition,2000
7. Veeranjana 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 (Analysing)
- 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, TataMcgraw-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 off 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.

OUTCOMES/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:** Analyse 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 Analysing 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:** Analyse 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 Analysing experimental data.. (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. 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, Higher Engineering Mathematics , Khanna publishers, 35th Edition, 2000
10. Veeranjana 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 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 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 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:** Analyse various possible methods to obtain the solution (Analysing)
- 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 boool 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

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
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint
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 $3/8^{\text{th}}$ 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 standard 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.Raisinghanian, S.Chand and Co.

DEPARTMENT OF PHYSICS

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; Planet 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 RoseOe; 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. W. Saslow, Electricity, Magnetism and Light.

PSWO0049: 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/LEARNINGOUTCOMES

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, etc. and LASER. (Understanding)

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.

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.

DEPARTMENT OF CHEMISTRY

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)

- Different types of natural resources and associated problems - forest resources, water resources, mineral resources, food resources, energy resources, land resources.
- Conservation of natural resources.

Module III: Ecosystems (4 hours)

- Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, food chains, food webs.
- 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)

- Definition, causes, effects and control measures of - air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards and e- pollution.
- Solid waste management
- Disaster management

Module VI: Social Issues and the Environment (6 hours)

- From unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, climate change, global warming, acid rain, ozone layer depletion.
- Environment protection act.
- 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. 1. g, 1991.
6. Cann, M. C. & Connelly, M. E., Real World Cases in Green Chemistry, ACS, , 2000.

CHCE0027: ENGINEERING CHEMISTRY

(4 Credits - 60 Hours) (L:3, T:1, P: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)

- Ionic, dipolar and van Der Waals interactions.
- 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>

CHCE6006: ENGINEERING CHEMISTRY I LAB

(1 Credit) (L:0, T:0, P: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)

CHCE6007: ENGINEERING CHEMISTRY II LAB

(2 Credits) (L:0, T:0, P: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 dissolved 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)

DEPARTMENT OF BOTANY

BOBI0001: BIOLOGY

(3 credits 45 hours) (L-T-P:2-1-0)

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:** 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:** Analyse biological processes at the reductionist level. (Analysing)
- 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, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
- 2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
- 3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
- 4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
- 5) 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)

- c. 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.

- d. 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)

- c. 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.
- d. 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:** 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:** Analyse biological processes at the reductionist level. (Analysing)
- 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, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
- 2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
- 3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
- 4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
- 5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

DEPARTMENT OF LANGUAGE STUDIES

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:

1. To develop an awareness in the students about writing as an exact and formal skill
2. To equip them with the components of different forms of writing
3. To enable the students to study academic subjects with greater facility through the theoretical and practical components of their text books.
4. To develop the study skills and communication skills necessary in formal and informal situations.
5. 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

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.*

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

COURSE / LEARNING OUTCOMES

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

- CO1:** Define subject-verb agreement in language. (Remembering)
- CO2:** Summarise the different processes of word formation in English. (Understanding)
- CO3:** Identify erroneous sentence structures. (Applying)
- CO4:** Distinguish between antonyms and synonyms. (Analyzing)
- CO5:** Explain the importance of proper punctuation in language. (Evaluating)
- CO6:** Elaborate the different writing styles in language. (Creating)

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

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

LSBC0039: BUSINESS COMMUNICATION

(Credits: 2-30 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 OUTCOME

At the end of this course the 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:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- 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 I (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

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

COURSE /LEARNING OUTCOMES

After the completion of this Lab the students will be able to:

- CO1:** List out the different vowel and consonant sounds. (Remembering)
- CO2:** Compare similar vowels and consonants and practice them in pairs of words. (Understanding)
- CO3:** Identify the erroneous pronunciations in language. (Applying)
- CO4:** Distinguish the mono-syllabic and multi-syllabic words with proper stress pattern. (Analyzing)
- CO5:** Determine the intonation patterns in connected speech. (Evaluating)
- CO6:** Compile a list of everyday conversations in familiar contexts. (Creating)

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

COURSE /LEARNING OUTCOMES

After the completion of this Lab the students will be able to:

- CO1:** List out the important tips for facing an interview. (Remembering)
- CO2:** Explain the different stages of writing a report. (Understanding)
- CO3:** Identify important debating skills. (Applying)
- CO4:** Analyse the pros and cons of a mock-interview. (Analyzing)
- CO5:** Determine common patterns in everyday conversations/dialogues. (Evaluating)
- CO6:** Elaborate the speech mechanism. (Creating)

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

COURSE /LEARNING OUTCOMES

After the completion of this Lab the students will be able to:

- CO1:** List out the different vowel sounds and consonant sounds (Remembering)
- CO2:** Illustrate the stress and intonation patterns in language. (Understanding)
- CO3:** Identify the erroneous pronunciations. (Applying)
- CO4:** Compare the pronunciation of similar sounding words. (Analysing)
- CO5:** Discuss the tips for facing an interview. (Evaluating)
- CO6:** Determine the common patterns in everyday conversations and dialogues. (Creating)

DEPARTMENT OF PHILOSOPHY

PYTW0021: THOUGHTS THAT SHAPED THE WORLD

(2 credits - 30 hours)

Objective: *The aim of this comprehensive course is to introduce the student of Technology to the different ideas that have shaped the world and continue to shape it. It gives an introduction to different Philosophical schools, thoughts on religion and thoughts on ethics and social issues. It is expected that this course will help to shape an emerging engineer holistically.*

Module I: Philosophy - Thoughts on Mind, Body, Matter, Will (11 hours)

Philosophy, Science and Religion; Prominent philosophers and their ideas on these issues – Plato, Aristotle, Rene Descartes, David Hume, Berkeley, Vivekananda, Radhakrishnan, Krishnamurthy; Recent developments in Existentialism, inter-cultural philosophy.

Module II: Religion - Thoughts on Life, Soul, Conscience, Life after Death, Reincarnation, Morality, Natural Law (8 hours)

The Hindu view; The Buddhist View; The Christian View; The Muslim View

Module III: Society - Thoughts on Ethics and Social Issues (11 hours)

- a) Right and Wrong, the idea of Conscience; Individual and Social Morality
- b) Applied Ethics: Sexual Morality: The Libertarian View (For and Against); Abortion: (for and Against); Euthanasia: (For and Against); Capital Punishment: (For and Against); Social Justice: (For and Against); Environmental Ethics (For and Against) and Eco- philosophy

Suggested Readings

1. J. Perry and M. Bratman, Introduction to Philosophy: Classical and Contemporary Readings, Oxford University Press, 1999.
2. B. Russell, A History of Western Philosophy, Routledge, 1992.
3. I. Copi and C. Cohen, Introduction to Logic, Macmillan, 1986.
4. J. N. Mohanty, Reason and Tradition in Indian Thought, Clarendon Press, 1992.
5. Colin McGinn, The Character of Mind: An Introduction to the Philosophy of Mind, Oxford University Press, 1997.
6. M. M. Agrawal, Ethics and Spirituality, Indian Institute of Advanced Studies, 1998.
7. Daya Krishna, Special issue on Historiography of Indian Civilizations, The Journal of Indian Council of Philosophical Research, Vol. 8, No.3 & 4, 1996.

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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