2018-2019

REGULATIONS AND SYLLABUS

School of Life Sciences

ASSAM
DON BOSCO UNIVERSITY
Tapesia Gardens | Azara, Guwahati - 781017
Sonapur - 782402 | Assam, India

ASSAM DON BOSCO UNIVERSITY

REGULATIONS AND SYLLABUS
2018-2019

School of Life Sciences

ASSAM DON BOSCO UNIVERSITY
Tapesia Gardens, Sonapur, 782402 | Azara, Guwahati 781017, Assam, India

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.

Contact Information

Director, School of Life Sciences:
Prof. J. N. Vishwakarma (+91 94361 01222)

Director, School of Humanities and Social Sciences:
Dr. Riju Sharma (+91 9101693219)

Director, School of Fundamental and Applied Sciences:
Dr. Monmoyuri Baruah (+91 94351 11797)

Director, School of Technology:
Prof. Manoranjan Kalita (+91 94351 13035)

Director, School of Commerce and Management:
Fr. Dr. John P.D. (+91 94367 30717)

Convener, Anti-ragging Squad (Tapesia Campus):
Mr. Baldwin Sumer (+91 96125 58808)

Convener, Anti-ragging Squad (Azara Campus):
Mr. P. Joseph (+91 98591 44283)

Convener, Anti-ragging Squad (Kharguli Campus):
Mr. Chandan Dutta (+91 88760 16764)

Administrative Officer (ADBU): Dr. Peter Paul Hauhnar (+91 99575 63590)

Administrative Officer (Azara): Dr. Vikramjit Kakoti (+91 78962 67739)

Head, Department of Life Sciences: Dr. Sr. Shiny C. Thomas (+91 8075967743)

Head, Department of Zoology: Dr. Prasanta Choudhury (+91 9435546597)

CONTENTS

ASSAM DON BOSCO UNIVERSITY

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 given below:

Programme	Number of Semesters	Number of Years
Bachelor of Technology (BTECH)	8	4
Bachelor of Computer Applications (BCA)	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.

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

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 shall 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
BCA, BCOM, BA Honours	Passed the qualifying examination in any stream with 45% marks in the aggregate of all subjects	Satisfactory performance in the Personal Interview
BSc Honours	Passed the qualifying examination in the science stream with 45% marks in the aggregate of Physics, Chemistry and Mathematics	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 60% marks in the aggregate in the relevant discipline and B.Sc. students who have secured a minimum of 50% 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.

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 (submitted at the time of returning to class).

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 ≤ x ≤ 100	O	Outstanding	10
80 ≤ x < 90	E	Excellent	9
70 ≤ x < 80	A+	Very Good	8
60 ≤ x < 70	A	Good	7
50 ≤ x < 60	B	Average	6
40 ≤ 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 SGPAs 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, using the following formula:
for CGPA <= 9.0, Percentage marks = (CGPA x 10) – 5
for CGPA > 9.0, Percentage marks = (CGPA x 15) – 50

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	50
End-semester test / viva voce	40

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. Students of the BTECH Programme are required to undergo an Industry Training/Internship

programme after the sixth semester in any industry or reputed organisation. BCOM students are required to do internship at the end of 4th or 5th semester.

8.5.2 Such programmes shall generally be of duration not less than 70 hours.

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 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 convenor. 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 Convenor 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 a period of six years from his/her enrolment for 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
BSc	4	4	8
BA	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 shall 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 twenty 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 a semester 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.

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

11.1.5 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.

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

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) to 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 of 50 % marks in the aggregate, with the relevant discipline as a subject	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.

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.

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 ≤ x ≤ 100	O	Outstanding	10
80 ≤ x < 90	E	Excellent	9
70 ≤ x < 80	A+	Very Good	8
60 ≤ x < 70	A	Good	7
50 ≤ x < 60	B	Average	6
40 ≤ 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 SGPAs 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, using the following formula:
for CGPA <= 9.0, Percentage marks = (CGPA x 10) – 5
for CGPA > 9.0, Percentage marks = (CGPA x 15) – 50

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	60
End-semester test / Viva voce	40

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 shall 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 a semester 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.

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

10.1.5 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 FOR MASTER'S 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.

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 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

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 six 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. Normally a student spends fifteen hours over two days per week in field work.

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 of ten days 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 concurrent field work during the first three semesters in social service agencies, medical institutions, the criminal justice system, etc., 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 of ten days with the faculty members, to a place approved by the department. The places are to be so chosen as to be of educational benefit to students. During the tour, the focus shall be to visit and interact with NGOs, hospitals, state/national/international organisations involved in psychological counselling. A report of the learning outcomes shall be submitted to the department at the end of the tour. The Study Tour shall be a Pass/No Pass course.

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 one semester in an organisation which offers counselling help to clients. The supervised internship shall ordinarily be organised during the last semester of the programme. 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 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 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.

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 and Audit

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. The students shall be trained in the principles and practice of performing a school audit and they shall undertake the audit of a school in groups during the course of the programme.

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.

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

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.

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 ≤ x ≤ 100	O	Outstanding	10
80 ≤ x < 90	E	Excellent	9
70 ≤ x < 80	A+	Very Good	8
60 ≤ x < 70	A	Good	7
50 ≤ x < 60	B	Average	6
40 ≤ 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

13.2.3 The CGPA may be converted into a percentage, using the following formula:
for CGPA <= 9.0, Percentage marks = (CGPA x 10) – 5.
for CGPA > 9.0, Percentage marks = (CGPA x 15) – 50

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	50
end-semester test / viva voce examination	40

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 a period of four years from his/her enrolment for 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 **Re-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 shall 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 a semester 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.

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 no dues to the University, Institute, Department, Hostels; and

16.1.5 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: BACHELOR'S 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	50
End Semester Test and/or Viva-Voce Examination	40
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 - MASTER'S DEGREE PROGRAMMES

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

Theory Courses

The different components of the scheme of in-semester Assessment and the weightages attached to them for the theory courses offered in the MSW, MSc-PC and MA-HR programmes 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 field work 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, Life Sciences, 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) Salvar, kurta and duppatta of the prescribed colour and material may also be used. 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 8:55 am. 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 9:00 am. Immediately after assembly all should proceed to the classroom to start class at 9:10 am. 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 enter the university before 8:55 am. At the Azara campus, the University gates shall remain closed from 9:05 am to 9:20 am. Anybody entering the University after the gates open at 9:20 am shall not be given attendance for the first hour of class although he/she may be permitted to attend the class.

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.

7.0 **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.

8.0 **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. Three of the most important activities are D'VERVE & BOSCOSIADE (intra-University sports and cultural festival), PRAJYUKTTAM (the inter-University technical festival) and CREAZONE (the University magazine). All students are expected to take part actively in such activities to showcase their talents, to develop leadership qualities and to gain the experience of working in groups.

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

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

11. Free Time

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

12. Faculty Performance Feedback

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

13. Mentoring

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

14. Interaction Meet With Parents

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

SCHOOL OF LIFE SCIENCES

DEPARTMENT OF LIFE SCIENCES

MASTER OF SCIENCE
IN BIOCHEMISTRY, BIOTECHNOLOGY AND MICROBIOLOGY

Semester 1

Type	Course Code	Course Name	Category	Credits	Page
Theory	BCBM0008	Biomolecules	SC/DC	4	62
	BTPE0009	Thermodynamics and Enzymology	SC/DC	3	74
	MBCG0001	Cell Biology and Genetics	SC/DC	4	79
	BCAT0002	Analytical Techniques for Biological Sciences	SC/DC	3	55
Lab	BCBM6001	Biomolecules Lab	SC/DC	1	64
	BCAT6002	Analytical Techniques Lab	SC/DC	1	64
	BTPE6009	Thermodynamics and Enzymology Lab	SC/DC	1	78
	MBCG6001	Cell Biology and Genetics Lab	SC/DC	1	86
Total Credits				**18**	

Semester 2

Type	Course Code	Course Name	Category	Credits	Page
Theory	BTCA0010	Computer Applications and Bioinformatics	SC/DC	3	75
	BCMB0003	Molecular Biology	SC/DC	4	56
	BTRM0003	Research Methodology and Biostatistics	SC/DC	4	67
	MBBM0007	Basic Microbiology	SC/DC	3	85
Lab	BTCA6010	Computer Applications and Bioinformatics Lab	SC/DC	2	78
	BCMB6003	Molecular Biology Lab	SC/DC	2	65
	MBBM6002	Basic Microbiology Lab	SC/DC	1	86
Total Credits				**19**	

Semester 3: BIOTECHNOLOGY

Type	Course Code	Course Name	Category	Credits	Page
Theory	BTAP0004	Animal and Plant Biotechnology	DC	4	68
	BTGE0005	Genetic Engineering	DC	3	69
	BTIM0006	Immunology	DC	3	70
	BTBE0007	Bioprocess Engineering	DC	3	72
Lab	BTAP6003	Animal and Plant Biotechnology Lab	DC	2	76
	BTGE6004	Genetic Engineering Lab	DC	1	76
	BTIM6005	Immunology Lab	DC	1	77
	BTBE6006	Bioprocess Engineering Lab	DC	1	77
	BTDI6007	Dissertation Phase I	DC	2	77
Total Credits				**20**	

Semester 4: BIOTECHNOLOGY

Type	Course Code	Course Name	Category	Credits	Page
Theory	BTAB0008	Advances in Biotechnology	DC	4	73
Lab	BTDI6008	Dissertation Phase II	DC	16	78
Total Credits				**20**	

Semester 3: BIOCHEMISTRY

Type	Course Code	Course Name	Category	Credits	Page
Theory	BCIM0004	Immunology and Medical Biochemistry	DC	4	57
	BTGE0005	Genetic Engineering	DC	3	69
	BCPY0005	Physiology	DC	3	58
	BCBM0006	Bioenergetics and Metabolism	DC	3	60
Lab	BCIM6004	Immunology and Medical Biochemistry Lab	DC	2	65
	BTGE6004	Genetic Engineering Lab	DC	1	76
	BCPY6005	Physiology lab	DC	1	65
	BCBM6006	Bioenergetics and Metabolism Lab	DC	1	66
	BCDI6007	Dissertation Phase I	DC	2	66
Total Credits				**20**	

Semester 4: BIOCHEMISTRY

Type	Course Code	Course Name	Category	Credits	Page
Theory	BCAC0007	Advances in Biochemistry	DC	4	61
Lab	BCDI6008	Dissertation Phase II	DC	16	67
Total Credits				**20**	

Semester 3: MICROBIOLOGY

Type	Course Code	Course Name	Category	Credits	Page
Theory	MBVB0003	Virology, Bacteriology and Mycology	DC	5	80
	MBDE0004	Microbial Diversity and Ecology	DC	2	81
	BTGE0005	Genetic Engineering	DC	3	69
	MBIM0005	Immunology and Medical Microbiology	DC	3	82
Lab	MBMT6003	Microbiology Techniques Lab	DC	2	86
	MBDE6004	Microbial Diversity and Ecology Lab	DC	1	87
	BTGE6004	Genetic Engineering lab	DC	1	76
	MBIM6005	Immunology and Medical Microbiology Lab	DC	1	87
	MBDI6006	Dissertation Phase I	DC	2	88
Total Credits				**20**	

Semester 4: MICROBIOLOGY

Type	Course Code	Course Name	Category	Credits	Page
Theory	MBAM0006	Advances in Microbiology	DC	4	84
Lab	MBDI6007	Dissertation Phase II	DC	16	88
Total Credits				**20**	

DEPARTMENT OF ZOOLOGY

MASTER OF SCIENCE IN ZOOLOGY

Semester 1

Type	Course Code	Course Name	Category	Credits	Page
Theory	ZGBT0001	Biosystematics, Taxonomy and Evolution	DC	4	89
	ZGBG0002	Cell Biology and Genetics – Theory and Applications	DC	4	90
	ZGBC0003	Molecular Biology and Biochemistry	DC	4	91
	ZGPE0004	Animal Physiology and Endocrinology	DC	4	92
	BCAT0002	Analytical Techniques for Biological Sciences	SC	3	55
Lab	ZGBT6001	Biosystematics and Taxonomy Lab	DC	2	114
	ZGBG6002	Cell Biology, Genetics, Physiology and Biochemistry Lab	DC	2	115
Total Credits				**23**	

Semester 2

Type	Course Code	Course Name	Category	Credits	Page
Theory	BTCA0002	Computer Applications for Biosciences and Bioinformatics	SC	3	75
	BTRM0003	Research Methodology and Biostatistics	SC	4	67
	ZGDB0005	Developmental Biology	DC	4	93
	ZGEE0006	Ecology, Environmental Biology and Ethology	DC	4	94
Lab	BTCA6002	Computer Applications for Biosciences and Bioinformatics Lab	SC	2	78
	ZGDB6003	Developmental and Environmental Biology Lab	DC	2	115
	ZGPR6004	Project Management, Reporting and Documentation	IC	2	116
Total Credits				**21**	

Semester 3

Type	Course Code	Course Name	Category	Credits	Page
Theory	ZGAZ0007	Applied Zoology I	DC	4	96
	Specialization 1: Entomology and Environmental Biology				
	ZGIF0008	Insects- Structure & Function	DE	4	97
	ZGIP0009	Insect Physiology	DE	4	98
	Specialization 2: Cell and Molecular Biology				
	ZGCB0010	Cell and Molecular Biology –I	DE	4	99
	ZGIY0011	Immunology I	DE	4	101
	Specialization 3: Fish and Fishery Biology				
	ZGTF0012	Taxonomy and Functional Anatomy	DE	4	102
	ZGAF0013	Aquaculture and Fish Genetics	DE	4	103
	Specialization 4: Animal Ecology and Wildlife Biology				
	ZGEB0014	Animal Ecology and Biogeography	DE	4	104
	ZGWM0015	Wildlife Conservation and Management	DE	4	105
Lab	ZGSL6005	Specialization Lab I	DC	2	118
Project	ZGDI6006	Dissertation (Phase I)	DC	4	
	ZGJP6007	Introduction to Journalism and Photography	IC	2	120
Total Credits				**20**	

Semester 4

Type	Course Code	Course Name	Category	Credits	Page
Theory	ZGAZ0016	Applied Zoology II	DC	4	106
	Specialization 1: Entomology and Environmental Biology				
	ZGIG0017	Insect Ecology	DE	4	107
	ZGPM0018	Principles of Pest Management	DE	4	108
	Specialization 2: Cell and Molecular Biology				
	ZBMB0019	Cell and Molecular Biology –II	DE	4	109
	ZGIM0020	Immunology II	DE	4	110
	Specialization 3: Fish and Fishery Biology				
	ZGCP0021	Capture fishery and Post-harvest Technology	DE	4	111
	ZGLF0022	Limnology, Fishery economics, Ornamental fishery and Fish pathology	DE	4	112
	Specialization 4: Animal Ecology and Wildlife Biology				
	ZGRE0023	Wildlife Resource Management and Economics	DE	4	113
	ZGWC0024	Wildlife Health, Forensics and Conflict	DE	4	114
Lab	ZGPL6008	Specialization Lab II	DC	2	119
Project	ZGDS6009	Dissertation (Phase II)	DC	8	
	ZGTM6010	Teaching Methodology and Class room Management	IC	2	120
Total Credits				**24**	

SCHOOL OF LIFE SCIENCES

DEPARTMENT OF LIFE SCIENCES

PROGRAMME: MASTER OF SCIENCE IN BIOCHEMISTRY, BIOTECHNOLOGY AND MICROBIOLOGY

DETAILED SYLLABUS

BIOCHEMISTRY

BCAT0002: ANALYTICAL TECHNIQUES FOR BIOLOGICAL SCIENCES
(3 credits - 45 hours)

Objective: *The aim of this course is to expose students to the basic principles of modern analytical techniques and their recent applications in biological sciences.*

Module I: Basic laboratory Instruments (9 Hours)

a) Review of concepts of acids and bases, Principle and working of pH meter, Buffer preparation, principle of Laminar-air flow chamber
b) Principles and applications of centrifugation techniques: Introduction to hydrodynamics, Types of centrifuges, preparative and analytical centrifugation, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods

Module II: Microscopy and Autoradiography (9 Hours)

a) Review of principles of light microscopy; principles and applications of phase contrast and fluorescence microscopy
b) Principles and applications of Transmission and Scanning Electron microscopy
c) Principle and applications of Autoradiography
d) Theories of Tissue fixation and staining techniques

Module III: Spectroscopy (9 Hours)

a) Basic principles of Spectroscopy, UV, IR, Raman, ESR, ORD
b) CD and structure of proteins using NMR and ESR
c) Neutron and X-Ray diffraction for elucidation of 3D structure
d) Molecular modelling, Mass Spectrometry

Module IV: Chromatographic techniques (9 Hours)

a) Principles, types and applications of Chromatography
b) Gas Chromatography, GC-MS, LC – MS / MS, MALDI TOF mass spectrometer
c) Ion Exchange Chromatography, gel permeation, Affinity and reverse phase chromatography
d) HPLC and FPLC

Module V: Electrophoretic Techniques (9 Hours)

a) Basic principles of Electrophoresis, Agarose gel, native and SDS-PAGE
b) Isoelectric focusing, 2D-PAGE and their uses in protein research
c) Fractionation and Blotting Techniques

COURSE/LEARNING OUTCOMES

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

CO1: Understand the basic principles of modern analytical techniques
CO2: Understand recent applications in biological sciences
CO3: Prepare protocol for separation and analysis of biological sample

Suggested Readings

1. H.H. Willard, L.L. Merritt Jr. and others, Instrumental Methods of Analysis. 6th Edition, 1986, CBS Publishers and Distributors.
2. Chatwal G and Anand, S., Instrumental Methods of Chemical Analysis, 1989, Himalaya Publishing House, Mumbai.
3. Williams, B.L. and Wilson, K., A Biologist's Guide to Principles and Techniques of Practical Biochemistry, 1975
4. B.B. Straughan and S. Walker Eds., Spectroscopy, Volume 1, Chapman and Hall Ltd.
5. Hanes, Gel Electrophoresis of Proteins - A Practical Approach
6. James Miller, Chromatography: Concepts and Contrasts, 1988, John Wiley and Sons Inc., New York.
7. Holme, Analytical Biochemistry
8. R.J. Hamilton and P.A. Sewell, Introduction to High Performance Liquid Chromatography
9. B.P. Straughan and S. Walker, Spectroscopy
10. Gordon M. Message, Practical aspects of Gas Chromatography and Mass Spectrometry, 1984, John Wiley and Sons, New York.
11. Tibor Kremmery, Gel Chromatography, Wiley Publications.
12. C.C. Thornburn, Isotopes and radiations in Biology, Butterworth and Co. Ltd., London.
13. J.M. Chapman and G. Ayrey, The Use of Radioactive Isotopes in the Life Sciences, George Allen and Unwin Ltd., London.

BCMB0003: MOLECULAR BIOLOGY

(4 Credits – 60 hours)

Objective: *Molecular biology is the study of biological macromolecules and the processes in which they are involved. It includes the molecular structure, chemistry and physics of DNA, RNA, and protein to understand their functions in the living system.*

Module I: Replication Biology (15 Hours)

Nucleic acid as genetic material: it's proof; Different modes of replication (conservative, semi-conservative and dispersive); DNA replication in prokaryotes, eukaryotes and virus (rolling circle model): General features and enzymology; detailed mechanisms of initiation, elongation and termination; experiments underlying each step and role of individual factors; proofreading and processivity of DNA polymerase; telomerases: mechanism of replication, maintenance of integrity and role in cancer; effect of different inhibitors on replication.

Module II: Transcription Biology (15 Hours)

Basic concepts of promoter, operator, terminator, enhancer; RNA polymerases and its sub Modules; different sigma factors and their relation to stress, viral infections etc; initiation, elongation and termination (rho-dependent and independent) mechanism of RNA synthesis; post transcriptional modification of RNA - capping, splicing and poly A tailing; effect of different inhibitors on prokaryotic and eukaryotic transcription.

Module III: Translation Biology (20 Hours)

The genetic code and its nature; structure of t-RNA, ribosomal structure; activation of amino acids; initiation, elongation and termination mechanism of polypeptide chain synthesis; role of r-RNA in polypeptide chain synthesis; differences between prokaryotic and eukaryotic translational processes; post-translational modification of peptide, its transportation; non- ribosomal peptide synthesis with special reference to cyclic polypeptide antibiotics synthesis in bacteria; effect of different inhibitors on protein synthesis in both prokaryotes and eukaryotes.

Module IV: Gene regulation (10 Hours)

Positive and negative control; catabolite regulation-definition and mechanism; effect of anti-termination and attenuation on the process of gene regulation; various protein motifs involved in DNA-protein interactions during gene regulation. Epigenetics - definition and mechanism.

COURSE/LEARNING OUTCOMES

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

CO1: Understand the structural and functional properties of biological macromolecules
CO2: Central dogma from Replication of DNA till Translation of protein
CO3: Regulation of gene action

Suggested Readings

1. Krebs JE, Kilpatrick ST, Goldstein ES. Lewin's Genes,Jones and Bartlett Learning.
2. Watson JD, Baker TA, Bell SP, Gann AAF, Levine M, Losick RM. Molecular Biology of the Gene, Benjamin Cummings.
3. Weaver RF. Molecular Biology, McGraw-Hill Higher Education.
4. Clark DP. Molecular Biology, Academic Press Inc.
5. Freifelder D. Molecular Biology, Narosa.

BCIM0004: IMMUNOLOGY AND MEDICAL BIOCHEMISTRY

(4 Credits - 60 hours)

Objectives: *This course is designed to equip students with the theoretical knowledge and understanding of practical applications of immunology and medical biochemistry. The course includes immune system of the body and various disorders of the metabolism and chronic diseases.*

PART A: Immunology

Module I: General Immunology (15 hours)

History and scope of immunology, hematopoietic stem cells, stromal cells, haematopoiesis, lymphoid tissues and organs (primary and secondary), B-lymphocytes and their activation, Thymus derived lymphocytes and their activation, antigen presenting cells, natural killer cells, dendritic cells, macrophages, structure and functions of Class I and II Major Histocompatibility complex (MHC) molecules, types of immunity: innate and acquired, active and passive, humoral and cell mediated, immunoglobulin: structure and function, clonal selection theory, generation of antibody diversity, organization and expression of immunoglobulin genes, antigens: T dependent and T independent antigens, adjuvant (definition, examples, function), antigen antibody reactions, cross reactivity, cytokines-definition, types, antigenic processing and presentation, circulation and homing of immune cells, regulation of immune response.

Module II: Advanced Immunology (10 hours)

The complement systems: definition, function, activation of complement, complements receptors and classical and alternate pathway, transplantation: organ transplantation and HLA tissue typing, autoimmunity, hypersensitivity reactions, immunological tolerance, immune suppression and immunotherapy, vaccine: definition, classification and function.

PART B: Medical Biochemistry

Module III: Metabolic disorders (15 hours)

a) Introduction of Medical Biochemistry;
b) Disorders of Carbohydrate Metabolism: Diabetes mellitus, glucose tolerance tests, sugar levels in blood, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia.
c) Disorders of Lipids metabolism: Plasma lipoproteins, cholesterol, triglycerides and phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies.
d) Abnormalities in Nitrogen Metabolism: Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance. Disorders of liver and kidney: Jaundice, fatty liver.

Module IV (10 hours)

a) Digestive diseases: Maldigestion, malabsorption, creatorrhoea, diarrhoea and steatorrhoea.
b) Diagnostic Enzymes: Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays – SGOT, SGPT, CPK, cholinesterase, LDH.

c) Water-Electrolytes and acid-base balance: Distribution of body water and electrolyte in the body, normal water and electrolyte balance, regulatory mechanisms, abnormal water and electrolyte metabolism, Acid base balance in normal health, acidosis, alkalosis.

Module V (10 hours)

a) Biochemistry of cancer: Cancer causative agents and control of cancer and carcinogenesis, viral etiology.
b) Biochemistry of AIDS: Structure and molecular features of HIV, Retroviral background, diagnosis of AIDS modes of transmission, immunological response in AIDS, Anti-retroviral therapy.
c) Biochemistry of Ageing: Definition of ageing, Life span and life expectancy, oxygen radicals, antioxidants and ageing, DNA repair, Heat shock proteins, role of dopamine receptors in ageing.

COURSE/LEARNING OUTCOMES

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

CO1: Explain the properties, structural and functional aspects of the different kinds of stem cells involved in the defense mechanism of immune cells
CO2: Understand the mechanism of complement systems, organ transplantation, hypersensitivity reactions, immunosuppression and immunotherapy
CO3: Understand and describe the different disorders of the body related to carbohydrate metabolism, lipid metabolism, Nitrogen metabolism and digestive disorders
C04: Explain biochemistry, causative agents, mechanisms involved behind the working of AIDS, Cancer and Aging

Suggested Readings

1. Kuby, J. Immunology. W. H. Freeman and Co.
2. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I. M. Roitt's Essential Immunology. Wiley-Blackwell
3. Abbas, A. K., Lichtman, A. H. H., Pillai, S. Cellular and Molecular Immunology. Elsevier
4. Franklin, T. J. and Snow, G. A. Biochemistry of Antimicrobial Action. Chapman and Hall, London
5. Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. Microbiology. Tata McGraw Hill
6. Chatterjee, M. N., Shinde, R. Medical Biochemistry JAYPEE Publications
7. Stryer, L. Biochemistry Freeman and Co.
8. Elkeles, R., and Tavill, A. Biochemical aspects of human diseases Blackwell Science Ltd
9. Devlin, T. M. Text-book of Biochemistry with clinical correlations J. Wiley and Sons.
10. Guyton. A.C. and Hall, J. E. Textbook of Medical Physiology Elsevier Health Sciences

BCPY0005: PHYSIOLOGY

(3 Credits - 45 hours)

Objective: *To teach students the basic concepts of plant and human physiology. At the end of the course the students will have a thorough understanding of the mechanisms of plant and human physiology.*

Part A: Plant Physiology

Module I: Cell Structure, Photosynthesis, Respiration and Photorespiration (8.5 hours)

Cell organelles and their physiological functions, structure and physiological functions of cell wall, cell inclusions; cell membrane structure and functions. Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways; Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway. Calvin Cycle: synthesis of hexoses from carbon dioxide and water, role of environmental conditions. The Pentose phosphate pathway: coordination of metabolism of glucose-6-phosphate with glycolysis, role of glucose-6-phosphate dehydrogenase in protection against reactive oxygen species.

Module II: Solute transport, photoassimilate translocation and stress physiology (7 hours)

Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates. Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses

Part B: Human Physiology

Module III: Homeostasis (2.5 hours)

The scope of human physiology, organization of the body – cells, tissues, organs and organ systems; homeostasis, characteristics of homeostatic control systems, components of homeostatic control systems, intercellular chemical messengers, processes related to homeostasis.

Module IV: The muscles, nervous system and brain (7.5 hours)

a) Muscles, Nervous System and Sensory Physiology: Muscle proteins, molecular mechanisms of muscle contraction (skeletal and smooth), nerve conduction, chemical regulation of synapses, neurotransmitters, neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture, primary sensory coding, sensory receptors, neural pathways in sensory systems, Somatic sensation, biochemistry of vision, chemical senses.

b) **Consciousness, the Brain and Behavior:** States of consciousness, conscious experiences, motivation and emotion, altered states of consciousness, learning and memory.

Module V: Cardiac and Respiratory Physiology (9 hours)

a) **Cardiovascular Physiology, Blood and Circulation:** Blood corpuscles, haemopoiesis and formed elements, plasma proteins and their functions, blood groups, clotting factors, extrinsic and intrinsic pathways of blood coagulation, mechanism of blood coagulation, fibrinolysis, Role of hemoglobin in transport of gases; Anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

b) Respiratory Physiology: Organization of the respiratory system, ventilation and lung mechanics, exchange of gases, transport of gases, waste elimination, neural and chemical regulation of respiration

Module VI: Physiology of the endocrine system and reproduction (5 hours)

Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation

Module VII: The physiology of digestion and absorption of food, regulation of water and inorganic ions (5.5 hours)

a) **The Digestion and Absorption of Food:** Digestion, absorption, energy balance, Basal Metabolic Rate

b) **The Kidneys and Regulation of Water and Inorganic ions:** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination regulation of water balance, acid-base balance. Components of body fluids, role of vasopressin, renin-angiotensin-aldosterone system and atrial natriuretic factor in water and electrolyte balance.

COURSE/LEARNING OUTCOMES

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

CO1: Understand the cell structure, photosynthesis, respiration, the different mechanisms of respiration, light harvesting and the different molecules involved, solute transport, translocation, stress physiology of higher plants

CO2: Have a sound understanding of homeostasis, the structural and functional organization, components of chemical messengers, organ systems of humans

CO3: Understand the anatomy, physiology and mechanism of the cardiovascular, respiratory, endocrine, reproductive and the digestive system

Suggested Readings

1. Murray R.K. et al., Harper's Illustrated Biochemistry, McGraw Hill Lange Med. Publ.
2. Devlin T. M. Textbook of Biochemistry with clinical correlations, Wiley-Liss Publ.
3. Barrett, K.E. et al Ganong's Review of Medical Physiology, Tata McGraw-Hill. Ed.
4. Guyton, A.C. and Hall, J.E. Textbook of Medical Physiology, Saunders, Elsevier.
5. Voet D. et al Principles of Biochemistry, John Wiley and Sons Inc.
6. Nelson D.L. and Cox M.M. Lehninger's Principles of Biochemistry, Freeman and Co, New York
7. Bhagavan N. V. Medical Biochemistry, Jones and Bartlett Publ.
8. Garret R.H. and Grisham C.M. Biochemistry, Saunders College Publ.

BCBM0006: BIOGENETICS AND METABOLISM

(3 Credits - 45 hours)

Objectives: *To introduce students to (i) concepts of energy transformation in living systems and (ii) principles of biochemical processes essential for the sustenance of life*

Module I: Overview of metabolism and membrane lipids (4 hours)

Metabolism is composed of many coupled interacting reactions, oxidation of carbon fuels is an important source of cellular energy, recurring motifs in metabolic pathways; common features underlying the diversity of biological membranes, fatty acids as key constituents of lipids, three common types of membrane lipids, formation of bimolecular vesicles (sheets) in aqueous media, role of proteins in membrane processes, in-plane membrane diffusion of lipids and membrane proteins, internal membranes compartmentalize eukaryotic cells

Module II: Glycolysis and Gluconeogenesis, Citric Acid Cycle (5 hours)

Glycolysis as an energy conversion pathway in many organisms, tight control of glycolytic pathway, synthesis of glucose from non-carbohydrate precursors, reciprocal regulation of gluconeogenesis and glycolysis; oxidation of two carbon Modules, controlled entry to the citric acid cycle and metabolism through it, citric acid as a source of biosynthetic precursors, the glyoxylate cycle.

Module III: Oxidative phosphorylation (5 hours)

The site of oxidative phosphorylation in eukaryotes, dependence on electron transfer, the respiratory chain, ATP synthesis, movement across mitochondrial membranes by shuttles, regulation of cellular respiration

Module IV: Detailed nutrient metabolism (8.5 hours)

a) **Glycogen metabolism:** Interplay of enzymes in glycogen breakdown, regulation of phosphorylase by allosteric interaction and reversible phosphorylation, role of epinephrine and glucagon, pathways and reciprocal regulation of glycogen synthesis and breakdown;

b) Fatty acid metabolism: triacylglycerols, utilization of fatty acids as fuels-steps involved, different pathways are involved in fatty acid synthesis and breakdown, the role of acetyl-CoA carboxylase in fatty acid metabolism, elongation and unsaturation of fatty acids;

c) Protein turnover and amino acid catabolism: Introduction, tight regulation of protein turnover, steps involved in amino acid degradation, disruption of amino acid degradation

Module V: Membrane Transport (5 hours)

Active and passive transport of molecules across membranes, use of ATP hydrolysis to pump ions across membranes, membrane proteins with ATP-binding cassette domains, secondary transporters, rapid movement of ions across membranes, gap junctions

Module VI: Signal transduction pathways (5 hours)

Activation of G-proteins by seven-transmembrane-helix receptors, hydrolysis of phosphatidylinositol bisphosphate by phospholipase C, Calcium as a ubiquitous cytosolic messenger, receptor signalling, defects in signalling pathways-leading to cancer and other diseases, recurring features of signal-transduction pathways reveal evolutionary relationships

Module VII: Nutrient biosynthesis (7.5 hours)

a) **Biosynthesis of amino acids:** Nitrogen fixation, amino acids are made from intermediates of the citric acid cycle and other major pathways, regulation of amino acid synthesis by feedback inhibition, amino acids as precursors of many biomolecules;

b) Nucleotide biosynthesis: de novo syntheses of pyrimidine and purine bases, deoxyribonucleotide synthesis, feedback inhibition, formation of NAD^+, FAD and coenzyme A from ATP, pathological conditions arising from disruption in nucleotide metabolism;

c) Biosynthesis of membrane lipids and steroids: phosphatidate –a common intermediate in synthesis of phospholipids and triacylglycerols, synthesis of cholesterol, complex regulation of cholesterol biosynthesis, important derivatives of cholesterol

Module VIII: Integration of metabolism (5 hours)

Metabolism consists of highly interconnected pathways, unique metabolic profile of organs, food intake and starvation induce metabolic changes, fuel choice during exercise is determined by intensity and duration of activity, ethanol alters energy metabolism in the liver.

COURSE/LEARNING OUTCOMES

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

CO1: Understand the working, mechanism of metabolism and the membrane lipids, glycolysis, gluconeogenesis, citric acid cycle and oxidative phosphorylation

CO2: Understand the nutrient metabolism in detail: glycogen metabolism, fatty acid metabolism, protein turnover and amino acid catabolism

CO3: Have an understanding of membrane transport systems and signal transduction pathways

CO4: Understand the biosynthesis of amino acids, nucleotide, membrane lipids, steroids and the different pathways integrated in metabolism

Suggested Readings

1. M. Berg, J. L. Tymoczko, L. Stryer, Biochemistry, Freeman Publication
2. Voet and Voet, Biochemistry John Wiley and Sons
3. Nicholls and Ferguson, Bioenergetics, Elsevier
4. Lowen, Alexander, Bioenergetics Penguin Books
5. Brown and Cooper, Bioenergetics: A practical approach, paperback, Oxford University Press

BCAC0007: ADVANCES IN BIOCHEMISTRY

(4 credits - 60 hours)

Objectives: *This paper will review principles and procedures of advanced techniques in Biochemistry. In this course students will be taught principles, applications and advances of techniques that are widely used in the field of biochemistry. They will also be required to do presentations and submit an assignment on the most recent developments in the field of biochemistry from the latest peer-reviewed journals.*

Module I: Genomics (10 hours)

Mapping and sequencing genomes: Genetic and physical mapping, Sequencing genomes different strategies, High-throughput sequencing, next-generation sequencing technologies, comparative genomics, population genomics, epigenetics, Human genome project, pharmacogenomics, genomic medicine, applications of genomics to improve public health, drug discovery and agriculture

Module II: Transcriptomics (10 hours)

The analysis of global gene expression and transcription factor regulation, global approaches to alternative splicing and its regulation, long noncoding RNAs, gene expression models of signalling pathways, from gene expression to disease phenotypes, introduction to isoform sequencing, systematic and integrative analysis of gene expression to identify feature genes underlying human diseases

Module III: Proteomics (10 hours)

Introduction to proteomics, techniques to study proteomics such as protein electrophoresis, chromatography and mass spectrometry and protein database analysis, case studies derived from scientific literature including comparisons between healthy and diseased tissues, new approaches to analyse metabolic pathways, comprehensive analysis of protein-protein interactions in different cell types

Module IV: Metabolomics (10 hours)

Metabolites and metabolism, structural diversity of metabolites, number of metabolites in biological systems, controlling rates and levels of metabolites, metabolite channelling or metabolons, networks of metabolites, sampling, sample preparation, analytical tools such as chromatographic systems, mass spectrometry, case studies: yeast metabolomics, plant metabolomics, microbial metabolomics, metabolomics in humans and mammals

Module V: Intellectual Property Rights (20 hours)

a) Introduction to intellectual property: patents, types, trademarks, copyright and related rights,
b) industrial design and rights, traditional knowledge, geographical indications, patentable and non patentables issues, patenting life, legal protection of biotechnological inventions, world intellectual property rights organization (WIPO), Indian Patent Act 1970 and recent amendments, entrepreneurship in bioscience.

COURSE/LEARNING OUTCOMES

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

CO1: Understand mapping and sequencing of genomes, sequencing techniques and its applications
CO2: Understand transcriptomics and proteomics
CO3: Explain the different aspects and techniques of metabolomics
CO4: Understand bioactive natural products and drug discovery
CO5: Understand the basic concepts of intellectual property rights and their significance in research

Suggested Readings

1. Twyman, R. M., Principles of Proteomics, 2004
2. Villas-Boas, S. G., Roessner, U., Hansen, M. A. E., Smedsgaard, J., Nielsen, J. Metabolome Analysis: An introduction
3. Langauer, T., Mannhold, R., Kubinyi, H., Timmerman, H. Bioinformatics - From genomes to drugs
4. Primrose, S. B., Twyman, R. M., Old, R. W. Principles of gene manipulation
5. Tringali, C. (ed.), Natural products as lead compounds in drug discovery CRC Press
6. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi
7. Kankanala C. (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
8. Goel D., Prashar S.. IPR, Biosafety and Bioethics. (2013).Pearson

BCBM0008: BIOMOLECULES

(4 credits - 60 hours)

Objective: *The objective of the course is to give the students a sound understanding of the structural and functional aspects of biomolecules.*

Module I: Basic concepts (6 Hours)

Ionization of water, pH and pK, buffers, weak acids and weak bases. General concepts on: Plane of symmetry, centre and axis of symmetry; Concepts of chirality; optical isomerism; geometrical isomerism; DL, RS nomenclature; Projection formula (Fischer and Howarth); Isomers: anomers, epimers.

Module II: Carbohydrates (12 Hours)

a) Classification, basic chemical structure, general reactions and properties, biological significance, Sugar derivatives, deoxy sugars, amino sugars, and sugar acids. Mutarotation of sugar. Anomeric effect of sugar (Methylation effect).Inversion (hydrolysis) of cane sugar.

b) Polysaccharides - occurrence, structure, isolation, properties and functions of homoglycans - starch, glycogen, cellulose, dextrin, inulin, chitins, xylans, arabinans, galactans.
c) Occurrence, structure, properties, and functions of heteroglycans - bacterial cell wall polysaccharides, glycoaminoglycans, agar, alginic acid,pectins, amino sugars and deoxy sugars, blood group substances and sialic acids.Glycoprotein and their biological applications.Lectins structure and functions.

Module III: Lipids (12 Hours)

Definition and Classification - (simple, complex, derived lipids - structure and example). Saturated and unsaturated fatty acids, Nomenclature of fatty acids, General chemical reactions of fatty acids – esterification, hydrogenation and halogenations, Phospholipids - classification, structure and functions, Ceramides and Sphingomyelins, Eicosanoids, structure and functions of prostaglandins, thromboxanes, leukotrienes, Types and functions of plasma lipoproteins. Amphipathic lipids - membranes, micelles, emulsions and liposomes.Steroids - cholesterol structure and biological role - bile acids, bile salts. General chemical reactions of fats: Hydrolysis, Saponification number, I_2 number, acetylation, acetyl number, and volatile fatty acid number - definition and related problems.Rancidity of fat.

Module IV: Vitamins and Porphyrins (8 Hours)

a) Vitamins - water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid- sources, structure, biochemical functions, deficiency diseases, daily requirements; fat soluble - vitamin A, vitamin D2, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements.
b) Porphyrins: the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome.

Module V: Nucleic acids (10 Hours)

Watson-Crick Model of DNA structure: A, B and Z – DNA. Chemical Properties: Hydrolysis (acid, alkali), enzymatic hydrolysis of DNA. Cruciform structure in DNA, formation and stability of cruciform, miscellaneous alternative conformation of DNA, HDNA, slipped mispaired DNA, parallel stranded, anisomorphic DNA, palindrome, secondary and tertiary structure of RNA, hnRNA, si RNA, methods for nucleic acid sequence determination, denaturation, strand separation, fractionation, isolation and purification of DNA, mRNA, rRNA and tRNA, molecular hybridization, Cot value curve, hypochromic and hyperchromic effect, DNA-protein interactions, Viscosity, Buoyant density, Tm.

Module VI: Proteins (12 Hours)

Definition, classification, structure, stereochemistry and reactions of amino acids;Classification of proteins on the basis of solubility and shape, structure, and biological functions. Isolation, fractionation and purification of proteins.Denaturation and renaturation of proteins. Primary structure - determination of amino acid sequences of proteins, the peptide bond.Ramachandran plot. Secondary structure - weak interactions involved - alpha helix and beta sheet and beta turns structure. Pauling and Corey model for fibrous proteins. Collagen triple helix.Super secondary structures - helix-loop-helix. Tertiary structure - alpha and beta domains. Quaternary structure - structure of hemoglobin. Solid state synthesis of peptides. Protein-Protein interactions, Concept of chaperones

COURSE/LEARNING OUTCOMES

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

CO1: Have a sound understanding of the structural and functional aspects of biomolecules (*Knowledge*)
CO2: Describe and draw the chemical structures of different biomolecules *(Comprehension)*
CO3: Estimate the different concentrations of biomolecules for biological applications (*Application*)
CO4: Analyze the interaction and importance of equilibrium maintenance of different biomolecules for health related issues (*Analysis*)

Suggested Readings

1. L. Stryer, Biochemistry, W.H. Freeman and Co.
2. Voet and Voet, Fundamentals of Biochemistry, John Wiley and sons NY.
3. David L. Nelson and Michael M. Cox, Lehninger's Principle of Biochemistry, W. H. Freeman and Co.

4. Thomas M. Devlin, John Wiley-Liss, Hobokhen, Text Book of Biochemistry with Clinical Correlation, NJ publishers
5. Zubey GL, Biochemistry, WCB Publishers

BCBM6001: BIOMOLECULES LAB

(1 Credit)

1. Preparation of buffers
2. Determination of pKa and pI of acidic, basic, and neutral amino acids
3. Estimation of amino acids by Ninhydrin method
4. Estimation of DNA by DPA method
5. Estimation of RNA by Orcinol method
6. Estimation of proteins by Bradford method
7. Estimation of proteins by Lowry method
8. Isolation and estimation of lipids from seeds
9. TLC of plant pigments
10. TLC of lipids

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Estimate and prepare buffer solutions for different experiments
CO2: Quantify various biomolecules at different concentrations for future research experiments
CO3: Apply the technique based on spectrophotometer for analysis of various biomolecules

Suggested Reading

1. Walker, J. H. (Ed.) The Protein Protocols Handbook, Humana Press
2. Sadasivam and Manickam Biochemical methods, New Age International

BCAT6002: ANALYTICAL TECHNIQUES LAB

(1 Credit)

1. SDS-PAGE separation of proteins
2. Study of serum proteins by horizontal submerged gel electrophoresis
3. Study of UV absorption spectra of biological macromolecules-proteins, nucleic acids
4. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC
5. Separation of bacterial lipids/amino acids/sugars/organic acids by Paper Chromatography
6. Separation of haeomoglobin or blue dextran by gel filtration
7. Quantitative estimation of hydrocarbons/pesticides/organic solvents/methane by gas chromatography
8. Demonstration of PCR, DNA sequencer and fermenter
9. Fricke Dosimetry
10. Optical characterization of liposomes by turbidimetry

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Apply the theoretical concepts learnt in the theory class for Analytical techniques lab

Suggested Readings

1. Walker, J. H. (Ed.) The Protein Protocols Handbook, Humana Press
2. Wilson K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press

BCMB6003: MOLECULAR BIOLOGY LAB
(2 Credits)

1. Isolation of plasmid DNA from bacteria.
2. Isolation of chromosomal DNA from bacteria.
3. Competent cell preparation of bacteria.
4. Bacterial transformation of exogenous DNA.
5. Polymerase chain reaction analysis
6. Restriction digestion of DNA

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Perform extraction of genomic and plasmic DNA from bacteria
CO2: Understand various steps of PCR and observe the amplicons in agarose gel electrophoresis
CO3: Carry out various steps involved in transformation and cloning

BCIM6004: IMMUNOLOGY AND MEDICAL BIOCHEMISTRY LAB
(2 Credits)

Immunology

1. Single radial immune diffusion
2. Double diffusion method of Ouchterlony
3. Electrophoretic separation of bovine protein
4. Agglutination reaction

Medical Biochemistry

1. Estimation of Lipoproteins.
2. Glucose tolerance test
3. Estimation of bilirubin
4. Estimation of blood urea
5. Estimation of creatine phosphokinase
6. Normal and abnormal constituents of urine

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Understand the principle and mechanism of single radial immune diffusion, double diffusion method of Ouchterlony, Agglutination reaction, electrophoretic separation of bovine protein
CO2: Practically estimate lipoprotein, bilirubin, blood urea, creatine phiosphokinase from a serum sample
CO3: Perform glucose tolerance tests and understand the normal and abnormal constituents of urine

Suggested Readings

1. Turgeon, M. L. Immunology and Serology in Laboratory Medicine Elsevier
2. Detrick, B., Hamilton, R. G., Folds, J. D. Manual of Molecular and Clinical Laboratory Immunology American Society of Microbiology Press
3. Talwar, G. P., Gupta, S. K. Hand Book of Practical and Clinical Immunology CBS Publishers and Distributors

BCPY6005: PHYSIOLOGY LAB
(1 credit)

(A minimum of 10 experiments to be performed)

1. Estimation of urea in serum
2. Estimation of cholesterol in serum.
3. Estimation of calcium in serum.
4. Assay of Serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyruvate transaminase (SGPT)
5. Assay of alkaline phosphatase

6. Assay of amylase in serum
7. Estimation of glucose in serum by glucose oxidase-peroxidase method.
8. Assay of LDH activity in serum
9. Separation of plasma proteins by electrophoresis
10. Estimation of glycosylated hemoglobin
11. Measuring the electrical activity of the heart
12. Measuring Basal Metabolic Rate using a respirometer
13. Counting white blood cells, red blood cells, platelets

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Estimate urea, cholesterol, calcium, glucose, glycosylated haemoglobin in serum
CO2: Perform an assay of SGOT, SGPT, alkaline phosphatase, amylase in serum, LDH activity in serum
CO3: Measure the electrical activity of heart, basal metabolic rate using a respirometer and count the number of red blood cells, white blood cells, platelets

BCBM6006: BIOENERGETICS AND METABOLISM LAB

(1 credit)

Bioenergetics

1. Cellular respiration in yeast
2. Photosynthesis and cellular respiration in plants
3. Deciphering how cells make energy (light driven ATP generation in chloroplasts causing pH change, also subjecting chloroplasts to pH changes resulting in ATP production-chemiosmosis theory)

Metabolism

1. Determining the specificity of lactase
2. Effect of pH on trypsin activity
3. Effect of temperature on amylase activity
4. Effect of bile on lipase activity

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Understand the mechanism of cellular respiration in yeast, photosynthesis and cellular respiration in plants
CO2: Decipher how cells manufacture energy-ATP generation
CO3: Understand the effect of pH on trypsin activity, temperature on amylase activity, bile on lipase activity

Suggested Reading

1. Brown, G. C. and Cooper, C. E. Bioenergetics: A Practical Approach Oxford University Press

BCDI6007: DISSERTATION PHASE I

(2 credits)

Objective: *Dissertation phase I is designed to familiarize the students with the research topics and methodologies by a thorough literature review.*
During dissertation phase I each student chooses a topic in consultation with the assigned supervisor and the student is asked to do thorough literature review under the guidance of the supervisor. At the end of the semester the student submits literature review report and students presents the matter at a school level seminar.

COURSE/LEARNING OUTCOMES

At the end of Dissertation phase I students will be able to:

CO1: Design experiment, prepare work plan and learn how to test hypothesis in research work

CO2: Present scientific information in a succinct manner and learn the process of scientific writing
CO3: Carry out literature survey and carry out the initial study required before designing their dissertation project.

BCDI6008: DISSERTATION PHASE II
(16 credits)

Objective: *Dissertation phase II involves execution of the research work decided in phase I leading to the preparation, submission and evaluation of the dissertation.*

During the course of the Master's Degree the student is expected to undertake a research work leading to a dissertation. The work will be divided into two phases spread over two semesters. During the research work the student shall study and incorporate recent trends in the area chosen by him/her, and develop a scientific dissertation based on the research and actual bench work. The student shall be required to make presentations and reports at various stages of the research work. The format for the final dissertation shall be as prescribed by the Department. There shall be a viva voce examination on the dissertation by an expert committee comprising external and internal members. The mode and components of the evaluation and the weightages attached to them shall be published by the Department at the beginning of the semester.

BIOTECHNOLOGY

BTRM0003: RESEARCH METHODOLOGY AND BIOSTATISTICS
(4 Credits – 60 hours)

Objectives: *To introduce students to a few aspects of doing research and to provide them with the statistical tools necessary for analysing and interpreting experimentally acquired data*

Module I: Introduction to Scientific Research (15 hours)

a) Definition, basic and applied research, interdisciplinary research,
b) Discriminative reading, reading and reviewing scientific literature – consulting source material, primary and secondary literature, biological abstract, current content, review, monograph, peer-reviewed journals, e-resources; research and review articles
c) Introduction on scientific problems, your scientific problem, methods and techniques, research conditions, data types, techniques, repeatability, reproducibility and reliability, validity, effect measure and choice of statistical test, experimental protocol, experimental routine
d) Scientific communication - scientific paper, scientific posters

Module II: Ethics and Scientific Conduct (5 hours)

Brief introduction to ethics, scientific conduct and misconduct-plagiarism, authorship issues, investigation and punishment of scientific misconduct, ethics of animal and human research

Module III: (15 hours)

a) Introduction to Biostatistics: definition and applications of biostatistics;
b) Data-types and presentation: types of biological data, accuracy and significant figures;
c) Populations and samples: populations, samples from populations, random sampling, variables and attributes, statistical errors
d) Frequency distributions
e) Graphical representation of data: line diagram, bar diagram, pie chart, histogram
f) Measures of central tendency: the arithmetic mean, median and mode
g) Measures of dispersion: range, mean deviation, variance, standard deviation, standard error of mean, standard score

Module IV: (6 hours)

a) Permutations and combinations, sets
b) Probability: introduction, counting possible outcomes, probability of an event, adding and multiplying probabilities
c) Probability distributions: Binomial, Poisson and Normal distribution

Module V: (19 hours)

a) Testing of hypothesis and goodness of fit: Null hypothesis, level of significance, errors of influence, Student's t-test, paired t-test, Fischer's test, Chi-square test, linear correlation and linear regression
b) Analysis of variance: variances of samples and their means, F-distribution, partitioning of the total sum of squares and degrees of freedom, models and types of ANOVA

COURSE/LEARNING OUTCOMES

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

CO1: Know the forms of research – basic, applied, interdisciplinary, etc.
CO2: Explain Ethical conduct of research and its communication
CO3: Perform Statistical methods of data analysis and interpretation

Suggested Readings

1. Creswell JW. Educational Research-Planning, conducting and evaluating quantitative and qualitative research, Pearson.
2. Laake P, Benestad HB and Olsen BR. Research Methodology in the medical and biological sciences Academic Press, Elsevier.
3. Kothari CR. Research Methodology: Methods and techniques, New Age International [Available online].
4. Gurumani N. Research Methodology for Biological sciences. MJP Publishers (753 pp).
5. Banerjee PK. Introduction to Biostatistics. S. Chand [Available in Guwahati].
6. Sokal RR and Rohlf FJ. Biometry: The principles and practices of statistics in biological research, W. H. Freeman and Company.
7. Zar JH. Biostatistical Analysis, Pearson Prentice Hall.
8. Bailey NTJ. Statistical Methods in Biology, Cambridge University Press.

BTAP0004: ANIMAL AND PLANT BIOTECHNOLOGY

(4 Credits – 60 hours)

Objective: *In this course students will be introduced to the techniques and underlying theories of both plant and animal biotechnology and their application in agriculture, veterinary sciences, medical sciences and reproductive technology. Ethical issues related to biotechnological research will also be addressed in this course.*

Part A: Animal Biotechnology

Module I: Animal cell culture (10 Hours)

General considerations of cell culture: Aseptic condition, Media, Balanced salt solution, Carbon dioxide incubator, feeder layer, serum, growth factors; Types of culture media (defined and undefined media), culture media composition; role of different media. Types of cell culture –organ, Organotypic, single cell, Histotypic/3D, primary cells, cell lines, adherent and suspension cell cultures; Characteristics of cells in culture; measurement of cell viability, apoptosis,senescence; Scaling up of animal cell culture, stem cell culture, embryonic stem cell and their applications.

Module II: Animal improvement (8 Hours)

Embryology: Collection and preservation of embryos; culturing of embryos; micromanipulation technology and fertilization in animals; Equipment used in micromanipulation; Assisted reproductive biotechnology in human and animal; Sperm sorting; Enrichment of semen for x (female) or y (male) sperm; Biotechnology Techniques in Animal Breeding: Artificial Insemination, In Vitro Fertilization and embryo transfer.

Module III:Transgenic animals and application (12 Hours)

Transgenic animal: methods of production and application; transgenic animals as models for human diseases; transgenic animals in livestock improvement; industry, biomedicine, bioreactors; chimera production; Gene knockouts, production of human antibodies in animals; vaccines and their applications; gene therapy for animal diseases; Knockout mice and mice of human (genetic) disease(s); Animal cloning and ethical issues in animal biotechnology.

Part B: Plant Biotechnology

Module IV: Plant tissue culture and Micropropagation (10 Hours)

Definition, brief history, principle and significance of tissue culture; Cellular totipotency: Cytodifferentiation: Organogenic Differentiation: induction, factors affecting shoot bud differentiation; Cell suspension Culture, Callus Culture, Embryo Culture, Haploid Culture: microspore and macrospore culture. Triploid culture: Endosperm Culture, Protoplast: isolation, Culture and Fusion; Somatic hybridization and cybridization; Somatic Embryogenesis and Synthetic Seed Production; Androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation.

Module V: Methods of gene transfer and Markers (8 Hours)

Introduction to transgenic plants, methods of gene transfer – Agrobacterium tumefaciens mediated, Agrobacterium rhizogenes mediated; Direct gene transfer methods – Chemical, Physical and alternative methods. Selectable markers, reporter gene and promoter in plant vectors.

Module VI: Transgenic plants and Medicinal Plant biotechnology (12 Hours)

Transgenic plants: Herbicide resistance; Drought, Salinity, thermal stress, flooding and submergence tolerance. Seed storage proteins; Protein engineering; Vitamins and other value addition compounds; Metabolic engineering of lipids, flavonoids, vitamin E biosynthesis, flavoring agents (monoterpenes and sesquiterpene), Carotenoid biosynthesis, secondary metabolites; Production of pharmaceutically important compounds; Bioenergy generation; Medicinal plants: different secondary metabolites, application of biotechnology in medicinal plants.

COURSE/LEARNING OUTCOMES

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

CO1: Have a basic understanding on increasing use of modern molecular genetics for genetic mapping and rapid development of new strains of improved crops, livestock, fish, and trees.

CO2: Understand the applications of tissue culture and micro-propagation for the rapid multiplication of horticultural crops and trees

CO3: Know the importance of Genetic engineering and transformation techniques for production of transgenic plants and animals carrying desirable traits

Suggested Readings

1. Ranga MM. Animal Biotechnology. Agrobios India Limited
2. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers.
3. Freshney IR, R. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.
4. Barnes D, Mather JP, Animal cell culture methods, Academic press.
5. Heldt HW. Plant Biochemistry and Molecular Biology, Oxford University Press.
6. Ignacimuthu S, Applied Plant Biotechnology, Tata McGraw-Hill.
7. Gamburg OL, Philips GC. Plant tissue and Organ culture fundamental methods, Narosa publications.
8. Slater A, Scott N and Flower M, Plant Biotechnology. The genetic manipulation of plants, Oxford University Press.
9. Singh BD.Text book of Biotechnology, Kalyani publishers.

BTGE0005: GENETIC ENGINEERING

(3 Credits – 45 hours)

Objective: *In this course students will learn the basics of genetic engineering and the principles of gene manipulation. Students will be exposed to modern tools and techniques used in various areas of biotechnological/microbiological/biochemistry research.*

Module I: Enzymes in Genetic Engineering (6 Hours)

Restriction nucleases: Exo and Endo nucleases: History, Restriction endonuclease nomenclature, classification of restriction endonuclease – type I, type II, and type III, cleavage patterns – sticky ends, blunt ends, applications; Modifying enzymes – ligases, kinases, RNAse, polymerases, phosphatases and methylases, RNA dependent DNA polymerase,Terminal Deoxynucleotidyl transferase.

Module II: Plasmids and Vectors (10 Hours)

Cloning vectors: Plasmids and plasmid vectors, phagemids, cosmids, artificial chromosome vectors (YAC, BAC), E.Coli plasmid vectors – pBR322, pUC18, pET21,Bacterio-phage vectors – λ and M13, Cosmids, phagemids and Phasmids, Shuttle vectors - Yeast vectors, Baculo virus vector. Intein-based vectors; Inclusion bodies; Plant based vectors, Ti and Ri as vectors, Yeast vectors, Insertion and Replacement vectors, Expression vectors; Strategies for production of foreign proteins in E. coli, Yeast, animal cell, pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag.

Module III: Molecular Cloning and Hybridization techniques (12 hours)

Isolation of genomic and plasmid DNA, DNA cloning; Strategies for construction of genomic and cDNA libraries, chromosome walking; screening of libraries; Oligonucleotide, cDNA and antibody probes; The Southern, Northern, Western, North-Western, Zoo blots, South western, Far western blotting and Colony hybridization, yeast-two hybrid system, c-DNA synthesis and cloning: mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis; Cloning interacting genes two-hybrid systems, cloning differentially expressed genes. Site directed mutagenesis and protein engineering.

Module IV: PCR and its applications (9 Hours)

Primer design, thermostable enzymes, Types of PCR – multiplex, nested, reverse transcription PCR, quantitative real time PCR, touchdown PCR, colony PCR, cloning of PCR products; PCR in gene recombination: Deletion, recombination, addition, and Site-specific mutagenesis, PCR in molecular diagnostics – mutation detection, mismatch amplification mutation assay (MAMA), Oligonucleotide Ligation Assay (OLA), Single-strand conformation polymorphism (SSCP), Allele-specific amplification (ASA).

Module V: DNA Sequencing and applications of genetic engineering (8 Hours)

Maxam and Gilbert method and Sanger's method, Next generation sequencing, Applications of genetic engineering: Transgenic animals and plants, production of recombinant pharmaceuticals, gene therapy, disease diagnosis, Transgenic and gene knockout technologies: Vector engineering, strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

COURSE/LEARNING OUTCOMES

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

CO1: Get an insight about the different cloning vectors and plasmids used in the recent genetic engineering procedures

CO2: Understand the concepts regarding different hybridization techniques and applications of different types of Polymerase Chain Reaction (PCR)

CO3: Understand the different generation in sequencing research and its applications in genetic engineering

Suggested Readings

1. S.B. Primrose, R.M. Twyman and R.W. Old; Principles of Gene Manipulation. S.B.University Press.
2. Brown TA, Genomes, Garland Science.
3. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL.
4. Glover DM, Hames BD, Cloming I & II. IRL Press
5. Innis MA, Gelfant MA, Sni skey JJ, PCR Strategies, IRL Press.

BTIM0006: IMMUNOLOGY

(3 Credits – 45 hours)

Objective: *This course is designed to provide a foundation in the basic concepts of immunology and immunotechnology. Students will acquire a sound working knowledge of the basic elements of the immune system and the techniques employed in immunodiagnostics, therapeutic techniques and research.*

Module I (16 Hours)

a) History and scope of immunology, hematopoietic stem cells, stromal cells, hematopoiesis, lymphoid tissues and organs (primary and secondary), B-lymphocytes and their activation, Thymus derived lymphocytes and their activation, antigen presenting cells, natural killer cells, dendritic cells, macrophages, structure and functions of Class I and II Major Histocompatibility complex (MHC) molecules;

b) Types of immunity: innate and acquired, active and passive, humoral and cell mediated, immune globulin: definition, structure and function, clonal selection theory, monoclonal antibody synthesis, generation of antibody diversity, organization and expression of immunoglobulin genes, antigens: T dependent and T independent antigens, adjuvant (definition, examples, function), antigen antibody reactions, cross reactivity, cytokines-definition: definition, types and functions.

Module II (7 Hours)

The complement systems: definition, function, classical and alternate pathway, transplantation: organ transplantation and HLA tissue typing, autoimmunity, hypersensitivity reactions, immunological tolerance, immune suppression and immunotherapy, vaccine: definition, classification and function.

Module III (10 Hours)

Purification of mononuclear cells from peripheral blood, isolation and characterization of T cells subsets; B cells and macrophages; mitogen and antigen induced lympho-proliferation assay; mixed lymphocyte reaction - assessment of delayed hypersensitivity reactions; macrophage cultures - assay of macrophage activation - isolation of dendritic cells; *In situ* and *In vivo* characterization of cells from tissues; generation of T cell clones.

Module IV (12 Hours)

a) Disease diagnostics and Immunotechnology: DNA diagnostics, array-based diagnostics and nucleotide polymorphisms; Immuno screening of recombinant library; Tumour immunity, Immunodeficiency disease - SCID, AIDS.

b) Immunoelectrophoresis, immunofluorescence, Immunohistochemistry; Fluorescent Activated Cell Sorter (FACS); Single and double immunodiffusion, Immunofluorescence, RIA, RID, ELISA, Western blot, Agglutination tests; Vaccine technology including DNA vaccines; identification of T and B epitopes for vaccine development.

COURSE/LEARNING OUTCOMES

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

CO1: Get an insight into the physical, chemical and physiological characteristics of the components of the immune system

CO2: Understand the molecular basis of immunity and the complex genetics that underlies the diversity of the immune system

CO3: Understand the basis of autoimmunity, hypersentivities and immune deficiencies

Suggested Readings

1. Kindt TJ, Goldsby RA, Osborne BA, Kuby J. Kuby Immunology. WH Freeman and company, New York.
2. Abbas AK, Lichtman AK and Pober JS (Eds). Cellular and Molecular Immunology. WB Saunders.
3. Delves P, Martin S, Burton D, Roitt I. Roitt's Essential Immunology. Wiley-Blackwell.
4. Weir DM and Steward J. Immunology. Churchill Livingstone, New York
5. Goding. Monoclonal antibodies. Academic Press.
6. Hay FC, Westwood OMR. Practical Immunology. Blackwell Publishing.
7. Price CP, Newman DJ. Principles And Practices of Immunoassay. Nature Publishing Group.

BTBE0007: BIOPROCESS ENGINEERING

(3 Credits – 45 hours)

Objective: *The course aims to present the students the basic principles of bioengineering in large-scale cultivation of microorganisms for production of industrially important products. Students will be introduced to different aspects in the field of Bioprocess Engineering including bioreactors and fermentors, food biotechnology and environmental biotechnology.*

Module I (8 Hours)

Introduction to bioprocess engineering, bioreactors, bioprocess kinetics, kinetic modeling, cell immobilization, production of biomass and applications; Isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth, media formulation for industrial fermentation, Air and media sterilization; Designing of a fermenter/Bioreactor.

Module II (8 Hours)

Types of fermentation process, analysis of batch: fed batch and continuous bioreactor, biotransformation, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.) Measurement and control of bioprocess parameters

Module III (12 Hours)

Downstream processing: introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment; Industrial production of chemicals using biological aid: alcohols, acids (citric, acetic and gluconic), solvents (glycerols, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid), single cell proteins.

Module IV (10 Hours)

Food Biotechnology: Food spoilage and preservation process, dairy products, wine, beer and other alcoholic Beverages and formulated plant products, petro crops, food from water, fungal protein food from yeast, hybrid seeds, conventional breeding of plant for food production. Transformation of steroids and non-steroid compounds; Mushroom: types, isolation and culture.

Module V (12 Hours)

Bioremediation: Concept (in situ and ex situ bioremediation) and role of bioremediation in controlling various pollution problems (industrial and medical effluents,). Basic concept of phyto-remediation and myco-remediation; Bioremediation of heavy metals, oil spills, plastics, cellulose and paper, xenobiotics; Radioactive waste: Sources, half-life of radioactive elements and mode of decay.

COURSE/LEARNING OUTCOMES

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

CO1: Describe the design and development of equipment and processes for the manufacturing of products

CO2: Understand biochemical and physiological studies of metabolism and enzymes as relevant to product formation

C03: Understand transport phenomena, reaction kinetics, design of reactors and downstream operations

Suggested Readings

1. Stanbury PF, Whitaker A, Hall SJ. Principles of Fermentation Technology. Butterwoth Heinemann. (Available online).
2. Glazer AN. and Nikaldo H. Microbial Biotechnology, WH Freeman and company network.
3. Prescott LM, Harley JP and Klein DA. Microbiology. McGraw Hill.
4. Stainer RY, Ingrtham JL, Wheels ML and Painter PR. General Microbiology. Macmillan.
5. Casida LE. Industrial Microbiology, John Wiley and Sons.
6. Flickinger MC, Drew SW. Encyclopedia of Bioprocess Technology. John Wiley and Sons.
7. Demian AL and Davis. JE. Industrial Microbiology and Biotechnology, ASM Press.

BTAB0008: ADVANCES IN BIOTECHNOLOGY

(4 Credits - 60 hours)

Objective: *This course will review the principles of advanced Biotechnology. The students will be exposed to the frontiers of research and latest techniques in Biotechnology and their applications. This will keep them abreast of the most recent developments in the area.The students will be required to make presentations and submit assignments on the latest developments in the field of Biotechnology with the help of reputed national and international journals.*

Module I: Genomics (10 hours)

Genome organisation, prokaryotic and eukaryotic genomes, chromosomal and extra-chromosomal genomes, model organisms, Next Generation Sequencing (NGS), whole genome sequencing, genome projects, microarrays; epigenetics, pharmacogenomics, comparative genomics, applications of genomics in health, agriculture and industry

Module II: Transcriptomics and proteomics (15 hours):

a) Transcriptome, analysis of gene expression - ESTs, SAGE, recent developments in RNA sequencing; metatranscriptomics, applications in gene regulation: alternative splicing, non-coding RNA
b) Proteins and their structure, proteome, 1D and 2D PAGE, X-ray crystallography, Mass spectrometry including MALDI-TOF, protein microarrays, recent developments in secretomics, interactomics; applications of proteomics in drug discovery

Module III: Metabolomics, bioinformatics and systems biology (15 hours):

a) Metabolome and its significance, recent advancements using high throughput analytical techniques like chromatography coupled with mass spectroscopy (GC-MS, LC-MS), NMR; data analysis (PCA, PLSDA)
b) Databases, sequence alignments, phylogenetic tree, analysis of -omics data using advanced tools of bioinformatics
c) Systems biology – complex biological data, computational and mathematical models, recent developments in network analysis

Module IV: Commercial biotechnology (10 hours)

Isolation of industrially important enzymes, commercial production of industrial bio-molecules in bioreactors; drug discovery from both natural and synthetic source, recombinant vaccines; commercial plant tissue culture including automation, strategies for environment cleanup using biotechnological tools

Module V: Intellectual Property Rights (10 hours)

Introduction to intellectual property: patents, types, trademarks, copyright and related rights, industrial design and rights, traditional knowledge, geographical indications, patentables and non-patentables, patenting life, legal protection of biotechnological inventions, world intellectual property rights organization (WIPO), Indian Patent Act 1970 and recent amendments, entrepreneurship in bioscience.

Suggested Readings

1. Primrose, S.B. and Twyman, R., Principles of Gene Manipulation and Genomics, Wiley - Blackwell Publishers.
2. Bernot, A., Genome, Trascriptome and Proteome Analysis. John Wiley & Sons Ltd.
3. Stumpf, M., Balding, D.J. and Girolami, M., Handbook of Statistical Systems Biology, Wiley Publishers.
4. Singh, K.K., Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer, India.

BTPE0009: THERMODYNAMICS AND ENZYMOLOGY

(3 Credits - 45 hours)

Objective: *The objective of the course is to give the students an in-depth knowledge of the properties and kinetics of enzyme catalyzed reactions in biological systems*

Module I (5 hours)

Laws of thermodynamics, reversible and irreversible processes, entropy, enthalpy, internal energy, free energy and equilibrium constant, Gibbs free energy equation, determination of free energy change of under standard and non-standard conditions, high energy compounds, coupled reactions, determination of feasibility of reactions.

Module II (5 hours)

Isolation and purification of enzymes, Salting out of protiens, Isoelectric point, Electrophoresis of protein. Classification, nomenclature and general properties like effects of pH, substrate and temperature on enzyme catalyzed reactions.

Module III (7 hours)

Kinetics of enzyme catalyzed reaction: Single substrate reactions, bi-substrate reactions, concept of Michaelis-Menten, Briggs Haldane relationship, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics.

Module IV (10 hours)

Activation energy and Arrhenius concept. Binding energy, Enzyme catalysis: enzyme specificity and the concept of active site, determination of active site. Stereospecificity of enzymes. Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Theories on mechanism of catalysis. Inhibition of enzyme activity: Competitive-cite: succinate on Malonate dehydrogenase as example, Non-competitive-cite: lodoacetamide on triose phosphate dehydrogenase and EDTA as example: Suicide inactivation-action of penicillin on bacterial cell wall biosynthesis as an example.

Module V (9 hours)

Mechanism of enzymes action: mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymease. Multienzymes system, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex. Coenzyme action.

Module VI (9 Hours)

Enzyme regulation: General mechanisms of enzyme regulation, Allosteric enzymes, Feedback Regulation, Sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of Allosteric enzymes. Reversible and irreversible covalent modification of enzymes, cascade systems. Immobilised enzymes and their industrial applications. Ribozyme (catalytic RNA) and Abzyme (use of antibody as enzyme) - definition only.

COURSE/LEARNING OUTCOMES

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

CO1: Comprehend the properties and kinetics of enzyme catalyzed reactions in biological systems (*Comprehension*)
CO2: Explain the chemical reactions and determine the various variables (*Comprehension, Application*)
CO3: Analyze the relationship of an enzyme and substrate specificity for product formation (*Analysis*)
CO4: Explain and Analyze the essential role of enzymes in metabolism (*Comprehension, Analysis*)

Suggested Readings

1. R. S. Berry, S. A. Rice and J. Ross; Physical Chemistry; Oxford University Press publisher
2. P. C. Rakshit; Physical Chemistry; Sarat Book House publisher
3. Jeremy M. Berg (Editor), John L. Tymoczko (Editor), Lubert Stryer (Editor); Biochemistry; W.H.Freeman & Co Ltd publisher
4. Donald Voet, Judith G. Voet, Charlotte W. Pratt; Fundamentals of Biochemistry; John Wiley & Sons Inc publisher

5. David L. Nelson, Michael M. Cox; Lehninger Principles of Biochemistry; W H Freeman & Co (Sd) publisher
6. Thomas .M. Devlin; Textbook of Biochemistry With Clinical Correlations; John Wiley & Sons publishers publisher

BTCA0010: COMPUTER APPLICATIONS AND BIOINFORMATICS

(3 Credits – 45 hours)

Objective: *This course is designed to equip students with a foundation for developing basic programming skills and a sound knowledge of computer applications in biological sciences. Students will learn how to effectively and independently use the available bioinformatics tools and resources. Using bioinformatics tools, students will have the opportunity to apply the concepts of genetics, cell and molecular biology to learn how to retrieve, analyze and process biological data.*

Module I (10 Hours)

a) Basic computer organization, Processor and memory, secondary storage devices, Input-Output devices.
b) Computer software, Computer language; Basic Ideas in Programming in C: Variables, Constants, Keywords, Input/output, Control Statements, Functions, Structures; Operating system –Basic commands in Linux.

Module II (5 Hours)

a) Introduction to Spreadsheet, presentation software, document and word processing.
b) World Wide Web, Client - server organization; Internet Protocols - FTP, HTTP, Telnet; Search engines - search concepts

Module III (12 Hours)

a) Concept of databases: Biological databases - Primary, secondary, composite databases; Databases for Literature, Sequence and structure; Searching and their retrieval.
b) DNA and Protein sequence alignments - Pairwise alignment, dot plot, global and local alignment algorithms - Needleman and Wunsch algorithm, Smith-Waterman algorithm; Multiple sequence alignment - progressive alignment and Iterative alignment algorithms; PAM and Blosum scoring matrices; Multiple sequence alignment based database searching – PSI-Blast; Bioinformatics for phylogenetic analysis.

Module IV (9 Hours)

a) Gene Prediction- Finding genes in prokaryotic and eukaryotic genomes, Regulatory sequence analysis; Genome maps and markers, Genome variation.Oligo design and analysis tool.
b) Human genome project; Concept and Software used in Gene expression analysis and Microarray.

Module V (9 Hours)

a) Structural biology - Protein structure prediction and classification; Homology modeling, Threading and Abinitio methods, Molecular visualization tools-Rasmol, Chime and Swiss pdb viewer. Structure analysis tools - VAST and DALI.
b) Drug Design and discovery, steps in drug discovery, ADME, Lead identification, QSAR. Proteomic research, metabolic reconstruction.

Suggested Readings

1. Sedgewick R and Wayne K. An Introduction to Computer Science, Princeton University [available online].
2. Blum R and LeBlanc Dee-Ann. Linux for Dummies, WILEY [available online].
3. Kanetkar YP. Let Us C [available online].
4. Rajaraman V. Fundamentals of Computers, Prentice-Hill India.
5. Rajaram R. Computer Concepts and C Programming, SCITECH INDIA.
6. Baxevanis DA, Francis BFO. Bioinformatics: a practical guide to the analysis of genes and proteins, John Wiley and Sons [available online].
7. Krane DE,Raymen, M. L. Fundamental Concepts of Bioinformatics, Benjamin Cummings.
8. Mount DW. Bioinformatics: Sequence and genome Analysis, CHSL Press [available online].

9. Bourne PE and Weissig H. Structural Bioinformatics, WILEY.
10. Ghosh Z and Mallick B. Bioinformatics Principles and Applications, Oxford University Press.
11. Attwood TK and Parry-Smith DJ. Introduction to Bioinformatics, Pearson Education.
12. Elmasr R and Navathe SB. Fundamentals of Database Systems, Pearson Education [available online].
13. Campbell AM and Heyer LJ. Discovering Genomics, Proteomics and Bioinformatics, Benjamin Cummings.

BTAP6003: ANIMAL AND PLANT BIOTECHNOLOGY LAB

(2 Credits)

(A) Animal Biotechnology

1. Isolation of genomic DNA from animal cells
2. Preparation of animal cell culture media and Filter sterilization
3. Subculturing / passaging cell lines
4. Preparation of single cell suspension from spleen/liver/thymus
5. Staining of the monolayer cells with Giemsa stain.
6. Quantitation of animals cells using hemocytometer
7. Cell viability test

(B) Plant Biotechnology

1. Isolation of plant genomic DNA, Chloroplast and Mitochondrial DNA
2. Preparation of Plant tissue culture media and Stock solutions
3. Callus induction
4. Shoot/ Root induction - organogenesis
5. Haploid production – Anther and ovule culture
6. Protoplast fusion by PEG
7. Agrobacterium mediated transformation
8. Gus assay/ GFP cloning

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Learn the techniques for isolation of DNA
CO2: Learn preparation of culture medias for cell cultures

BTGE6004: GENETIC ENGINEERING LAB

(1 Credit)

1. Isolation of genomic DNA from animals/plants
2. DNA amplification using polymerase chain reaction
3. Cloning in plasmid/ Phagemid vectors
4. Gene expression in E. coli and analysis of gene product
5. Agarose gel electrophoresis
6. Ligation of DNA
7. Silver staining of gels
8. Methylene Blue Staining
9. RAPD (Random Amplification of Polymorphic DNA)

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Learn isolation of genomic DNA and amplification using polymerase chain reaction (PCR)
CO2: Perform ligation of DNA molecule
CO3: Analyze gene expression
CO4: Learn RAPD technique

BTIM6005: IMMUNOLOGY LAB
(1 Credit)

1. Isolation of WBC and RBCs
2. Differential counting of WBC
3. Single radial immune diffusion
4. Double diffusion method of Ouchterlony
5. Immunoelectrophoresis
6. Rocket electrophoresis
7. Agglutination reactions
8. Separation of peripheral blood mononuclear cells by Ficoll-Hypaque
9. Immunodiagnostics (Demonstration using commercial kits)
10. DOT ELISA for the presence of specific antigen.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Understand antigen-antibody interaction
CO2: Determine the concentration of known antigens
CO3: Understand the immunodiagnostics application

BTBE6006: BIOPROCESS ENGINEERING LAB
(1 Credit)

(A minimum of 10 experiments to be conducted)

1. Parts and design of fermenter
2. Solid state fermentation
3. Submerged fermentation
4. Conservation of Bacteria by Lyophilization
5. Production and estimation of protease
6. Production and estimation of amylase
7. Isolation, Preservation and Maintenance of Industrial Microorganisms
8. Growth kinetics for batch culture
9. Media for Industrial Fermentation
10. Immobilization of bacterial cells
11. Scale up fermentation process
12. Production and quantification of alcohol using yeast
13. Lactic acid fermentation process

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Understand the parts, design and different fermentation processes
CO2: Perform the production and estimation of enzymes
CO3: Understand the scale up fermentation process

BTDI6007: DISSERTATION PHASE I
(2 Credits)

Objective: *Dissertation phase I is designed to familiarize the students with the research topics and methodologies by a thorough literature review.*

During dissertation phase I each student chooses a topic in consultation with the assigned supervisor and the student is asked to do thorough literature review under the guidance of the supervisor. At the end of the semester the student submits literature review report and students presents the matter at a school level seminar.

COURSE/LEARNING OUTCOMES

At the end of Dissertation phase I students will be able to:

CO1: Undertake a research work leading to a dissertation
CO2: Incorporate recent trends in the chosen area and develop research work

BTDI6008: DISSERTATION PHASE II

(16 Credits)

Objective: *Dissertation phase II involves execution of the research work decided in phase I leading to the preparation, submission and evaluation of the dissertation.*

During the course of the Master's Degree the student is expected to undertake a research work leading to a dissertation. The work will be divided into two phases spread over two semesters. During the research work the student shall study and incorporate recent trends in the area chosen by him/her, and develop a scientific dissertation based on the research and actual bench work. The student shall be required to make presentations and reports at various stages of the research work. The format for the final dissertation shall be as prescribed by the Department. There shall be a viva voce examination on the dissertation by an expert committee comprising external and internal members. The mode and components of the evaluation and the weightages attached to them shall be published by the Department at the beginning of the semester.

BTPE6009: THERMODYNAMICS AND ENZYMOLOGY LAB

(1 Credit)

1. Determination of Km and optimum pH and temperature of amylase from sweet potatoes
2. Determination of Km and Vmax of urease from bean.
3. Determination of Km of Lipase from moong seeds.
4. Assessment of inhibitor on enzyme activity.
5. Assessment of activator on enzyme activity.

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Understand and determine the factors affecting enzyme activity, Km and Vmax for different samples

BTCA6010: COMPUTER APPLICATIONS AND BIOINFORMATICS LAB

(2 Credits)

1. Basic Programing in C
2. Running basic LINUX commands
3. Usage of NCBI resources
4. Usage/Retrieval of sequence/structure from databases
5. Visualization of structures
6. Protein Docking and Docking of ligand receptors
7. Sequence alignments, Blastn, Blastp, Psi-Blast, Clustal Omega
8. Homology modeling
9. Primer designing and analysis
10. Phylogenetic Analysis using MEGA5.0

MICROBIOLOGY

MBCG0001: CELL BIOLOGY AND GENETICS

(4 Credits - 60 hours)

Objective: *This course is designed to give a better understanding of cellular biology with complicated biochemical and physiological processes. The course also focuses on genetics as it relates to the function and structures of cells. It will also serve as a foundation for further studies in advanced molecular biology and biochemistry.*

Module I (9 Hours)

Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, ribosomes, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure function of cytoskeleton and its role in motility. Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting; Protein synthesis on free and bound polysomes, golgi sorting, post- translational modifications.

Module II (12 Hours)

Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons. Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Uncontrolled cell growth – cell cycle in cancer; oncogenes, tumor suppressor genes; Programmed cell death, aging and senescence

Module III (15 Hours)

Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cell signaling: Hormones and their receptors, cell surface receptor, signal transduction pathways: GCPR, RTK etc., second messengers and their roles in signal transduction, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

Module IV (15 Hours)

a) Mendelian principles and extension: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance.
b) Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers mapping by using somatic cell hybrids, development of mapping population in plants. mapping, electron microscope heteroduplex mapping; Fine structure of genes and complex loci in eukaryotes Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.
c) Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Module VI (9 Hours)

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Transposable Genetic Elements: Transposable elements in bacteria, transposable elements in eukaryotes. Recombination: Homologous and non-homologous recombination, including transposition, site-specific recombination.

COURSE/LEARNING OUTCOMES

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

CO1: Explain cellular biology with complicated biochemical and physiological processes
CO2: Relate the cellular process in genetic level
CO3: Explain genetics as it relates to the function and structures of cells

Suggested Readings

1. Cooper, G. M., Cell (A Molecular Approach)
2. Karp, G., Cell and Molecular Biology (1996)
3. Sadava D. E., Cell Biology (1993)
4. Kish V. M. and Kleinsmith L. J., Cell and Molecular Biology (1995)
5. deRobertis and deRobertis, Cell and Molecular Biology
6. Gardner, Principles of Genetics
7. Strickberger, Genetics
8. Ram Mahabal, Fundamentals of Cytogenetics and Genetics

MBVB0003: VIROLOGY, BACTERIOLOGY AND MYCOLOGY

(5 Credits - 75 Hours)

Objective: *The contents of this course will help students to understand the evolution, growth, life cycle and applications of virus, bacteria and fungus which will lead the students towards progressive advancement of the subject.*

Module I (8 hours)

History and perspective of virology, distinctive properties of virus, variation in morphology of virus, capsid arrangement, envelope composition, viral nomenclature, classification of virus including Baltimore's classification, assay of plant virus, animal virus and bacteriophage, multiplication of viruses inside the host: infection of host cells, synthesis of viral macromolecules, regulation of the expression of phage genes, viral DNA replication, role of DNA modification, maturation and release of viral particle, isolation and purification of phage.

Module II (17 hours)

Bacterial viruses: classification and nomenclature, lytic and lysogenic phage, regulation in switching between lytic and lysogenic mode, lysogenic conversion, replication of bacterial phage, plant viruses: classification and nomenclature, structure and life cycle of plant viruses, replication of the genetic material of plant viruses, plant diseases caused by virus and their control, animal viruses: classification and nomenclature, structure and lifecycle of animal viruses, replicative strategies employed by DNA and RNA viruses, epidemiology, pathogenesity, diagnosis, prevention and treatment of animal viruses including HIV, viral vaccines, interferon, and antiviral drugs.

Module III (25 hours)

History and development of mycology in the scientific development, general characteristics of fungi, fungal structure and organization, criteria for fungal classification, colony communication and signaling, nutrition requirement of fungi, saprophytic, parasitic, obligatory and facultative, biotrophic, semi-biotrophic and necrotrophic mode of growth, fungal cell differentiation, reproduction in fungi - vegetative, asexual and sexual with special reference to their significance, homothallism and heterothallism, sex hormones in fungi, ecto-mycorrhizae, endo mycorrhizae and vesicular arbuscular mycorrhizae, fungal-plant interactions: symbiotic and antagonistic interactions, use of endophytic fungi as biocontrol agents against plant diseases caused by fungi, fungi and animal diseases - Dermatophytes and agents of superficial mycoses, significance of fungi in biotechnology and industrial application, fungal metabolites and their economic significance - mycotoxins, medicinal uses of fungi (antibiotics), fungi as food - mushrooms, mushroom poisoning.

Module IV (10 hours)

History and development of bacteriology in the scientific development, general features of eubacteria and archaebacteria, morphology of bacteria, bacterial cell wall composition and synthesis, plasma membrane, cytoplasmic matrix, nucleoid, inclusion bodies, ribosomes, flagella, Pilli, endospore and exospores, plasmids and episomes, staining techniques: basic and acidic dyes, simple and differential staining, Grams staining, acid fast staining, flagella and spore staining.

Module V (15 hours)

Bacterial growth curve, effect of physical and chemical factors on bacterial growth, measuring bacterial growth-spectrophotometric method, microscopic counting, serial dilution and viable cell count, most probable number, and filtration technique, bacterial reproduction, bacterial culture media: chemically defined, complex, differential and special selective media, nutritional types: photoautotroph, photoorganotroph, chemolithotroph (ammonia, nitrite, sulfur, hydrogen, iron oxidizing bacteria), chemoorganotroph, effect of oxygen on growth, classification on the basis of oxygen requirement and tolerance, bacterial two component signaling system, application of bacteria in agriculture (nitrogen fixing organisms; bioremediation of hydrocarbons and biopesticides), antibiotics and chemotherapeutic drugs, antibiotic sensitivity assays, sterilization, physical and chemical control of bacteria.

COURSE/LEARNING OUTCOMES

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

CO1: Understand the growth and life cycles of virus, bacteria and fungus
CO2: Explain evolution in the study and development of microbial life forms
CO3: Apply the information toward development of strategies in using microbes for biochemical reactions, bioremediation, agriculture and in the study of disease progression
CO4: Explain role of micro-molecules with regard to cellular communication, sexual development of microbes, and plant-microbe interaction.
CO5: Understand the role and patterns in epidemiology, pathogenecity, diagnosis, prevention and treatment

Suggested Readings

1. S. E. Luria, J. E. Darnell; General Virology; John Wiley and Sons publisher
2. A.J. Rhodes, C.E. Van Rooyen; Text book of Virology; 5th revised edition
3. Kerry F. Harris, Oney P. Smith, James E. Duffus; Virus-insect-plant Interactions; Academic Press Inc
4. S. J. Flint, Lynn W. Enquist, Robert M. Krug, Vincent R. Racaniello; Principles of Virology: Molecular Biology, Pathogenesis, and Control; American Society for Microbiology
5. Constantine J. Alexopoulos, Charles W. Mims, Meredith M. Blackwell; Introductory Mycology; 4th Edition edition
6. A. H. S. Onions, D. Allsopp, H. O. W. Eggins; Smith's Introduction to Industrial Mycology; 1st edition
7. Jr., Michael Pelczar; Microbiology; 5th edition
8. Joanne Willey, Linda Sherwood, Chris Woolverton; Microbiology; 8th edition
9. R Y, J L Ingraham et. al. Stanier; General Microbiology; 5th edition
10. Schlegel; General microbiology; Cambridge University Press

MBDE0004: MICROBIAL DIVERSITY AND ECOLOGY

(2 Credits - 30 Hours)

Objective: *To provide students with an introduction and in depth knowledge to microbial diversity and microbial ecology with emphasis on recent molecular, biological and genomics developments in these fields.*

Module I (8 hours)

Prokaryotic taxonomy: classical and modern (polyphasic approach), prokaryote and eukaryote species concept, biodiversity: definition and classification, molecular chronometers, molecular phylogeny, chemotaxonomy, estimation of diversity of microbial community by different methods including both metabolic and molecular, culture dependent and culture independent microbial community, metagenomics studies and its applications.

Module II (6 hours)

Microbial biodiversity analysis and documentation, major drivers of biodiversity change, biodiversity management approaches, extremophiles-definition, classification and survival strategies in hostile environment, importance and applications of extremophiles.

Module III (7 hours)

Microbial ecology vs. macroecology, concept of habitat and niche, fundamental and realized niche, resource partitioning, character displacement, microbial community structure, microbial interactions within community, characteristics of microbial population growth curves, microbial population regulation, r and K selected strategies, microbial community succession, microbial biofilm: definition, development and importance.

Module IV (9 hours)

Structure and function of ecosystems-terrestrial (forest, grassland) and aquatic (freshwater, marine, estuarine), microbial role in biogeochemical cycles (C,N,P), primary production and decomposition, environmental pollution and greenhouse gases, several sustainable approaches for remediation of xenobiotic compounds, wastewater remediation, genetically modified organism: definition and applications.

COURSE/LEARNING OUTCOMES

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

CO1: Understand phylogenetic relationship, construction of trees, chemotaxonomic relationship among various microbial taxon, its metagenomic profiling and both classical and modern approaches in prokaryotic taxonomy.

CO2: Understand biochemical and molecular mechanisms extremophiles evolved to adapt to the surrounding and different environmental conditions and its applications in industry

CO3: Perform quorum sensing and biofilm production and detection; microbial population growth profiles and community succession

C04: Have basic information in the structure, anatomy, function of an ecosystem, the role of microbes in the sustenance of the ecosystem

C05: Develop interest to know the role of microbes in bioremediation and apply their knowledge in environment pollution to apply microbes in bioremediation process (using the information gathered in the theory of the previous course: Virology, Bacteriology, Mycology)

Suggested Readings

1. Prescott, Harley and Klein; Microbiology; McGraw Hill Education publisher
2. S.C. Tiwari, G.D. Sharma; Microbial Diversity: Status and Potential Applications; Scientific Book Centre publisher
3. D.J. Bagyaraj, K. V. B. R. Tilak, H.K. Kehri; Microbial Diversity and Functions; New India Publishing Agency
4. James T. Staley, Anna-Louise Reysenbach; Biodiversity of Microbial Life: Foundation of Earth's Biosphere; Wiley-Blackwell publisher
5. Michael T. Madigan, John M. Martinko, Paul V. Dunlap; Brock biology of the microorganisms; Pearson publisher
6. Ronald M. Atlas; Microbial ecology-Fundamentals and applications; Pearson Education publisher
7. Heinz Stolp; Microbial Ecology: Organisms, Habitats, Activities; Cambridge University Press 8. Morris A. Levin; Microbial Ecology: Principles, methods and applications (Environmental Biotechnology); McGraw Hill Higher education publisher.
8. Frank R. Spellman; Handbook of Environmental Engineering; CRC Press
9. J. McArthur; Microbial Ecology: An Evolutionary Approach; Academic Press Inc publisher

MBIM0005: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

(3 Credits - 45 Hours)

Objective: *This course is designed to provide students with an in depth knowledge in two complementary disciplines; the immune system and how they interact with the challenges posed by pathogens.*

Module I (16 hours)

History and scope of immunology, hematopoietic stem cells, stromal cells, hematopoiesis, lymphoid tissues and organs (primary and secondary), B-lymphocytes and their activation, Thymus derived lymphocytes and their activation, antigen presenting cells, natural killer cells, dendritic cells,

macrophages, structure and functions of Class I and II Major Histocompatibility complex (MHC) molecules, types of immunity: innate and acquired, active and passive, humoral and cell mediated, immunoglobulin: definition, structure and function, clonal selection theory, monoclonal antibody synthesis, generation of antibody diversity, organization and expression of immunoglobulin genes, antigens: T dependent and T independent antigens, adjuvant (definition, examples, function), antigen-antibody reactions, cross reactivity, cytokines: definition, types and functions.

Module II (7 hours)

The complement systems: definition, function, classical and alternate pathway, transplantation: organ transplantation and HLA tissue typing, autoimmunity, hypersensitivity reactions, immunological tolerance, immune suppression and immunotherapy, vaccine: definition, classification and function.

Module III (12 hours)

History of medical microbiology, normal microflora of human body, role of resident microbial flora, host parasite interactions, microbial infection steps: colonization, association, adhesion and invasion of host tissue and toxigenesis with details account of several virulence factors, pathogenesity islands, endo-toxins and exo-toxin, water and food born pathogenic microorganisms, laboratory diagnosis, epidemiology, prevention and treatment.

Module IV (10 hours)

Principles of chemotherapy, antimicrobial agents (synthetic compounds and antibiotics): mechanism of work, drug discovery: historical perspective and current approaches, phases of drug discovery, toxicity evaluation of drug (LD50, acute, sub-acute and chronic toxicity), drug trial, drug metabolism, microbial drug resistance.

COURSE/LEARNING OUTCOMES

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

CO1: Understand the working of the immune system in humans; explain the role of every defense barrier in avoiding infection and the genetic role in diversity in antibody development

CO2: Understand the processes involved in immunotherapy, vaccine development, monoclonal antibody production

CO3: Understand the mechanism of host-parasite interaction, the stages in disease progression, the differences in pathogenicity, virulence and toxicity owing to microbes

CO4: Design diagnostic strategies to study disease prognosis

CO5: Understand mechanism of antibiotic resistance – both molecular and physiological, the economic design in discovery of novel antibiotic candidates, the phases in drug discovery and clinical trials

Suggested Readings

1. Stewart Sell, Ira Berkower; Immunology and immunopathology and immunity; 5th Edition
2. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai; Cellular and molecular immunology; 8th Edition
3. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt; Essential Immunology; 12th Edition
4. Thomas J Kindt, Barbara A. Osborne, Richard Goldsby; Immunology; 6th Edition
5. Jawitz, Melnick and Adelberg; Review of Medical Microbiology; 27th Edition; Mc Graw Hill education LANGE
6. Mark Gladwin, Trattler William, C. Scott, M.D. Mahan; Clinical Microbiology Made Ridiculously Simple; 6th Edition
7. Bailey, Scott; Diagnostic Microbiology; 13th Edition
8. Dennis L. Kasper, Anthony S. Fauci; Harrison's Infectious Diseases; 2nd Edition
9. Ananthanarayan, Paniker; Textbook of Microbiology; 8th Edition
10. WWC Topley, Sir Graham S; Topley and Wilson's Principles of Bacteriology, Virology and Immunity: Bacterial Diseases; Volume 3

MBAM0006: ADVANCES IN MICROBIOLOGY

(4 Credits - 60 Hours)

Objective: This course deals with the principles, procedures and applications of advanced techniques in Microbiology. This course will introduce students to the current tools and processes in Microbiology which will make them competent to pursue research in cutting-edge areas in Microbiology. Students will be required to make presentations and submit an assignment on the most recent developments in the field of Microbiology from reputed peer-reviewed national and international journals and books.

Module I: Industrial microbiology (20 hours)

Microbial strain improvement, production of industrially important enzymes, production of recombinant molecules and therapeutic compounds through bioreactors, microbial production of bioplastic, biopesticides, biofuel; biological weapons - definition and applications; microbial biosensors, downstream processing strategies.

Module II: Food and Dairy microbiology (10 hours)

Food spoilage and preservation, fermented foods, probiotics, genetically modified foods, biosensors in food, applications of important microbial enzymes in food and dairy industry, food sanitation and control; quality assurances in foods, Government regulatory practices and policies - FDA, EPA, HACCP, ISI and BIS.

Module III: Advanced molecular studies (10 hours)

Microbial biodiversity analysis using different advanced sequencing strategies including pyrosequencing and next gen sequencing, metatranscriptomics, metaproteomics and metabolomics.

Module IV: Microbial diagnosis and measures (10 hours)

Biochemical, serological and molecular methods - agglutination, ELISA, immuno-fluorescence, nucleic acid based methods - PCR, nucleic acid probes; recent outbreaks of human microbial diseases (SARS/ Swine flu/Ebola) – causes, spread and control; microbial mediated cancers and nosocomial infections, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains, concept of DOTS; vaccines: importance, types, and applications.

Module V: Intellectual Property Rights (IPR) (10 hours)

Introduction to intellectual property: patents, types, trademarks, copyright and related rights, industrial design and rights, traditional knowledge, geographical indications, patentable and non patentability issues, patenting life, legal protection of biotechnological inventions, world intellectual property rights organization (WIPO), Indian Patent Act 1970 and recent amendments, entrepreneurship in bioscience.

COURSE/LEARNING OUTCOMES

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

CO1: Learn the principles, procedures and applications in recent techniques in microbiology in different levels such as industry, food and dairy and diagnosis

CO2: Have thorough understanding in the recent developments in microbiology research

CO3: Understand the protocol in ethical research, filing of patents, trademarks and copyrights, and what is novelty in microbiology research.

Suggested Readings

1. Adams MR. Food Microbiology. New Age International Private Limited
2. Joshi VK. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. (Volume 2) Educational Publishers & Distributors.
3. Patel AH. Industrial Microbiology. Macmillan India Limited.
4. Casida LE. Industrial Microbiology. Wiley Eastern
5. Davis JE, Demain AL. Manual of industrial Microbiology and Biotechnology. 2nd edition. ASM publications.
6. Fraser CM, Read TD, Nelson KE. Microbial Genomes, Humana Press.2.
7. Miller RV, Day MJ. Microbial Evolution-Gene establishment, survival and exchange, ASM Press.

8. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
9. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
10. Goel D, Prashar S. IPR, Biosafety and Bioethics. (2013).Pearson
11. Collee JG, Fraser, AG, Marmion, BP, Simmons A. Practical Medical Microbiology. (2007) 14th edition, Elsevier.
12. Bailey's and Scott's Diagnostic Microbiology. Tille P (2013), 13th edition, Mosby

MBBM0007: BASIC MICROBIOLOGY

(3 Credits – 45 hours)

Objective: *The course is designed to impart a general knowledge on the different aspects of microbiology on the basis of various microorganisms like virus, bacteria etc. with modern microbial techniques.*

Module I: (10 Hours)

a) Historical Perspective: Discovery of microbial world; Landmark discoveries relevant to the field of microbiology; Controversy over spontaneous generation; Role of microorganisms in transformation of organic matter and in the causation of diseases.
b) Microbial Taxonomy and Diversity: Bacteria, Archea, Virus and their broad classification;
c) Staining of microorganisms: simple, differential, negative and positive staining, Gram staining, acid fast staining.

Module II: (10 Hours)

a) Microbial Growth: Definition of growth; Growth curve; Mathematical expression of exponential growth phase; Measurement of growth and growth yields; Synchronous growth; Continuous culture; Effect of environmental factors on growth.
b) Principles of microbial nutrition: nutritional groups of bacteria.
c) Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development.

Module III: (10 Hours)

a) Microbial Metabolism: An overview of metabolism; Glycolysis; Pentose-phosphate pathway; Entner-Doudoroff pathway; Glyoxalate pathway; The citric acid cycle; Fermentation; Aerobic and anaerobic respiration.
b) Photosynthesis: classification of photosynthetic bacteria, photosynthetic electron transport systems.

Module IV: (5 Hours)

Microbial Diseases and Host Pathogen Interaction: Normal microbiota; Classification of infectious diseases; Reservoirs of infection; Nosocomial infection; emerging infectious diseases.

Module V: (10 Hours)

a) Microbial ecology: Physiology, molecular adaptation and applications of acidophiles, alkalophiles, halophiles, thermophiles and hyperthermophiles, psychrophiles, barophiles.
b) Antimicrobial Antibiotics: General characteristics of antimicrobial drugs; Antibiotics: classification, mode of action and resistance; Antifungal and antiviral drugs, mode of action, resistance to antibiotics.

COURSE/LEARNING OUTCOMES

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

CO1: Understand microbial diversity and taxonomy
CO2: Microbial culture, metabolism and host pathogen interactions
CO3: Microbial ecology- survival strategies like antibiotics, extremophiles

Suggested Readings

1. Pelczar MJ, Ried RD and Chan, ECS, Microbiology
2. Prescot and Dunn, Industrial Microbiology
3. Ananthanarayanan and JayaramPaniker, Text Book of Microbiology
4. Gerard J Tortora, Berdell R Funke, Microbiology: An Introduction Christine L Case Benjamin-Cummings Publishing Company.
5. The Prokaryotes. A handbook on the biology of bacteria: ecophysiology, isolation, identification, applications. Volumes I-IV by Balows, A., Truper, H. G., Dworkin, M., Harder, W., Schleifer, K. H.Springer-Verlag, New York.
6. Albert G. Moat and John W. Foster. Microbial Physiology, John Wiley and Sons. Gopal Reddy et al., Laboratory Experiments in Microbiology

MBCG6001: CELL BIOLOGY AND GENETICS LAB

(1 Credit)

1. Subcellular fractionation: mitochondria and chloroplast and their characteristics
2. Study of mitosis and meiosis in plants/cultured cells
3. Isolation of DNA from animal and plant sources
4. Agarose gel electrophoresis of isolated genomic DNA
5. Determination of Tm of DNA
6. Isolation of auxotrophic mutants by replica plating

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Understand and identify different stages of cell division
CO2: Learn the technique of extraction of DNA from both plant and animal tissues
CO3: Determine the Tm of the melt curve of DNA

MBBM6002: BASIC MICROBIOLOGY LAB

(1 Credit)

1. Growth curve: Effect of temperature, pH and carbon and nitrogen source on growth
2. Microscopic examination and study of bacteria, yeast and molds by Gram stain, acid fast stain and staining of spores
3. Assay of antibiotics
4. Isolation and maintenance of organisms by plating, streaking and serial dilution methods
5. Observation of specimen and permanent slides

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Isolate and maintain bacteria as pure culture
CO2: Study microbial growth and nutrition and factors affecting growth (temperature, pH, etc.)
CO3: Measure the Minimum Inhibition Concentration against a bacterial isolate using different antibiotic discs.

MBMT6003: MICROBIOLOGY TECHNIQUES LAB

(2 Credits - 60 hours)

1. Isolation of bacteriophage from natural sources
2. Cultivation and quantification of phages
3. phage induction
4. Isolation of fungi from soil
5. Staining of fungus
6. Pure culture preparation and preservation of microorganism
7. Microbial growth measurement by direct cell count method, serial dilution method, turbidity method

8. Staining technique-simple, Gram's staining, negative staining, spore staining, acid fast staining of bacteria
9. Determination of bacterial motility
10. Microbial biofilm detection

COURSE/LEARNING OUTCOMES

At the end of the lab experiments students will be able to:

CO1: Isolate and identify coliphages, bacteria, fungi and algae from various natural environment sources, its enumeration by serial dilution and turbidity analysis, infer from the colony and cell morphology, and motility
CO2: Prepare single colonies and preserve the cultures
CO3: Produce and detect bacterial biofilms

Suggested Readings

1. S. E. Luria, J. E. Darnell; General Virology; John Wiley & Sons publisher
2. A.J. Rhodes, C.E. Van Rooyen; Textbook of Virology;
3. Kerry F. Harris, Oney P. Smith, James E. Duffus; Virus-insect-plant Interactions; Academic Press Inc
4. S. J. Flint, Lynn W. Enquist, Robert M. Krug, Vincent R. Racaniello; Principles of Virology: Molecular Biology, Pathogenesis, and Control; American Society for Microbiology
5. Constantine J. Alexopoulos, Charles W. Mims, Meredith M. Blackwell; Introductory Mycology
6. A. H. S. Onions, D. Allsopp, H. O. W. Eggins; Smith's Introduction to Industrial Mycology
7. Jr., Michael Pelczar; Microbiology
8. Joanne Willey, Linda Sherwood, Chris Woolverton; Microbiology
9. R Y, J L Ingraham et al. Stanier; General Microbiology
10. Schlegel; General microbiology; Cambridge University Press

MBDE6004: MICROBIAL DIVERSITY AND ECOLOGY LAB

(1 Credit)

1. Isolation of thermophilic microorganisms
2. Isolation of Cyanobacteria from natural sample
3. Isolation of halophiles
4. Isolation of anaerobic microorganisms
5. Isolation of nitrogen fixing bacteria from soil
6. Isolation of protease secreting bacteria from soil
7. Effect of stress (temperature/pH/salt concentration) on microbial community
8. Determination of DO, COD and BOD of water sample

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Evaluate different strategies in isolation and identification of extremophiles and nitrogen fixers and normal skin microbiota
CO2: Determine level of pollution in water by both chemical and microbial processes
CO3: Identify industrially important protease secreting bacteria growing in varied environmental conditions

MBIM6005: IMMUNOLOGY AND MEDICAL MICROBIOLOGY LAB

(1 Credit)

1. Single radial immunodiffusion
2. Double diffusion method of Ouchterlony
3. Electrophoretic separation of bovine protein
4. Agglutination reaction
5. Minimum inhibitory concentration (MIC) determination of antimicrobial compound against microorganism

6. Antibiotic assay using standard curve
7. Study of natural microflora of skin
8. Isolation of hemolytic bacteria using blood agar media

COURSE/LEARNING OUTCOMES

At the end of the Lab experiments students will be able to:

CO1: Understand antigen-antibody interaction (based on zone of equivalence)
CO2: Study and understand bacterial growth patterns in normal and antibiotic stressed conditions and hence design epidemiological study of antibiotic resistance pattern
CO3: Evaluate different strategies in isolation and identification of normal skin microbiota and understand their response to antibiotics
CO3: Differentiate between haemolytic and non-haemolytic bacteria

MBDI6006: DISSERTATION PHASE I
(2 credits)

Objective: *Dissertation phase I is designed to familiarize the students with the research topics and methodologies by a thorough literature review.*

During dissertation phase I each student chooses a topic in consultation with the assigned supervisor and the student is asked to do thorough literature review under the guidance of the supervisor. At the end of the semester the student submits literature review report and students presents the matter at a school level seminar.

COURSE/LEARNING OUTCOMES

At the end of Dissertation phase I students will be able to:

CO1: Design experiment, prepare work plan and learn how to test hypothesis in research work
CO2: Present scientific information in a succinct manner and learn the process of scientific writing
CO3: Carry out literature survey and carry out the initial study required before designing their dissertation project

MBDI6007: DISSERTATION PHASE II
(16 credits)

Objective: *Dissertation phase II involves execution of the research work decided in phase I leading to the preparation, submission and evaluation of the dissertation.*

During the course of the Master's Degree the student is expected to undertake a research work leading to a dissertation. The work will be divided into two phases spread over two semesters. During the research work the student shall study and incorporate recent trends in the area chosen by him/her, and develop a scientific dissertation based on the research and actual bench work. The student shall be required to make presentations and reports at various stages of the research work. The format for the final dissertation shall be as prescribed by the Department. There shall be a viva voce examination on the dissertation by an expert committee comprising external and internal members. The mode and components of the evaluation and the weightages attached to them shall be published by the Department at the beginning of the semester.

DEPARTMENT OF ZOOLOGY

PROGRAMME: MASTER OF SCIENCE IN ZOOLOGY

DETAILED SYLLABUS

ZGBT0001: BIOSYSTEMATICS, TAXONOMY AND EVOLUTION
(4 Credits-60 hours)

Objective: *The objective of this course is*

- *to acquaint the student with different procedures of taxonomy and different methods of analysis of variations and theories of classification.*
- *to enable the students to identify, classify and name the organisms according to international code of zoological nomenclature.*
- *to comprehend the scientific concepts of animal evolution through an understanding of its evidences, its mechanics, process and products.*

Module I: Biosystematics (10 hours)

Trends in Biosystematics: Chemotaxonomy, Cytotaxonomy, Numerical and Molecular Taxonomy; Dimensions of Speciation; Species Concepts: Subspecies and other intra specific Categories; Cladistics

Module II: Taxonomy and Nomenclature (10 hours)

Taxonomic Categories. Different Kinds, Hierarchy of Categories; Taxonomic Procedures: Taxonomic collections, Preservations, Process of identification (General Idea); Taxonomic Keys: types, merits and demerits; International Code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of important rules; Formation of names of various Taxa.

Module III: Biodiversity Indices (10 hours)

Evaluation of Biodiversity, Biodiversity indices: Shannon- Weiner Index, Richness Indices; Dominance Index, Association index, Similarity and Dissimilarity Index

Module IV: Concept of Evolution (15 hours)

Micro and Macro evolution; Natural Selection- Concept of stabilizing selection, Frequency dependent selection, Balancing selection, Disruption selection; Destabilizing factors- Mutation, Genetic drift, Migration, Meiotic drive; Neural Theory - Emergence of Non Darwinian theory of evolution, Neutral theory of evolution (Kimura).

Module V: Genetic Parameters (15 hours)

Isolation Mechanisms - Isolation Mechanisms and their role in speciation, Models of speciation (Allopatric, sympatric, parapatric); Gene frequencies in population - The Hardy-Weinberg principle and analysis of gene frequencies in natural population. Major factors influencing gene frequencies (migration, inbreeding), effects of selection and mutation on gene frequencies. Gene flow between subpopulations; Molecular basis of evolution- Constructing evolutionary trees, measures of genetic relationship among organisms, Molecular clock of evolution, Molecular phylogeny; Origin and Evolution of Primates - Evolution of Anthropoid Primates, The first hominids and origin of modern man.

Suggested Readings

1. G. G. Simpson. Principle of animal taxonomy; Oxford IBH Publishing Company.
2. V.C Kapoor-Theory and practice of animal taxonomy
3. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapma & Hall, New York.
4. E.O. Wilson, Biodiversity, Academic Press, Washington.
5. E. Mayer & P. Ashlock. Principles of systemic Taxonomy
6. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northem & Co.
7. Dalela and Sharma.Animal taxonomy and Museology,Jaipraash nath & company.
8. Bugs, Butterflies, Spider, snakes (1998).Kern Preston-Mafham,Nigel Marven & Roblturvey

9. Dbzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valentine. Evolution. Surject Publication, Delhi.
10. Futuyama, D.J. Evolutionary Biology, Suinuaer Assciates, INC Publishers, Dunderland. 11. Jha, A.P- Genes and Evolution. John Publication, New Delhi.
11. Ashok Verma, Principles of Animal Taxonomy, Alpha Science International Ltd, Delhi.
12. Ramesh Chandra Tripathi, Biosystematics and Taxonomy, University Book House, Jaipur.
13. Avers, C. J. Evolution Process and Pattern in Evolution Oxford University, Press, New York, Oxford.
14. Ayala, F. J. and Valentine J. W. Evolving the theory and Process of Organic Evolution,
15. Brookfield, A. P. Modern aspects of Evolution. Hutchinson London, Melbourne.
16. Gallow, P. Evolutionary principles.
17. Chapman and Hall. Freeman, S. and Herron, Jon C. Evolutionary analysis Pearson Prentice Hall, New Jersey.
18. Futuyma, D. J. Evolutionary Biology, Sinauer Assoc. Inc. Pub. USA.
19. Meglitsch, P. A. Invertebrate Zoology (3rd edition), Oxford University Press.
20. Minkoff, E. C. Evolutionary Biology, Addison Wesley Pub. Co., London.
21. Wen-Hsiung Li, Molecular Evolution, Sinauer associates Inc.Pub. USA.
22. Burton S. Guttman: Evolution a beginner's guide, Oneworld Publications.

ZGBG0002: CELL BIOLOGY AND GENETICS – THEORY AND APPLICATIONS

(4 Credits 60 hours)

Objective: *This course is designed to give a better understanding of cellular biology with complicated biochemical and physiological processes. The course also focuses on genetics as it relates to the function and structures of cells. It will also serve as a foundation for further studies in advanced molecular Biology and Biochemistry.*

Module I: Cell Organisation (14 hours)

Complexity and organisation of cell - Structural and Molecular features of Prokaryotic and Eukaryotic cells.

a) Biomembranes - Molecular composition and functional feature of membrane lipid, protein and carbohydrate.
b) Cytoskeletons - Structure and Organisation of Microfilament, Microtubule and Intermediate filament.
c) Cell Motility - Muscle contractility, intercellular transport, kinesin-dynin, cilia and flagella.

Module II: Cell Division and Signalling (24 hours)

a) Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle); Genetics of Cell Cycle - Cyclins and Cyclin Dependent Kinases (CDK), Regulation of CDK-Cyclin activity, Molecular basis of Cellular Check Points; Extracellular Matrix and Cell Interaction - Cell walls, Adhesion junctions, Tight junctions, Gap junctions, Plasmodesmata; Cell-Cell Adhesion - Ca^{++} dependent and Ca^{++} independent Homophillic Cell-Cell Adhesion
b) Cell-Cell Signalling - Cell Signalling, Cell surface receptors, G-Protein coupled receptors and Second messenger
c) Cell cycle in cancer – uncontrolled cell growth, oncogenes, tumor suppressor genes; programmed cell death, aging and senescence

Module III: (10 hours)

a) Organisation of genetic material - Nucleosome, Molecular anatomy of eukaryotic chromosome; Genome size and Complexity - C value paradox, Unique and repetitive DNA, Euchromatin and Heterochromatin
b) Sex Chromosomes - Sex determination, Role of Y chromosome, Dosage Compensation in Drosophila and Human Being, X-Chromosome inactivation, Sex chromosome anomalies
c) Human Genetics - Normal Human Karyotyping, Autosomal chromosome abnormalities, Principle and Methods of Pedigree Analysis
d) Genetic Imprinting - Imprinting of genes, Epigenetic, Epigenetic regulation by DNA methylation; Somatic Cell Genetics - Cell fusion technology, Chromosome mapping, Application of Somatic Cell Genetics.

Module IV: Genetic Inheritance (12 hours)

a) Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests; Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters

b) Extra Chromosomal Inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance; Genetic Counselling - Objectives, Ethics, Principles, Methods for counselling for Point mutation, Chromosomal Disorder

Suggested Readings

1. Cooper, G. M., Cell (A Molecular Approach)
2. Sadava D. E., Cell Biology
3. Kish V. M. and Kleinsmith L. J., Cell and Molecular Biology
4. DeRobertis & DeRobertis: Cell and Molecular Biology (Lee & Febiger, 1987)
5. Gardner, Principles of Genetics
6. Strickberger, Genetics
7. Ram Mahabal, Fundamentals of Cytogenetics and Genetics
8. Brooker: Genetics : Analysis and Principles
9. Griffith et al: Modern Genetic Analysis
10. Hartl & Jones: Essential Genetics: A Genomic Perspective
11. Karp: Cell and Molecular Biology
12. Lewin, Genes VIII
13. Lodish et al: Molecular Cell Biology
14. Pollard & Earnshaw: Cell Biology
15. Russell: Genetics
16. Snustad & Simmons: Principles of Genetics
17. Switzer and Garrity: Experimental Biochemistry, Freeman
18. T.A.Brown, Genome
19. Wilson and Walker: Practical Biochemistry, Cambridge Univ. Press
20. B. Guttman, A. Griffiths, D. Suzuki, T. Cullins: Genetics a beginner's guide. Oneworld Publications
21. Verma P.S. and Agarwal V.K, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.
22. Verma P.S. and Agarwal V.K, Cell Biology (Cytology, biomolecules and Molecular Biology), S. Chand & Company Ltd.
23. Verma P.S. and Agarwal V.K, Genetics, S. Chand Publishing.
24. Verma P.S. and Agarwal V.K, Genetic Engineering, S. Chand Publishing.

ZGBC0003: MOLECULAR BIOLOGY AND BIOCHEMISTRY

(4 Credits-60 hours)

Objective: *The objective of this course is to provide a comprehensive knowledge of molecular aspects of biological function at the molecular level, with particular emphasis on the structure and regulation of genes, as well as the structure and synthesis of proteins and its applications.*

Module I: Nucleic Acids (16 hours)

a) Nucleic acids - Molecular Structures of DNA and RNA.

b) DNA Replication - Replication in Prokaryotes and Eukaryotes, Semi conservative nature of DNA replication, Messelsons-Stahl experiment, Enzymes and proteins associated with replication, DNA polymerases, Regulation of eukaryotic genome replication.

c) DNA Damage and Repair Mechanism - Different types of DNA Damage, Direct repair system, Excision repair system, Mismatch repair system, DNA break repair.

Module II: Transcription and Translation (16 hours)

a) Transcription - Basic concept of Prokaryotic and Eukaryotic transcription, Promoters (Pribnow box, TATA box, Cp Gisland), Transcription factors, Initiation, elongation and termination of transcriptions in Eukaryotes.

b) Post Transcriptional Modification - Post transcriptional processing of RNA, Molecular events in Capping, Polyadenylation and Splicing mechanism
c) Translation - Genetic Code, Mechanism of Initiation, Elongation and Termination.

Module III: Metabolism (18 hours)

a) Carbohydrate metabolism - Glycolysis, Glycogenolysis, Gluconeogenesis, TCA cycle, Cori cycle, Phosphogluconate pathway.
b) Lipid metabolism - Oxidation of fatty acid, Cholesterol biosynthesis and metabolism, Prostaglandins.
c) Protein metabolism - Amino acid Classification, Amino acid degradation, Decarboxylation, Deamination, Ornithine Cycle.

Module IV: Bioenergetics and Enzymes (10 hours)

a) Bioenergetics - Energy producing and utilizing system, Electron transfer system and Oxidative Phosphorylation.
b) Enzymes - Classification of enzymes, General properties of enzymes, Mechanism of enzyme action, Enzyme kinetics, Michaelis-Menten and Lineweaver-Burke Equations; Enzyme inhibition.

Suggested Readings

1. Alberts et al: Molecular Biology of the Cell, Garland
2. Berg et al.: Biochemistry, Freeman
3. Boyer: Modern Experimental Biochemistry and Molecular biology
4. DeRobertis & DeRobertis: Cell and Molecular Biology
5. Freifelder: Physical Biochemistry
6. Holme and Peck: Analytical Biochemistry,Tata McGraw Hill
7. Karp: Cell and Molecular Biology (John Wiley & Sons)
8. Lodish et al: Molecular Cell Biology, Freeman
9. Pollard and Earnshaw: Cell Biology
10. Switzer and Garrity: Experimental Biochemistry
11. Biochemistry, Tata-McGraw Hill
12. N. Arumugan, Molecular Biology, Saras Publication.
13. N. Arumugan, Cell Biology and Molecular Biology, Saras Publication.
14. U. Satyanarayana and U. Chakrapani,Biochemistry, Elsevier.
15. U. Chakrapani and U. Satyanarayana, Fundamentals of Biochemistry, New Central Book Agency (P)

ZGPE0004: ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY

(4 Credits- 60 hours)

***Objective**: This course aims to help students to understand the internal physical and chemical functions of animals and their parts which include digestion, excretion, circulation, respiration, nervous system, sense organs and reproduction. Hormones and their influence on body metabolisms is also studied with special reference to reproduction.*

Module I (18 hours)

a) Physiology of digestion: Glands and secretion of digestives enzymes, Mechanism of digestion, Gastrointestinal hormones, Absorption of Carbohydrates, lipids and proteins.
b) Physiology of Respiration: Alveolar ventilation, alveolar-capillary gas exchange, Transport of O_2 and CO_2 Oxygen dissociation curve and the factors influencing it, Regulation of respiration.
c) Mammalian blood chemistry, blood groups, blood clotting mechanism, cardiac cycle and its regulation in mammals.
d) Musculature in vertebrates: Types of muscles, Ultrastructure and chemical composition of skeletal muscles, molecular mechanism and regulation of muscle contraction, muscle fatigue and rigor mortis.

Module II (15 hours)

a) Physiology of Excretion: Ultrastructure of nephron, mechanism of urine formation, excretion of dilute solutes and mechanism of excretion of excess solutes. Osmoregulation in different animal groups (aquatic and terrestrial)
b) Thermoregulation: Heat balance in animals, Adaptations to temperature extremes, Aestivation and hibernation, acclimatization, avoidance and tolerance, stress and hormone
c) Neuron: Ultrastructure, types and function, Resting membrane, membrane potential, action potential, Nerst Equation, Chronaxi, Rheobase, utilization time.
d) Neural impulse induction through an axon, neurotransmitters and synaptic transmission-mode of information transfer across electrical and chemical synapses

Module III (7 hours)

Basic concepts of Endocrinology, Hormone and homeostasis; Chemical nature of hormones: Amino-acid derived hormones, Peptide hormones, Glycoprotein hormones, Steroid hormones and Prostaglandin; Hormone receptor and target organ concept, Feedback system and trophic hormones; Biosynthesis and mechanism of action of peptide and steroid hormones.

Module IV (10 hours)

a) Structure of the pituitary gland; pituitary hormones and their functions Hypothalamo - hypophysialaxis
b) Structure of thyroid glands, thyroid hormones – biosynthesis and metabolic functions. Role of thyroid hormone in amphibian metamorphosis
c) Structure of adrenal gland; Synthesis of adreno-cortical and medullary hormones and their functions.
d) Structure of endocrine pancreas and Hormones of Islets of Langerhans, testis and ovary – endocrine structure and their functions; Hormone therapy

Module V (10 hours)

Reproduction: Reproductive cycle, Reproductive processes (implantation, parturition and lactation), neuroendocrine regulators in insects and mammals, pheromones, counter current mechanism

Suggested Readings

1. Brooks and Marshall: Essentials of Endocrinology, Blackwell Science.
2. Ganong: Review of Medical Physiology, Lang Medical Publications
3. Guyton and Hall: Text Book of Medical Physiology , W.B. Saunders
4. Hadley: Endocrinology, Prentice hall. International Edition.
5. Keel et al: Samson Wright's Applied Physiology,Oxford Press,
6. Larson: Williams Text Book of Endocrinology, 10th edition. W. B. Saunders Company, Philadelphia.
7. Murray et al: Harper's Illustrated Biochemistry, Appleton & Lange
8. Norris: Vertebrate Endocrinology. Lea &Febriger.
9. Turner and Bagnara: General Endocrinology, W. B. Saunders Company Philadelphia.
10. West: Best and Taylor's Physiological Basis of Medical Practice , Williams and Wilkins,
11. N Arumugam and A Mariakuttikan, Animal Physiology, Saras Publication.
12. N Arumugam, Animal Physiology & Biochemistry, Saras Publication.
13. Dharmalingam, Textbook Of Endocrinology, Jaypee Brothers Medical Publisher
14. Verma P.S, Agarwal V.K and Tyagi B. S, Animal Physiology, S. Chand Publishing.

ZGDB0005: DEVELOPMENTAL BIOLOGY

(4 Credits–60 hours)

Objective: *The objective of this course on Developmental Biology is to enable the students understand the process of development in animals and the phenomena associated with it. It will enable the students understand the environmental influences on development and factors responsible for ageing and also to imbibe the current knowledge pertaining to the development of animal embryos of diverse taxonomic groups through experimental analyses based on modern biological tools.*

Module I (14 hours)

a) Fertilization - pre and post fertilization events, activation of eggs, gamete fusion and prevention of phylogeny
b) General concept of Induction: mesoderm development, Determination: Imaginal disc of insects, Differentiation: Formation of fruiting bodies in Dictyostellium
c) Neocytoplasmic interaction in development of unicellular organism and in early development and differentiations of multicellular organisms, importance and role of cytoplasm, hybridization experiments, nature of changes in nuclei, cell hybridization, nuclear transplantation experiments.

Module II (10 hours)

a) Principles of experimental embryology: the developmental dynamics of cell specifications stem cells and developmental commitment, totipotency and pluripotency.
b) Morphogenesis and cell adhesion - the thermodynamic model of cell interactions, concept of morphogen gradient and morphogenetic field, cell adhesion molecules.

Module III (10 hours)

Role of maternal contribution in early embryonic development in Drosophila: maternal effect genes, gap genes, pair rule genes and hox genes in development.

Module IV (10 hours)

Organogenesis: vulva formation in Caenorhapditis elegans; Regeneration of Salamander limbs: Polar Co-ordinate model; Lens regeneration in amphibia; Bone and neural regeneration - Medical Advances in regeneration.

Module V (16 hours)

a) Medical implications of Developmental Biology - Genetic error of human development; Environmental assault on human development, Teratogenic agents (Retinoic acid, pathogens, alcohol, drugs and chemicals, heavy metals); Environmental oestrogens.
b) Infertility - In vitro fertilization and embryo transfer. Cloning experiments – Amphibians and Mammals. Embryonic stem cells and their applications; ethical issues
c) Sex determination - Timing and gene expression in mammalian sex determination, Brain sex determination pathways in vertebrates and flies, Hormone disruptors and sex determination problems, Temperature-dependent sex determination in turtles, Evolution of sex from invertebrate to vertebrate; ethical issues

Suggested Readings

1. Balinsky, B.I. An Introduction to Embryology. W.B Saunders Co., Philadelphia.
2. Gilbert, S.F. Developmental Biology. Sinamer Associates Inc. Saunderland, Massachusets, U.S.A.
3. John E. Hall: Text Book of Medical Physiology. Guyton & Hall
4. Kalthoff: Analysis of biological development. McGraw-Hill, 1996.
5. Karp,G. and Berrill,N.J. Development. McGraw Hill, New York.
6. Nagabhushanam,R. and Sarojini,R. Invertebrate Embryology. Oxford and IBA Publishing Co.
7. Oppenheimer, S.B. Introduction to Embryonic Development. Allyn and Bacon, Inc.
8. Saunders, J.W. Developmental Biology. MacMillan Co., London.
9. Tyagi and Shukla, Development of Fishes. Jaya Publishing House, New Delhi.
10. Wolpert: Principles of development. Oxford.
11. N. Arumugan, A textbook on Embryology,Saras Publication.
12. Gurbachan S. Miglani, Developmental Genetics, I.K. International Publishing House Pvt. Ltd.
13. Verma P.S. and Agarwal V.K, Chordate Embryology, S. Chand Publishing.
14. Chordate Embryology by Verma P.S. and Agarwal V.K., S. Chand Publishing.
15. Saidapur.S.K. Reproductive cycles of Indian vertebrates. (Allied Publishers Ltd. New Delhi)
16. Sarkar. H.B.D Principles of Vertebrate reproductive Biology
16. Chester-Jones I: Fundamentals of Comparative vertebrate Endocrinology (Pleum Press: NY)

ZGEE0006: ECOLOGY, ENVIRONMENTAL BIOLOGY AND ETHOLOGY

(4 Credits – 60 hours)

Objective: *The purpose of this course is to familiarize students with essential aspects of environmental conservation and management through a comprehensive understanding of animal behaviour and the components of the ecosystem, biological cycles, habitat ecology, resource ecology, pollution and its management.*

Module I (10 hours)

a) Definition and structure of ecosystems - abiotic and biotic components and their relationship; Types of ecosystems – Salient features of aquatic and terrestrial ecosystems and their biotic communities.
b) Ecological energetics and energy flow; Measuring ecosystem productivity
c) Population Ecology - Population density, Growth rate, Natality, mortality, survivorship curves and life tables, Biotic potential

Module II (10 hours)

a) Community Ecology - Types of biotic communities, organization, population density, dominance, carrying capacity, r and k-selection, species richness, species diversity.
b) Community Development – Types of community changes, ecological succession - its causes and examples, climax community.
c) Positive and Negative interactions between two species, Competition theory, Niche, Habitat, Ecological Equivalents, Character displacement; Liebig law of minimum, Shelford's law of tolerance, Significance of limiting factors, Ecotone and Edge effect.

Module III (10 hours)

a) Eutrophication in freshwater, coastal and marine ecosystem, Remediation of eutrophication.
b) Acidification in aquatic and terrestrial environment, Consequences and control strategies.
c) Major environmental regimes of Earth, Environmental monitoring, Environmental impact assessment and environmental management plan.
d) Biogeochemical cycles – carbon, nitrogen, sulphur cycles, impact of human activity on nutrient cycles.

Module IV (10 hours)

a) Biodegradation and Bioremediation: concept, environmental limitation for bioremediation, bioremediation of ecosystem (Air/water/soil)
b) Wastes in Ecosystem and management: Agricultural wastes and Management, Biomedical wastes and Management, Domestic waste, effects and management for purification and recirculation.
a) Environmental toxicology: Diversity and classification of environmental toxins, Air, Water and soil pollutants, Food additives and contaminants, Pesticides, Metals and Solvents, Radioactive pollution.

Module V (10 hours)

a) Concepts of Ethology, Genes and behaviour; Evolution of behaviour, Development of behavior
b) Neuroethology: Methods of studying brain and behaviour - neuroanatomical, neurophysiological and neurochemical; Mammalian Brain and Behaviour, Limbic system and hypothalamus; Sleep-arousal and reticular formation
c) Definition of Social behaviour: Properties and advantages of social grouping, social group of monkeys; Sociobiology - Darwinian fitness, individual fitness, kin selection, group selection, cooperation, reciprocation, altruism , reciprocal altruism, Proximate and Ultimate causations; Home range, territory, core area and aggression; Human behaviour

Module VI (10 hours)

Feeding and sexual strategies in animals; Parental care in animals (amphibians); Communication in animals - vocal, tactile, visual and chemical; Learning: Introduction and definition, Types - Habituation, trial and error, conditioning, cognition and imprinting; Short and long term memory, neural mechanism of learning

Suggested Readings

1. Asthana, D.K. and Asthana, M. Environmental Problems and Solutions. S. Chand and Co., New Delhi.
2. Odum : Basic Ecology (Saunders)
3. Odum : Fundamentals of Ecology (Saunders)
4. Odum. E.P. Fundamentals of Ecology. Nataraj Publishers, Dehra Dun.
5. Raven, Berg, Johnson : Environment (Saunders College Publishing)
6. Sharma : Ecology and Environment (Rastogi Publication)
7. Smith, R.L. Elements of Ecology. Harpet and Row Publishers, New York.
8. Trivedi, P.R.and Gurdeepraj, K. Environmental Biology. Akashdeep Publishing House New Delhi
9. Turk and Turk : Environmental Science
10. Drickamer & Vessey: Animal Behaviour –Concepts, Processes and Methods, Wadsworth
11. Goodenough et al : Perspectives on Animal Behaviour, Wiley,
12. Grier : Biology of Animal Behaviour, Mosby,
13. Verma P.S. and Agarwal V.K,Environmental Biology (Principles of Ecology) by., S. Chand Publishing.
14. Gupta S.R. and Singh S.P., Ecology Environmental Science and Conservation, S. Chand Publishing
15. Manju Yadav, Ecology, Discovery Publishing House
16. Rana S. V. S., Essentials of Ecology and Environmental Science, S.V.S. Rana. Publisher, Prentice-Hall of India
17. Anderwartha, H.G. and Birch, L. C., The distribution and abundance of animals, University of Chicago Press, Chicago London.
18. Beeby, A., Applying Ecology Chapman and Hall Madras.
19. Begon, M., Harper J. L. and Townsend, C. R, Ecology – Individuals, populations and communities, Blackwell Science, Cambridge UK.
20. Brewer, R., The science of Ecology, Saunders College of Publishing, New York.
21. Chapman, J. L. and Resis, M. J., Ecology- Principles and applications, Cambridge University Press, Cambridge UK.
22. Kaeighs, S. C., Ecology with special references to animal and Man, Prentice Hall Inc.
23. Putmann, R. J. and Wratten, S. D., Principles of Ecology,
24. Crown Helm, London. Salanki, J., Jeffery E. and Hughes G. M., Biological Monitoring of the Environment (A manual of Methods) CAB International, Wallingford UK.
25. Singh M C: Environment Protection and the Law (Ashish Publishing House)

ZGAZ0007: APPLIED ZOOLOGY I

(4 Credits - 60 Hours)

***Objective**: This course aims to provide a basic understanding of sericulture, apiculture, aquaculture and immunology*

Module I (20 hours)

a) Sericulture: Types of Silk Worm (Tasar, Muga and Eri), their host plants, silkworm rearing and management practices. Diseases and Pest of Silk Worm and their management, Sericulture Extension: Principles and importance of extension education in sericulture, methods of sericulture extension, Marketing and Management of Sericulture: Marketing of cocoons and raw silk yarn, traditional and regulated markets. Silk exports - challenges and growth, Seri-germplasm conservation - methods, centres of collection and significance

b) **Apiculture:** Different species of honey bees, bee plants, pollen calendar, bee keeping and management practices, bee products, Bee enemies and diseases.

Module II (20 hours)

Aquaculture: Aquarium fish keeping:Ornamental Fishes of India special reference to North East India, common aquarium fishes; Aquarium Maintenance, Fisheries management: Composite fish culture, induced breeding and hybridization; Prawn and Pearl Culture, Exotic and Indigenous food Fishes of NE India, Fish and shell fish diseases and their control measures. Fish genetic resource conservation; Aquaphonics–prospect and future.

Module III (20 hours)

Immunology: Immune system-innate and adaptive immunity; components and characteristic features, humoral and cell-mediated immunity; Cells and organs of immune system; T cells and B cells - maturation, activation and differentiation; Antigens- immunological properties of antigens, factors influencing antigenicity; Immunoglobulin- structure and function, classes of Ig molecules, Antigen-antibody interactions; Complement system- classical, alternative and lectin pathways, regulation of complement system, biological consequences of complement activation; Major Histocompatibility Complex (MHC)- general organization and inheritance of the MHC, MHC molecules and genes; Hypersensitivity reactions- types, mechanisms of type I to IV hypersensitivity reactions; Autoimmunity- Organ specific autoimmune disease and treatment.

Suggested Readings

1. Venkitaraman: Economic Zoology, Sudarsana Publishers
2. Srivastava : A Text Book of Applied Entomology, Vol. II & II.I Kalyani Publishers
3. Shukla & Upadhyaya : Economic Zoology. Rastogi Publishers.
4. Ananthakrishnan, T. N. and K.G. Shivaramakrishnan. Ecological entomology: Insect life in odd environment. Scientific Pub.: India
5. David, B. V and T.N. Ananthakrishnan. General and Applied Entomology. 2nd Edition. Tata McGraw-Hill Publ. Co. Ltd.: New Delhi
6. Fenemore P G and Prakash Applied Entomology (New Age Publishers: New Delhi)
7. Packer, B. Aquaponics System: A Practical Guide to Building and Maintaining Your Own Backyard Aquaponics
8. Jayashree, K.V., C.S. Tharadevi& N. Aurumugam.Apiculture.Saras Publication
9. Chandra Girish. Apiculture & the Honey Bee (Know about the species of honey bees, beekeeping, pollination, beehives, entomology, beekeepers, honey making
10. Arumugam, N., T. murugan , R. Ram Prabhu, J. Johnson Rajeshwar. Applied Zoology.Saras publication
11. Ganga & Chetty.Comprehensive Sericulture 2nd Edition Paperback.Oxford & IBH publication
12. Narasaiah, M.L. Problems and Prospects of Sericulture.Discovery Publishing Pvt.Ltd
13. Sharma, A.K., K. Jaiswal & R.N. Pandey.Research and Development in Indian Sericulture.Alfa Publications
14. Singh, R.N. & C.M. Bajpeyi.MugaCulture.APH Publishing Corporation
15. Marepally, L.Tasar Culture. Educreation Publishing
16. Bernstein , S. Aquaponic Gardening: A Step-By-Step Guide to Raising Vegetables and Fish Together New Society Publishers

SPECIALISATION I: ENTOMOLOGY AND ENVIRONMENTAL BIOLOGY

ZGIF0008: INSECTS- STRUCTURE AND FUNCTION

(4 Credits-60 hours)

Objective: *To help students learn about Insect systematics and insect biology.*

Module I (20 hours)

Origin and evolution of insects; Segmentation of insect: head, thorax and abdomen; Type of mouthparts, antennae, legs, their modifications and functional significance; Wings: wing structure, venation and wing coupling; Insect flight taking Drosophila as a model

Module II (20 hours)

Classification of insect up to family with example : a) Coleoptera, Diptera, Hymenoptera; b) Lepidoptera, Odonata; c) Orthoptera, Hemiptera and Isoptera; Insect molecular taxonomy- DNA as a new tool for insect identification

Module III (10 hours)

Insect plant interaction, Plant resistance to insects / Parallel evolution of Insect and angiosperm, Pollination Biology with special reference to Bees

Module IV (10 hours)

Receptor organ in insects (Chemo receptors, mechanoreceptors and photoreceptors); Sound and Light producing organs in insects; Locomotion in insects

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
2. Modern Entomology, D.B. Tembhare Himalaya Publishing House
3. Text Book of Applied Entomology Vol- I & Vol- II, K.P. Srivastava, Kalyani Publishers
4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil kumar Saxena, Astral International (P) Ltd.
5. Indian Insect Pests, H. Maxwel-Lefroy & F.M. Howlett, Astral International (P) Ltd.
6. A Handbook on Economic Entomology, Abhishek Shukla, Astral International (P) Ltd.
7. Insect Pest Management: Ecological Concepts, T.V.Sathe & Jyoti M. Oulkar, Astral International (P) Ltd.

ZGIP0009: INSECT PHYSIOLOGY

(4 Credits-60 Hours)

Objective: To provide in-depth knowledge of insect physiology.

Module I (18 hours)

Digestive System: Different types of alimentary canal, salivary glands, physiology of digestion and absorption; Respiratory System: General organization of respiratory system, classification of respiratory system, respiration in terrestrial insects- different types of spiracles and their structure, opening and closing mechanism of spiracle, trachea and tracheoles, air sac, ventilation of tracheal system, mechanism of gaseous exchange, respiration in aquatic insects, physiology of gill and plastron respiration, respiration in parasitic insects; Circulatory system: Diaphrams and sinuses, doral vessels, accessory pulsatory organs, blood circulation, chemical composition of haemolymph, different types of haemocytes and their functions.

Module II (15 hours)

Nervous system: Structure and types of neurons, central nervous system basic plan, gross anatomy and microanatomy of brain and ganglion, sympathetic nervous system, nerve impulse transmission; Excretory System: Basic and cryptonephreial system, malpighian tubules-anatomy and histology, accessory organs of excretion, metabolic pathways of formation of uric acidand ammonia, elimination of Uric acid by malpighain tubules; Diapause: Hormonal control of embryonic, larva, pupal and reproductive diapause

Module III (15 hours)

Reproductive System: male and female reproductive system, spermatogenesis, oogenesis; Hormonal control of reproduction in male and female insects; Neuroendocrine system: Neuroendocrine organs, hormones produced by neurosecretory cells, corpus allatum, corpus cardiacum and prothoracic gland, their chemical nature and functions, insect immunity; Growth and metamorphosis of insects; Insect Pheromones.

Module IV (12 hours)

Insect integument: Structure, chemical compositions, bio-composition of chitin, function of integument.

Intermediary metabolism: the energy demand for insect flight, mechanism stores carbohydrate resources, proline as a fuel for flight, mobilization and use of lipid for flight energy.

Insect muscle: Structure and function, attachment to exoskeleton, physiology of contraction

Insect eye: Structure and function, physiology of vision.

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
2. Modern Entomology, D.B. Tembhare Himalaya Publishing House
3. Text Book of Applied Entomology Vol- I & Vol- II, K.P. Srivastava, Kalyani Publishers

4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil kumar Saxena, Astral International (P) Ltd.
5. Indian Insect Pests, H. Maxwel-Lefroy & F.M. Howlett, Astral International (P) Ltd.
6. A Handbook on Economic Entomology, Abhishek Shukla, Astral International (P) Ltd.
7. Insect Pest Management: Ecological Concepts, T.V.Sathe & Jyoti M. Oulkar, Astral International (P) Ltd.

ZGIG0017: INSECT ECOLOGY

(4 Credits- 60 Hours)

***Objective**: At the end of the course student will develop understanding of Insect diversity and behavior.*

Module I (16 hours)

Dynamics of insect life system-determinants of insect abundance, population change, birth rate, death rate, movements; Effect of environment on insect development-effect of light, temperature & humidity, Regulation of insect populations, resistance of insect population to pest management; Basic concept of surveillance and sampling of insect

Module II (10 hours)

Dominance of insect-cause of success; Adaptation of insect- aquatic, terrestrial, soil, boring wood

Module III (12 hours)

Insect biodiversity, threats to insect biodiversity, impact of climate change on insect communities; Natural history of dragonfly, leaf insect, hawk moth, lime butterfly, milkweed butterfly, sal stem borer, golden beetle.

Module IV (22 hours)

Insect behavior: chemotropism, thigmotropism, hydrotropism, rheotropism, anemotropism, phototropism, thermotropism, geotropism, instinct. Protective behavior: mimicry. crypsis, warning coloration. Behavioural defence, chemical defence; Breeding behavior; Insect association: Passive insect association, active association, aestivating aggregation, protective aggregation, swarming aggregation, sleeping aggregation, dissociation, social aggregations.

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
2. Modern Entomology, D.B. Tembhare Himalaya Publishing House
3. Text Book of Applied Entomology Vol- I & Vol- II, K.P. Srivastava, Kalyani Publishers
4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil kumar Saxena, Astral International (P) Ltd.
5. Indian Insect Pests, H. Maxwel-Lefroy & F.M. Howlett, Astral International (P) Ltd.
6. A Handbook on Economic Entomology, Abhishek Shukla, Astral International (P) Ltd.
7. Insect Pest Management: Ecological Concepts, T.V.Sathe & Jyoti M. Oulkar, Astral International (P) Ltd.

SPECIALIZATION II: CELL AND MOLECULAR BIOLOGY

ZGCB0010: CELL AND MOLECULAR BIOLOGY-I

(4 Credits-60 Hours)

***Objective:** Through course aims to provide an understanding of the structure and working of various components of the cell such as biomembranes and its role in the transport of various macromolecules, cell cytoskeleton and their role in maintaining proper cell shape and cell movement, chromosomal structure and organization, genes and gene regulation and protein hierarchical structure.*

Module I (10 hours)

Biomembranes: Composition, universality and fluidity of biomembranes, Difference in phospholipid composition in two membrane leaflet- Intrinsic and extrinsic proteins, Integral membrane lipids and glycolipids; Mobility of lipids and integral proteins in biomembrane.

Transport across cell membrane: Mechanism of diffusion, Facilitated diffusion; Osmosis and water channels, movement, Flick's law, Donnan equilibrium; Uniporter-catalyzed transport, difference between uniport-catalyzed transport and passive diffusion, GLUT- 1 transport & its kinetics; Intracellular ion environment and membrane electric potential; Active transport - P-class ion pumps, F-class and V-class ion pumps and ABC superfamily, Plasma Membrane Ca++ ATPase pump, Muscle Ca++ ATPase pump and Na+/K+ ATPase pump; Cotransport by symportors and antiporters; Transport across epithelia, Receptor mediated endocytosis.

Module II (20 hours)

Cytoskeleton: Microfilaments: Actin cytoskeleton, G-actin and F-actin; structural and functional polarity. Cortical actin network, erythrocyte and platelet cytoskeleton; Actin bundle support projecting fingers of membrane; Dynamics of actin assembly, actin polymerization; Toxins effect on actin monomer - polymer equilibrium, stabilization of actin filaments by actin capping proteins; Movement with actin polymerization (a) Intracellular bacterial and viral movements (b) Actin polymerization at the leading edge of moving cells; Myosin: (a) Structure and mechanism of movement with actin (b) Conformational changes in myosin during movement.

Microtubules: Microtubules structure and microtubule assembly from organizing centers, Microtubule dynamics, Microtubule associated proteins (MAP's) and crosslinking of microtubules.

Microtubules and mitosis (a) Centrosome duplication (b) Kinetochore and force for poleward chromosome movement (c) Organization of spindle pole and orientation of assembly (d) Formation of poles and capture of chromosomes (e) Kinetochore and force of poleward chromosome movement (f) Astral microtubule and cytokinesis (g) Microtubules and plant cell formation.

Cell movements: (a) Intracellular transport: Role of kinesin and dynein, microtubule tracks and intracellular membrane vesicles (b) Amoeboid movements (c) Second messengers and signal transduction pathways for coordination of migration of cells.

Cilia and Flagella: Structure and movements (a) Sliding of outer doublet (b) Dynein sliding forces in axonemes (c) Dynein and exonemal bending (d) Dyenin regulatory complex.

Module III (20 hours)

Molecular structure of genes and chromosomes: Definition of gene; Chromosomal organization of genes- coding and non-coding DNA; Functional re-arrangements in chromosomal DNA; Organizing cellular DNA into chromosomes; Morphological and functional elements of eukaryotic chromosomes.

Regulation of Gene expression: Operon concept; Positive and Negative regulation; Inducers and corepressors; Regulation by attenuation-his and trp operons.

Module IV (10 hours)

Protein structure and function: Structure and chemistry of amino acids; Hierarchical structure of proteins-Secondary structure: α-helix, β-pleated sheets and bends; Prediction of secondary structure, Ramachandran plot; Tertiary structure, forces stabilizing tertiary structure; Domains and Motifs; Quarternary structure of proteins

DNA binding proteins and gene regulation: DNA binding domain; Homeodomain proteins; Zinc finger proteins; Winged-helix (Forked head) proteins; Leucine-Zipper proteins; Helix Loop helix proteins.

Suggested Readings

1. Cooper, G. M., Cell (A Molecular Approach)
2. DeRobertis & DeRobertis: Cell and Molecular Biology
3. Lodish et al: Molecular Cell Biology
4. Karp: Cell and Molecular Biology
5. Becker et al: World of Cell
6. T.A. Brown: Genome
7. Griffith et al: Modern Genetic Analysis
8. Hartl & Jones: Essential Genetics: A Genome Perspective
9. Ram Mahabal, Fundamental of Cytogenetics and Genetics
10. Lewin, Genes VIII

ZGIY0011: IMMUNOLOGY-I

(4 Credits-60 Hours)

Objective: Through this theory paper, the course aims to provide a basic introduction to the immune system, its components, cells and organs associated with providing cellular and humoral immunity, antigen and antibody structure, monoclonal antibodies, Major histocompatibility complex, hypersensitivity and autoimmunity.

Module I (15 hours)

Cells and organs of immune system: Hematopoiesis- B-Lymphocytes, T-lymphocytes and Null cells; Mononuclear cells (antimicrobial and cytotoxic activities, secretion of factors); Granulocytic cells (Neutrophils, Eosinophils and Basophils); Mast cells; Dendritic cells and Langerhans cells; Organs of immune system: Primary lymphoid organs (Thymus and bone marrow), Secondary lymphoid organs (Lymph nodes, spleen, mucosal associated lymphoid tissue and cutaneous associated lymphoid tissue, tonsils and Peyer's patches; Lymphatic system.

Molecular Immunology: Components of immunity; Innate (nonspecific) immunity- Anatomic barriers, Chemical barriers, Phagocytic barriers, Inflammatory barriers; Adaptive (specific) immunity- Humoral and cell-mediated immunity (CMI): (a) Recognition of antigen by B-and T-lymphocytes and antigen presenting cell (APC) (b) Clonal selection of lymphocytes; Cellular interactions required for generation of immune responses (a) Activation and proliferation of B and T cells (b) Generation of humoral immune responses (c) Generation of Cell mediated immune responses.

Module II (15 hours)

Antigens: Immunogenicity versus antigenicity; Factors that influence immunogenicity, Contribution of the immunogens (foreignness, molecular size, chemical composition and heterogenesity, susceptibility to antigen processing and presentation); Haptens and epitopes; Immunogen dosage and route of administration and adjuvants.

Immunoglobulins structure and function: Molecular structure of Ig; Immunoglobulin classes (lgG, lgM, IgE and lgD and their biological activities; Immunoglobulin - mediated effector functions (Opsonization, activation of complement, antibody dependent cell- mediated cytotoxicity , neutralization); Antigenic determinants on immunoglobulin (isotype, allotype and idiotype); Monoclonal antibodies: Formation and selection of hybrid cells, Production of monoclonal antibodies, Clinical uses of monoclonal antibodies, Catalytic monoclonal antibodies (abzymes).

Antigen - Antibody Interaction: Antibody affinity and activity; Cross reactivity; Agglutination reactions; Precipitation reaction.

Module III (20 hours)

Major Histocomptability complex: General organization and inheritance of MHC; Location and function of MHC; MHC haplotypes; MHC molecules and gene: Structure of class I molecules; Structure of class II molecules; Organization of class I and II genes; Peptide binding by MHC molecules; Class III molecules; Regulation of MHC expression; MHC and immune responsiveness; MHC and disease susceptibility.

Antigen processing and presentation: Role of antigen presenting cell, Early evidence for the necessity of antigen processing; Cells that function in antigen presentation; Evidence for two processing and presentation pathways; Endogenous antigens (The cytosolic pathway): (a) Peptide generation by proteosomes (b) Peptide transport from the cytosol to rER (c) Assembly of peptide with class I MHC molecules; Exogenous antigens (The endocytic pathway) (a) Peptide generation in endocytic vesicles (b) Transport of class II MHC molecules to endocytic vesicles. (c) Assembly of peptide with class 11 MHC molecules.

Module IV (10 hours)

Hypersensitivity: Type I, II, III and IV; In vivo and in vitro

Autoimmunity: Organ specific autoimmune disease; Systemic autoimmune disease.

Suggested Readings

1. Kuby et al.: Kuby Immunology
2. Abbas A.K., Lichtman A.K. and Pober J.S. Cellular and Molecular Immunology
3. Roitt et al,: Essential Immunology

4. Price C.P., Newman D.J., Principles and Practices of Immunology
5. Kindt T.J., Osborne B.A., Goldsby R., Immunology

SPECIALIZATION III: FISH AND FISHERY BIOLOGY

ZGTF0012: TAXONOMY AND FUNCTIONAL ANATOMY
(4 Credits- 60 Hours)

Objective: To provide knowledge on Fish taxonomy and functional biology.

Module I (10 hours)

Fin fish taxonomy: General characters and classification, major fish groups (extant & extinct), phylogeny of fishes; Gross external anatomy of fishes: skin and its derivatives, scales and their significance; Significance of fish osteology in taxonomy, Fish barcoding

Module II (30 hours)

Fin fish functional biology: Food and feeding habits: Food– Kinds and varieties, abundance of food and its availability, structural adaptation, search for food, classification based on food and feeding habits; respiratory organs in fishes – Modification of gills and Tracheae in relation to habit – Structural adaptations of air breathing fishes; Age and growth: Growth, length weight relationships, condition factors, morphometric indices and bioenergetics index, variation in growth rate, age determination; Modes of reproduction, reproductive cycle, gonad maturity stages, Hormonal regulation of gonadal development, activity of Gonadotropin-releasing hormone, modes of spawning; Environmental factors controlling reproduction and factors affecting development.

Module III (20 hours)

Shell fish taxonomy and functional anatomy: General characters of crustaceans and mollusks; Food, feeding habits and adaptations of cultured prawn and shrimps; Food, feeding habits and adaptations of cultured Mollusks; Reproductive patterns in prawn and shrimp, reproductive organs, gonad maturity, spawning and fertilization; Endocrine organs in crustaceans and their role in reproduction; Reproductive patterns in Molluscs, reproductive organs, gonad maturity, spawning and fertilization

Suggested Readings

1. Barrington, F.J.W. Invertebrates: Structure and Functions. EIBS.
2. Carl, B.E. Biology of Fishes. Saunders,
3. Fretter, V. & A. Graham.The functional anatomy of vertebrates.Academic Press Inc. (Lon.) Ltd.
4. Kaestner, A. Invertebrate Zoology. Vol. I – III, John Wiley & Sons
5. Kurian, C.V. & V.O. Sabastian.Prawns and Prawn Fisheries of India.
6. Lagler, K.E. et. Al. Ichthyology. John Wiley,
7. Low, M.S. & G.M. Calliet (eds.). Readings in Ichthyology. Prentice Hall,
8. Moyle Peterb, Fishes : An Introduction to Ichthyology. Prentice Hall.
9. Nikolsky, G.V. Ecology of Fishes. Academic Press, NY. Howar, W.S. & D.J. Randal. Fish Physiology, Vols. 1–4, Academic Press, NY
10. Norman, J.R. & P.H. Greenwood.A History of Fishes, Ernest Benn Ltd.
11. Jayaram K. C. The fresh water fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka.
12. Jhingran V. G. Fish and Fisheries of India.
13. Lagler, K.F. Ichthyology. John Wiley Publication
14. Norman, J.R. & P.H. Green Wood.A history of fishes.
15. Bond, E. Carl. Biology of fishes.
16. Kumar S and ThembreM Anatomy and Physiology of Fishes (Vikas Publishing House)
17. Love, M.S. &Cailiet, G.M. Readings in Ichthyology.Prentice Hall Publications.
18. Srivastava, C.B.L. Textbook of Fishery Science and Indian Fisheries. KutubMahal
19. Khanna S. S. and H. R. Singh. A textbook of Fish Biology and Fisheries, Narendra Publishing House
20. Beaven C R. Handbook of the freshwater fishes of India (Narendra Publishing House)
21. Biswas K P A Text Book of Fish, Fisheries and Technology, (Narendra Publishing House)
22. Brown E and Margret 1957 Physiology of Fishes Vol I & II (Academic Press, Inc. Publishers)

23. Daniels R J R Freshwater fishes of Peninsular India (Universities press)
24. Kumar S andThembre M Anatomy and Physiology of Fishes (Vikas Publishing House)
25. Bond, E. Carl. Biology of fishes.
26. Brown E and Margret Physiology of Fishes Vol I & II (Academic Press, Inc. Publishers)
27. Lagler, K.F. Ichthyology. John Wiley Publication
28. Love, M.S. &Cailiet, G.M. Readings in Ichthyology. Prentice Hall Publications, 1979.
29. Norman, J.R. & P.H. Green Wood.A history of fishes.
30. Pandey.Fish and Fisheries.Rastogi Publications

ZGAF0013: AQUACULTURE AND FISH GENETICS

(4 Credits-60 Hours)

Objective: *This course is designed to provide in depth knowledge of Aquaculture management and to develop theoretical knowledge on Fishery Genetics and Fish Biotechnology*

Module I(15 hours)

Fishery Management: Construction of fish farm and reclamation of swamps; Selection of species for culture – Biological principles, Preparation and management of nursery ponds, rearing ponds and stocking ponds along with control of weeds, pests and predators, Construction of hatcheries and their management.

Aquaculture Management: Feed, health and water quality management; prophylaxes; quarantine measures.

Module II (30 hours)

Freshwater fish culture : Indian Major carps and exotic carps - Composite Fish Culture; Air breathing fishes; Integrated Fish Farming – Paddy cum Fish Culture and Fish cum Livestock Culture, Monoculture, Monosex culture; Sewage fed fisheries, Catfish culture, Trout culture.

Freshwater prawn culture; shrimps and Crab culture; cage culture and pen culture, Lobster culture, Mussel culture; Pearl oyster culture; Edible oyster culture

Fish nutrition: Nutritional requirements, formulation and preparation of fish feeds Food & Feeding habits of commercially important fishes. Larval nutrition — Importance of live feed and artificial feed, Different types of feed available for larvae.

Fish seed resources: Procurement and transportation of seed from natural resources; management of brood stock and induced breeding of carp and air breathing fishes.

Module III (15 hours)

Fishery Genetics and Biotechnology: Inheritance in fishes, sex determination, hybridization

Cytogenetics and molecular techniques in fisheries: Comet Assay, Micronuclei Test, Fish Cell Culture, Application of biotechnological tools: Recombinant DNA, Application of Hybridoma Technology, Transgenesis and AndrogenesisCell lines and cell culture; production of monoclonal antibodies. Jellyfish Green Fluorescent Proteins and their applications, Cryopreservation

Suggested Readings

1. Arumugam, N. Aquaculture & Fisheries, Saras Publication
2. Bardach, J.E., Ryther, J.H. and McLarney, W.O. Aquaculture. John Wiley & Sons Inc., USA.
3. Beaven C R Handbook of the freshwater fishes of India (Narendra Publishing House)
4. Boris, Gomelsky. Fish Genetics.VDMVerlag
5. C.I.F.R.I., Prawn Fisheries Bulletin
6. Chakroff,M., Freshwater Fish Pond Culture and Management, Scientific Publishers
7. Christenson, K. Aquaculture: Introduction to Aquaculture for Small Farmers. Createspace Independent Publishing Platform
8. Daniels R J R Freshwater fishes of Peninsular India (Universities press)
9. Dholakia, A.D. Identification of Prawns/Shrimps of India and Their Culture. Daya Publishing House
10. Elizabeth Gosling.BivalveMolluscs: Biology, Ecology and Culture Wiley-Blackwell
11. Ghosh, S.., Palanisamy, K. and Pathak, S.C. Shrimp and Freshwater Hatchery Public Relations Division, National Bank for Agriculture and Rural Development, Bombay.

12. Gray, CamilloW.Guide to Shrimp and Prawn Culture in Bangladesh. University of Stirling Institute of Aquaculture
13. Gupta S.K., Gupta P.C .General & Applied Ichthyology.S Chand & Company
14. Hall, C. B., Ponds and Fish Culture, Agro Botanical Publishers
15. Harvey, B. J. and Hoar, W. S.. Theory and practice of induced breeding in fishes.
16. Hora, S. L. and Pillay, T.V. R. Handbook on Fish Culture in the Indo-Pacific Region, Fisheries Division, Biology Branch, FAO,
17. Huet, M., Textbook of Fish Culture, Breeding and Cultivation of Fish, Fishing News (Books) Ltd..
18. CAR.Handbook of Fisheries and Aquaculture Reddy,
19. M.S. A Text Book of Aquaculture, Discovery Publishing Pvt.Ltd
20. Jhingran V. G. Fish and Fisheries of India.
21. KolappanNisha. Identification of Genetic Relation Between Fish Species Using Sds-Page. ambert Academic Publishing
22. Kurian, C.V. and Sebastian,V.O. Prawns and prawn Fishery of India. Hindustan Publishing Corporation (India), New Delhi.
23. Lakra W. S., Abidi SAH, Mukherjee SC and Ayyappan S. 2004.Fisheries Biotechnology.
24. Lucas, J.S. Aquaculture: Farming aquatic animals and plants (Fishing News Books)
25. MacKLenzie, Simon A. Genomics in AquacultureAcademic Press
26. Michael Bernard New(Editor), Wagner CotroniValenti(Editor), James H. Tidwell(Editor). Freshwater Prawns: Biology and Farming Wiley-Blackwell
27. Mikhalev, Viktor. Genetics and Fish Breeding.Arcler
28. Nigel Preston(Editor), Dean R. Jerry(Editor)Biology and Culture of Farmed Marine Shrimps. CRC Press
29. Pandian, T.J. (Editor), C.A. Strüssmann (Editor), M.P. Marian (Editor).Fish Genetics and Aquaculture Biotechnology.CRC Press
30. Pandian, T.J. Genetic Sex Differentiation in Fish. CRC Press
31. Pillay, T. V. R.. 1993. Aquaculture – Principles and Practices. Fishing News Book.
32. Pillay, T.V.R. and M.N. Kutty, Aquaculture: Principles and Practices. Wiley India Pvt Ltd; Second edition
33. Rao, K. L. 1975. India's water wealth.
34. 3Rath, R.K. Freshwater AquacultureScientific Publishers Journals Dept
35. RavishankarPiska, 1999. Fisheries and Aquaculture.Lahari Publications, Hyderabad.
36. Santhanam,R. Fisheries Science, Daya Publishing House, 1990.
37. Selvamani B.R &Mahadevan R.K 2008 Freshwater fish farming (Campus Books International)
38. Singh, B.& A. Dey. Fish and Fisheries. Invincible Publishers
39. Singh, N.P. & B. Santosh. Handbook of freshwater aquaculture.New India Publishing Agency
40. Turner, Bruce. Evolutionary Genetics of Fishes (Monographs in Evolutionary Biology).Springer

SPECIALIZATION IV: ANIMAL ECOLOGY AND WILDLIFE BIOLOGY

ZGEB0014: ANIMAL ECOLOGY AND BIOGEOGRAPHY

(4 Credits-60 Hours)

Objective: To develop an understanding of the theoretical perspectives of Ecology and Biogeography

Module I (10 hours)

Basic Ecological Concept: Habitat and Niche, Competitive displacement, Ecological equivalents; Species richness, Global patterns in species richness, Theories of species richness, Species diversity, Ecotone, Edge effect; Gause's principle, Invasive species and its effect on species richness; Ecological Versatility and Niche dimension

Module II (20 hours)

Habitat and landscape ecology: Introduction to Habitat Ecology; Ecology of major habitats: Grasslands, Wetlands, Forests; Edge ecotones, interspersion and juxtaposition; Physical and anthropogenic factors influencing habitats. Habitat fragmentation and its effect on resident community; Inventory,

evaluation and monitoring of wildlife habitat - Measuring wildlife habitat, availability, quality, palatability of graze and browse; Inventory of unique habitats and their distribution, Animals signs as indicators of habitat use; Monitoring changes in habitat parameters.

Module III (10 hours)

Population Ecology: Monitoring population and other demographic parameters, Predator-Prey relation, Population Genetics, Estimation of Survival, Recruitment, and other transition states. Ecological Model

Module IV (20 hours)

Biogeography: History of biogeography; Ecology of dispersal and faunal exchange, barriers, mode of dispersal, origins and radiation; island biogeography theory; Endemism, refugia; Continental drift; dispersal and vicariance biogeography; dispersal mechanisms and dispersal barriers; reconciling distribution of fauna and flora; Biogeographic affinities of the fauna and flora of the Indian sub-continent; India's biogeographic classification.

Suggested Readings

1. Smith TM and Smith RL (2012). Element of Ecology (9th edition). Pearson Publication
2. Begon M, Townsend CR and Harper JL (2006). Ecology From individuals to Ecosystems (4th edition). Blackwell Publishing
3. Ricklefs RE and Miller GL (1999). Ecology (4th edition). WH Freeman Publication
4. Mani MS (1974). Ecology and Biogeography in India. Springer Netherlands
5. Cox CB, Moore PD and Ladle R (2010). Biogeography: An Ecological and Evolutionary Approach (9th Edition). Wiley-Blackwell.
6. Huggett RJ (2004). Fundamentals of Biogeography (2nd edition). Routledge London and New York
7. Ladle R and Whittaker RJ (2011). Conservation Biogeography. WileyBlackwell
8. MacArthur RH (1984). Geographical Ecology: Patterns in the Distribution of Species. Princeton University Press.
9. MacArthur RH and Wilson EO (2001). The Theory of Island Biogeography. Princeton University Press.
10. Mayr E (1969). Principles of Systematic Zoology. Tata McGraw Hill Publ. Co.
11. Mayr E and Ashlock PD (1991). Principles of Systematic Zoology. McGraw Hill International Edition.
12. Simpson GG (1961). Principles of Animal Taxonomy. Columbia University Press.

ZGWM0015: WILDLIFE CONSERVATION AND MANAGEMENT

(4 Credits-60 Hours)

Objective: The Basic objective of the course is to give the students a sound understanding of the wildlife Conservation and Management

Module I (25 hours)

Conservation Biology: Introduction to conservation biology, values of biodiversity and conservation ethics, Patterns and process of biodiversity, losses and threats to biodiversity. Local and regional extinctions, changes in species composition and problem of climate change; Strategies for conservation – in situ conservation: International efforts and Indian initiatives; protected areas in India – sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity; Control of invasive species; Significance of ecological restoration in conservation; Ex situ conservation : Principles and practices; botanical gardens, fields gene banks, seed banks, in vitro repositories, cryobanks; non-formal conservation efforts.

Module II (25 hours)

Wildlife Management: Principles and practices of wildlife management; Management of special habitats: riparian zones,Grasslands, wetlands; Species conservation projects: tiger, lion, rhino, crocodile, turtle and adjutant stork; Role of Biology in management; Management plan for Protected Areas; Principles of planning: objectives, resource surveys, analysis of surrounding

region, management zones, theme plans, communications, staff and visitor amenities, monitoring; Financing protected areas: Forest working plans and wildlife management plans; Need for wildlife management planning.

Module III (10 hours)

Phytoresource Utilization and Conservation: Plant Biodiversity: Concept, status in India, utilization and concerns; Forest products: Important timber yielding plants, Timber types, identification, diagnostic features, structure and quality; Important fire wood plants; Non Timber forest products: bamboos, rattans, fibers pulp; gums, resins, tannins, latex, fruits & tubers; Plants used as avenue trees for shade, pollution control and aesthetics; Threatened plants of India with special reference to NE India

Suggested Readings

1. Hillis DM (1996) (ed). Molecular Systematics. SinauerPubl Inc. Dash, M. Fundamentals of Ecology. Tata Mcgraw Hill
2. Gopal, R. Wildlife Management, Allied International
3. Saharia, V. Wildlife conservation
4. Primack- Essentials of Conservation Biology
5. Dyke- Conservation Biology- Foundation, Concepts , Applications
6. Primack- A primer of Conservation Biology
7. Singh- Textbook of Wildlife Management
8. Bailey- Principles of Wildlife Mangement
9. Krausman and Cain- Wildlife Management and Conservation
10. B.B. Dutta- A handbook of Plant Resource Utilization and Conservation
11. Kibue- Wildlife Conservation and Utilization
12. Trivedi and Sharma- Plant Resource Utilization and Conservation

ZGAZ0016: APPLIED ZOOLOGY II

(4 Credits- 60 hours)

Objective: *The course is designed to provide knowledge on parasitology with special reference to emerging viral diseases, Pest management, Poultry rearing and Biodiversity*

Module I: Parasitology (20 hours)

Parasitism and types of parasites, primary and secondary hosts, transmission of parasitic infection. Host- parasitic interactions – parasitic effects benefiting the parasites, parasitic effects benefiting the host. *Vibrio cholera* and *Clostridium titani*- Life cycle, mode of transmission, infection and treatment. Influenza, Dengue, Bird flu, Nipah and H1 N1 viruses- Life cycle, mode of transmission, infection and treatment. Toxins and antitoxins, Identification characters, life cycle, pathogenecity and control of *Taenia solium* and *Ancylostoma duodenale*

Module II: Insect pest management, Public Health and Forensic Entomology (10 hours)

Concept of Pest, concept of integrated pest management (IPM)
Mosquito (Aedes, Culex, Anopheles), Housefly- Taxonomy, Biology, Behavior and their control.
Life cycle of Calliphora and Scrophaga, determination of death and causes of death.

Module III: Poultry management (8 hours)

Poultry Rearing / Farming: Housing and equipment; Nutritional Requirements; Poultry diseases
Poultry products: Broilers, meat processing and meat products; Egg structure and quality, factors affecting size and egg processing; Poultry by products

Module IV Biodiversity (12 hours)

Components of Biodiversity (Genetic, Organismal and Ecological), Value of Biodiversity, threats to biodiversity, biodiversity conservation, Mega biodiversity countries, hot spots and heritage sites, Threats to biodiversity. IUCN Red list categories. Habitat diversity of Indian wildlife, endemic and threatened species of northeast India
Ethnozoology with special reference to Northeast India

Vermiculture: species of worms, condition for efficient vermiculture (domestic and commercial level), Economics of Vermiculture

Suggested Readings

1. Venkitaraman: Economic Zoology, Sudarsana Publishers
2. Srivastava : A Text Book of Applied Entomology, Vol. II & II.I Kalyani Publishers
3. Shukla & Upadhyaya : Economic Zoology. Rastogi Publishers.
4. Ananthakrishnan, T. N.and K.G. Shivaramakrishnan.Ecological entomology: Insect life in odd environment. Scientific Pub.: India
5. David, B.VandT.N. Ananthakrishnan.General and Applied Entomology. Tata McGraw-Hill Publ. Co. Ltd.: New Delhi
6. Dent, D. R.Insect pest management.Westville Publishing House: Delhi
7. Eldridge B Medical entomology (Springer)
8. Fenemore P G and Prakash Applied Entomology (New Age Publishers: New Delhi)
9. Madigan, M. T., J. M. Martinko and J. Parker Brock Biology of Microorganisms (Ed. IX).Prentice Hall International Publication.
10. Kreier, J.P. and J.R. Baker.Parasitic Protozoa. Allen and Unwin Press.
11. Kathering ,M.G. A. James paul and V. Zaman. Churchill Livingstone.Medical and Veterinary Protozoalogy
12. Asa C. Chandler, (7th ed.), Introduction to Parasitology, With Special Reference to the Parasites of Man, New York: Wiley
13. Despommier, Gwadz, Hotez, Knirsch: Parasitic Diseases (5th Ed). Apple Trees Productions, LLC.
14. Stephen A. Berger, John Marr, Human Parasitic Diseases Sourcebook, Jones & Bartlett Learning
15. D Molyneux, Advances in Parasitology- Control of Human Parasitic Diseases, (1st Ed).Academic Press.
16. Jeremy Farrar & Peter Hotez& Thomas Junghanss&Gagandeep Kang & David Lalloo& Nicholas J. White. Manson's Tropical Diseases, (23rd Ed).Elsevier publication.
17. Howes, H. Modern Poultry Management.Read Books
18. Jadhav & Siddiqui .Handbook of Poultry Production and Management.Jaypee Publications
19. Maiti, P.K. & P. Maiti. Biodiversity: Perception, Peril and Preservation. PHI Learning Private Limited
20. Bharucha, E.The Bio-Diversity of IndiaHardcover.Grantha Corporation
21. Krishnamurthy. An Advanced Textbook On Biodiversity : Principles and Practice. Oxford & IBH Publishing
22. Johns, J. Worm Farming - Creating Compost at Home With Vermiculture. Createspace Independent Pub
23. NPCS Board of Consultants & EngineersThe Complete Technology Book on Vermiculture and Vermicompost
24. ICAR. Handbook of Integrated Pest Management (IPM) Pub: ICAR, Govt. of India
25. Metcalf, R W.H.Luckmann. Introduction To Insect Pest Management. Wiley India Pvt Ltd

ZGIG0017: INSECT ECOLOGY

(4 Credits- 60 Hours)

***Objective**: At the end of the course student will develop understanding of Insect diversity and behavior.*

Module I (16 hours)

Dynamics of insect life system-determinants of insect abundance, population change, birth rate, death rate, movements; Effect of environment on insect development-effect of light, temperature & humidity, Regulation of insect populations, resistance of insect population to pest management; Basic concept of surveillance and sampling of insect

Module II (10 hours)

Dominance of insect-cause of success; Adaptation of insect- aquatic, terrestrial, soil, boring wood

Module III (12 hours)

Insect biodiversity, threats to insect biodiversity, impact of climate change on insect communities; Natural history of dragonfly, leaf insect, hawk moth, lime butterfly, milkweed butterfly, sal stem borer, golden beetle.

Module IV (22 hours)

Insect behavior: chemotropism, thigmotropism, hydrotropism, rheotropism, anemotropism, phototropism, thermotropism, geotropism, instinct. Protective behavior: mimicry. crypsis, warning coloration. Behavioural defence, chemical defence; Breeding behavior; Insect association: Passive insect association, active association, aestivating aggregation, protective aggregation, swarming aggregation, sleeping aggregation, dissociation, social aggregations.

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
2. Modern Entomology, D.B. Tembhare Himalaya Publishing House
3. Text Book of Applied Entomology Vol- I & Vol- II, K.P. Srivastava, Kalyani Publishers
4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil kumar Saxena, Astral International (P) Ltd.
5. Indian Insect Pests, H. Maxwel-Lefroy & F.M. Howlett, Astral International (P) Ltd.
6. A Handbook on Economic Entomology, Abhishek Shukla, Astral International (P) Ltd.
7. Insect Pest Management: Ecological Concepts, T.V.Sathe & Jyoti M. Oulkar, Astral International (P) Ltd.

SPECIALISATION I: ENTOMOLOGY AND ENVIRONMENTAL BIOLOGY

ZGPM0018: PRINCIPLES OF PEST MANAGEMENT

(4 Credits-60 Hours)

Objective: *To develop understanding of theoretical perspective of insect pest control and management*

Module I (23 hours)

Concept of pest and pest status, kinds of pest; House hold pest: Cockroach, lepisma, bedbug, their life history and control; Stored grain pest: Sitophilusoryzae, Triboliumcastaneum, Troagodermagranarium, Sitotrogacerellela, Callobruchuschinensis, life history and control; Major pest of rice vegetables, tea, jute and pulses- classification upto family, life history, nature and damage control (two each); Forest insects: defoliators, borers and suckers of teak, sal and gamari classification upto family, life history and control (two each), Insect damage and sign categories of forest insects.

Module II (12 hours)

Pest management: Economic decision level for pest population- Concept of economic injury level, economic threshold, crop susceptibility to injury, Pre insecticide era, insecticide era, concept of pest management.

Module III (25 hours)

Primary control measure: Physical, mechanical, traditional and legislative measure. Chemical control: concept of LD 50 and LC 50, Classification and mode of action of important insecticides, Insecticide toxicity to humans, drawbacks of chemical control, Insect resistance to pesticides, Fumigants application and operation precautions, insecticide law and regulations. Pheromonal control.

Biological and genetic control: Use of parasites, parasitoids, predators and pathogenic organisms, sterile insect techniques, lethal mutations, inherited sterility, cytoplasimic incompatibility; Integrated Pest Management and a case study

Suggested Readings

1. The Insect Structure and Functions, R.F. Chapman, Cambridge University Press
2. Modern Entomology, D.B. Tembhare Himalaya Publishing House
3. Text Book of Applied Entomology Vol- I & Vol- II, K.P. Srivastava, Kalyani Publishers

4. Introduction to General and Applied Entomology, Abhishek Shukla and Sushil kumar Saxena, Astral International (P) Ltd.
5. Indian Insect Pests, H. Maxwel-Lefroy & F.M. Howlett, Astral International (P) Ltd.
6. A Handbook on Economic Entomology, Abhishek Shukla, Astral International (P) Ltd.
7. Insect Pest Management: Ecological Concepts, T.V.Sathe & Jyoti M. Oulkar, Astral International (P) Ltd.
8. Indian Pest Aphids, T.V.Sathe & B.V.Jadhav, Astral International (P) Ltd.
9. Insect Pest Predators, T.V.Sathe & Y.A.Bhosale, Astral International (P) Ltd.
10. Insect Predators and Pest Management, Vaishali J. Patil & T.V.Sathe, Astral International (P) Ltd.
11. Insect in Vegetables, Dhamo K. Butani & M.G.Jotwani, Astral International (P) Ltd.

SPECIALIZATION II: CELL AND MOLECULAR BIOLOGY

ZGMB0019: CELL AND MOLECULAR BIOLOGY-II

(4 Credits-60 Hours)

Objective: This course aims to provide understanding of cell adhesion molecules and their role in cell junctions, various cell signaling methods, intracellular protein traffic, cell cycle, cell death, aging and cancer, and cytogenetic analysis.

Module I (15 hours)

Cell-Cell adhesion and cell-matrix adhesion: Cadherin mediated Ca++-- dependent homophilic cell-cell adhesion; N-CAM's mediate Ca++-- independent homophilic cell-cell adhesion; Cadherin containing junctions; Gap junctions and connexins; Integrin in cell matrix and cell-cell interaction; Integrin and cell to substratum attachment; Collagen-Basic structure and assembly; Non-collagen components of extracellular matrix (Laminin, fibronectin and cell surface proteoglycans)

Cell-Cell Signaling: Endocrine, paracrine and autocrine signaling; Receptor Proteins- Cell Surface receptors and intracellular receptors; Cell Surface receptors-G-protein coupled receptors, ion channel receptors, tyrosine kinase-linked receptors and receptors with intrinsic enzymatic Activity; Second messenger System - cAMP and IP3, DAG; MAP kinase cascade, JAK/STAT and TGF –β / Smad signaling, NF-kB signaling; Signaling from plasma membrane to nucleus (a) CREB links cAMP signals to transcription (b) MAP kinase.

Module II (10 hours)

Protein sorting and targeting to organelles: Protein traffic through the endomembrane system; Targeting of proteins to the Rough Endoplasmic Reticulum and Golgi complex; Anterograde and retrograde transport; Signal-mediated protein transport to organelles (a) Nucleus (b) Mitochondria (c) Peroxisome

Module III (10 hours)

Genetic analysis in Cell Biology: Mutation: type and causes; Isolation and analysis of mutants; Physical and Genetic mapping of mutations; Molecular cloning of genes defined by mutations.

Module IV (15 hours)

Cell Cycle: Bacterial cell cycle (Helmstetier - Cooper or I+C+D model); Partition and cytokinesis; Eukaryotic cell cycle – G l, S, G 2 and M phases; Cell cycle check points; Molecular basis of cell cycle regulation (a) Cyclins and cyclin - dependent kinases (b) Regulation of CDK cyclin activity.

Cell Death: Apoptosis and necrosis; Apoptosis-its characteristics; Genes involved in apoptosis.

Module V (10 hours)

Aging, the biology of senescence: Maximum life span and life expectancy; Causes of aging: (a) General wear and tear and genetic instability (b) Free radicals, oxidative damage and antioxidants (c) Telomerases and aging.

Cancer: Tumor cells and onset of cancer; Proto-oncogenesis and tumor suppressor genes; Mutation causing loss of cell cycle; Mutations affecting genuine stability.

Suggested Readings

1. Cooper, G.M., Cell (A Molecular Approach)
2. Sadava, D.E., Cell Biology
3. Karp, G., Cell and Molecular Approach
4. Kish, V.M. and Kleinsmith L.J., Cell and Molecular Biology
5. Gardener, Principles of Genetics
6. Strickberger, Genetics
7. Ram mahabal, Fundamental of Cytogenetics and Genetics

ZGIM0020: IMMUNOLOGY II

(4 Credits-60 Hours)

Objective: *This course aims to provide a detailed understanding of the organization and expression of the immunoglobulin genes, functional significance of cytokines, immune responses to various infectious diseases, immunodeficiencies and immunization techniques, transplantation and tumour immunology.*

Module I (20 hours)

Organization and expression of Ig genes: Multigene organization of Ig genes; Light-chain multigene family; Heavy chain multigene family; Variable region gene rearrangement, V-J rearrangements in light chain DNA, V-D-J rearrangements in heavy chain DNA, Mechanism of gene rearrangement, Allelic exclusion; Generation of antibody diversity, Multiple germ line V, D and J gene segments; Combinatorial V-J and V-D-J joining; Junctional diversity; Association of heavy and light chain; Expression of Ig genes, Differential RNA processing of heavy chain primary transcripts, Expression of membrane secreted Ig, Simultaneous assembly and secretion of IgM and IgD, Synthesis, assembly and secretion of Ig; Class switching of constant regions

Module II (15 hours)

Cytokines: Properties of cytokines, General structure of cytokines, Function of cytokines, Cytokines related diseases, Bacterial septic shock, Bacterial toxic shock and similar diseases, Lymphoid and myeloid cancers, Chagas disease

Immune system in health and disease: Immune response to infectious disease; Viral infections (a) Viral neutralization by humoral antibody (b) Cell - mediated antiviral mechanism (c) Viral evasion of host defense mechanisms; Bacterial infections (a) Immune responses to extra cellular and intracellular bacteria (b) Bacterial evasion of host defense mechanism; Protozoan diseases; Diseases caused by helminthes.

Module III (15 hours)

Vaccines: Active and passive immunization; Designing vaccines for active immunization; Whole organism vaccine (a) Attenuated viral or bacterial vaccines (b) Inactivated viral or bacterial vaccines; Polysaccharide vaccines; Recombinant vector vaccines; DNA vaccines; Synthetic peptide vaccines; Multivalent peptide vaccines

Immunodeficiencies: Primary and Secondary Immunodeficiencies, lymphoid and myeloid lineage; AIDS: Structure and types, genome organization, replication, opportunistic agents and therapeutic agents

Module IV (10 hours)

Tumor immunology: Tumor antigen; Tumor evasion; Immune system against tumors; Therapies.

Transplantation immunology: Acute, hyperacute and chronic rejection; Tissue matching (HLA typing); Graft Vs host (GVH) reaction; Xenotrasplantation; Immunosuppressive drugs; role of monoclonal antibodies in transplantation.

Suggested Readings

1. Kindt, T.J., Osborne, B.A., Kuby, J., Kuby Immunology
2. Kasper, D.l., Fauci, A.S., Harrison's Infectious Diseases
3. Abbas, A.K., Lichtman, A.H.H., Pillai, S., Cellular and Molecular Immunology
4. Sell, S., Berkower, I., Immunology and Immunopathology and Immunity

SPECIALIZATION III: FISH AND FISHERY BIOLOGY

ZGCP0021: CAPTURE FISHERY AND POST-HARVEST TECHNOLOGY

(4 Credits-60 Hours)

Objective: The students will learn about River systems and their fishery, Marine fishery, Fish yield and preservation, processing and marketing of fishes and their by products

Module I (40 hours)

Capture fishery: Fish catch statistics of the world special reference to India; Riverine Fisheries River systems in India, their ecology and fisheries (Ganga & Brahmaputra); Reservoir Fisheries: Development, Exploitation and management of Reservoirs with special reference to India – Dams and their effect on fish migration; Beel fisheries of Assam: Fish resources, problems and management; Cold water fisheries: Hill stream fisheries of North East India; Mahseer fisheries: prospects and problems with special reference to NE India;Major Estuaries of India and their fisheries; Brackishwater Fisheries: Chilka lake

Hilsa fishery – causes of decline and efforts for revival; Craft and Gear used in Fisheries : Traditional and mechanized boats and nets used in catching fish; Marine fish catch in India and fisheries of commercial importance; Coastal fisheries of India (Sardine & Mackerel fisheries); Population Dynamics : Fish populations and factors affecting the population structures ; Estimation of fish yield and control of over-fishing; Fishing crafts and gears used in Inland capture fisheries; Destructive fishing – its impact on fish diversity.

Module II (20 hours)

Post harvest technology and fish by-products: Preservation and processing: Methods of preservation of both finfish and shell fish preservation (Refrigeration and freezing, Drying, Salting, Smoking, Canning, Pickling, pasting and spicing)and associated problems; Rigor mortis and post-mortem changes.handling and packaging of fish for marketing; product stability and shelf -life

Fish By-products:Fish oils, Fish Proteins, Fish manure, Fish glue, Fish flour, Isinglass, Fish meal, Fish Silage, Fish guano, Bone meal; Production of fish sauce by lactic acid fermentation

Suggested Readings

1. Bal, D.V. and VeerabhadraRao, K. Marine Fisheries. IBH Publications
2. Balakrishnan, N. N. and Thampy, D. M.A textbook of marine ecology.
3. Beaven C R Handbook of the freshwater fishes of India (Narendra Publishing House)
4. Biswas K P A Text Book of Fish, Fisheries and Technology, (Narendra Publishing House)
5. Brody , Fishery by-products technology., AVI, Westport
6. Chandy, M. Fishes, National Book Trust, India;
7. EIRI Board.Hand Book Of Fish Farming & Fishery Products
8. Gopakumar, K., Singh, B.N. and Chitranshi, V.R. Fifty Years of Fisheries Research in India, Fisheries Division Indian Council of Agricultural Research, New Delhi.
9. Gupta S.K., Gupta P.C .General & Applied Ichthyology.S Chand & Company
10. Jayaram K. C. The fresh water fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka.
11. Jhingran V. G. Fish and Fisheries of India.
12. Jobling M Environmental Biology of Fishes (Chapmen and Hall)
13. Khanna S. S. and H. R. Singh. A textbook of Fish Biology and Fisheries, Narendra Publishing House,
14. Kreuzer, R., Fishery products., FAO, Fishing News Books Ltd., England
15. Krishnaveni, G., N.VeerabhdraRao and K.Veeranjaneyulu Recent Technologies in Fish and Fisheries.Rigi Publication
16. Lagler, K.F. Ichthyology. John Wiley Publication.
17. Nikolsky, G.V. Ecology of fishes. Academic Press.
18. Pandey.Fish and Fisheries.Rastogi Publications
19. Rao, K. L. India's water wealth.
20. Ravishankar Piska. Fisheries and Aquaculture. Lahari Publications, Hyderabad.

21. Ricker, W.E. 1984.Methods for assessment of fish production in freshwaters.Blackwell Publications.
22. Rounsfell, G.A. and Everhart, W.H. Fishery Science: it's Methods and Applications John Wiley & Sons,
23. Sachindra, N.M. & N.S. Mahendrakar. Fish Processing Byproducts: Quality Assessment And Application Studium press
24. Santhanam,R. Fisheries Science, Daya Publishing House, 1990.
25. Singh, B. A. Dey. Fish and Fisheries. Invincible Publishers
26. Srivastava, C.B.L. A Textbook of Fishery Science and Indian Fisheries, Kitab Mahal.
27. The Wealth of India, Raw Materials Vol. IV, Fish and Fisheries, CSIR, 1962

ZGLF0022: LIMNOLOGY, FISHERY ECONOMICS, ORNAMENTAL FISHERY AND FISH PATHOLOGY (4 Credits-60 Hours)

Objective: *The course will help the students to understand the principles of limnology and economics of fishery. The students will also develop knowledge on fish diseases and control*

Module I (15 hours)

Limnology: Physico-chemical factors of fresh water habitat; Nutrients – Availability, Seasonal distribution and availability of phosphorous, Nitrogen andSilicon; Ecological classification of freshwater organisms; Plankton – Distribution, seasonal variation in space and time, plaktonic migration, cyclomorphosis

Module II (15 hours)

Fishery economics: Larvivorous fishes in relation to public health; Yield and optimum catch; Exclusive Economic Zone (EFZ) and its strategy; Fisheries co-operatives and their role in fish production and marketing; Aquaculture and rural development in India; Fishery education, training and extension; Fishery research Institutes in India; Fishery legislation and their role in fishery development.

Module III (15 hours)

Ornamental fishery: Ornamental fish culture: Ornamental aquarium fishes, Breeding and care of fresh water aquarium fishes; Aquarium keeping — Design and construction of tanks; species-wise tank size requirement; heating, lighting, aeration and filtration arrangements; decorations; common aquarium plants and their propagation; Maintenance of Natural Colour of fishes in Aquarium.

Module IV (15 hours)

Fish pathology: Fish and Prawn/ Shrimp Diseases: Types of Diseases- viral, bacterial, fungal, protozoan and otherparasitic diseases; symptoms & control measures; Diagnosis - Histopathological methods; Immunoassay; Biochemical assay; Serological techniques; Role of biopesticides; Application of monoclonal antibodies; Vaccines and immune stimulants; Drug resistance.

Suggested Readings

1. Agarwal, S.C. Limnology
2. Bond, E. Carl. Biology of fishes.
3. Datta, J. J. DattaMunshi. Fundamentals of Limnology
4. Dholakia, A.D. Ornamental Fish Culture and Aquarium Management.Daya Publishing House
5. Edward,J. Noga. Fish Disease: Diagnosis & Treatment
6. Gerald, A. Textbook of Limnology. The C.V. Morby Co.
7. Hutchinson, G.E.A. Treatise on Limnology. Vol.1. John Wiley & Sons.
8. Kumar, Arvind. Fundamentals of Limnology.APH Publishing Corporation
9. Nikolsky, G.V. Ecology of fishes. Academic Press.
10. Ricker, W.E. Methods for assessment of fish production in freshwaters.Blackwell Publications.
11. Ruttner, F. Fundamentals of Limnology. University of Toronto Press, 1968.
12. Sharma Shailendra &Pawan Kumar Bharti. Limnology and Aquatic Science. Discovery publishing house
13. Smith David J. Aquarium Keeping: Aquarium Keeping Essentials

14. Thornton Kent W., Bruce L. Kimmel, Forrest E. Payne. Reservoir Limnology: Ecological Perspectives
15. Untergasser, D. Handbook of Fish Diseases. TFH Publications
16. Welch, P.S. Limnological Methods. McGraw Hill Book Company, New York.
17. Wetzel, Robert G. Limnology: Lake and River Ecosystems. Elsevier Academic Press

SPECIALIZATION IV: ANIMAL ECOLOGY AND WILDLIFE BIOLOGY

ZGRE0023: WILDLIFE RESOURCE MANAGEMENT AND ECONOMICS
(4 Credits-60 Hours)

Objective: The course is designed to equip students with a foundation for Natural Resource Management and Conservation

Module I (20 hours)

Species conservation: IUCN categories, criteria for allocation into different categories; Threatened animal species of India with special reference to NE India; Role of Iconic species designation in conservation; Concept and significance of conservation of Flagship (Target) species – Wildlife projects implemented in India; An overview of conservation problems and issues of fauna of Indian sub-continent.

Module II (15 hours)

Natural resource management and conservation: Introduction to forestry, principles of forest management, forest and wildlife as natural resources; Importance and performance of joint forest management (JFM) – Role of Non-government Organizations (NGO); Conservation movement in India, socio-economic and political realities; Concept of stakeholders; International conservation bodies: IUCN UNDP, FAO, WWF.

Environmental Laws, Environment Impact Assessment; Intellectual Property Right

Module III (5 hours)

Natural resource economics: Need for integrating environment and economics, cost and benefits of biodiversity conservation. Need for ecosystem service valuation.

Module IV (20 hours)

Population ecology: Demographic and life history parameters, evolution of life history parameters: r & K selection, allometry, aging and sexing, life tables, age and stage structures models, methods of estimation of life history parameters; Sampling designs for population estimation, population estimation methods: Distance based Sampling Methods, Mark-Recapture for Closed Population, Indices, and Estimation of Demographic parameters.

Suggested Readings

1. Caughley G (1978). Analysis Of Vertebrate Populations. John Wiley, Chichester.
2. Hastings A (1997). Population Biology: Concepts And Models. SpringerVerlag, New York.
3. Neal D (2004). Introduction to population biology. Cambridge University Press. UK
4. Ricklefs R (2010). The Economy of Nature (6 edition). W. H. Freeman
5. Tokeshi M (1998). Species Coexistence: Ecological and Evolutionary Perspectives.
6. W.J.Ecological Census Techniques Cambridge University Press
7. Patro, L. Biodiversity Conservation and Management
8. Misra, H.N. – Managing Natural Resources- Focus on Land and Water
9. Anderson, Sweeney and Williams- Wildlife and Natural Resource Management
10. Deal, K.H. Environmental Economucs and Natural Resource Management
11. Kumar, R. Environmental Laws
12. Muthukrishna- Natural Resource Economics
13. Field, B.C. Economics of Environment
14. Began, M. & Mortimer, M.- Population Ecology
15. Rockwood- Introduction to population Ecology

ZGWC0024: WILDLIFE HEALTH, FORENSICS AND CONFLICT

(4 Credits-60 Hours)

Objective: To develop skills in understanding the wildlife health management, To understand the concept of Wildlife Forensics, To develop an understanding of the theoretical perspectives in the area of Human Animal Conflicts

Module I (20 hours)

Wildlife Health: Introduction to disease and epizootiology; Determinants of disease and disease transmission, Disease and population dynamics; Review of major viral, bacterial, protozoan, fungal and parasitic diseases of Indian wild mammals, birds, amphibians and reptiles; Assessment of condition, health and nutritional status in free-ranging populations; Disease control operations, Planning and management of wildlife health programmes

Module II (15 hours)

Capture and handling of wild animals: Capture and handling of animals - purpose, restraint techniques, different capture methods and animal barriers; Drug immobilization - drug delivery equipment and accessories; Handling and transport of wild animals, designing sledge, crate and holding enclosures

Module III (15 hours)

Conservation Genetics and Wildlife Forensics: Introduction to Bio-molecules-DNA, RNA and Proteins; Molecular markers; PCR, DNA Sequencing, Genotyping; Allelic variation; Interpretation of genetic data; Application of genetics for wildlife conservation; Loss of genetic diversity; Wildlife Forensics- Overview, various forensic protocols for species identification, Molecular markers used in wildlife forensics; Wildlife forensics based on morphometry and DNA analysis

Module IV (10 hours)

Human-wildlife conflict: Causes and management; Impact on ecosystem, lives and livelihood of human; Ecotourism: problems and prospects with special reference to northeast India.

Suggested Readings

1. Fowler- Restraint and Handling of wild and Domestic Animals
2. Briscoe, Ballou and Frankhan- Introduction to Conservation Genetics
3. Leeschcke, Temivk and Jain – Conservation Genetics
4. Frankhan, Ballou and Briscoe- Primer of Conservation Genetics
5. Cooper and Cooper- Wildlife Foresnsic Investigations
6. Huffman and Wallacw- Wildlife Forensics – Methods & Applications
7. Sahaipal, Thakar & Goyal – Forensic Examination of Hair of Protected Indian Wildlife Species
8. Linacre and Tobe- Wildlife DNA analysis
9. Rao, G. Textbook on pathology of Wildlife Diseases
10. Jani, R. Basic of Wildlife Health Care Management
11. Ayadi, D.P. Human Wildlife Conflict
12. Wang, J. Human Wildlife Conflict management: Understanding the Fundamentals of Human Wildlife Conflicts in Human Dominated Landscape

ZGBT6001: BIOSYSTEMATICS AND TAXONOMY LAB

(2 credits)

1. Collection, preservation, curation and identification of non-chordate and chordate species (only pest and cultured species)
2. Taxidermy of fish/rat/pigeon/fowl
3. Identification with only diagnostic features (specimen or model/diagnostic photograph)
   a) Spongilla, one coelenterate, Ascaris (male & Female), Fasciola, Taenia, Earthworm, Leech, Julus, King crab, spider, crab, prawn, cricket, leaf insect, stick insect, beetle, butterfly, grasshopper, termite, Pila, sepia, Achitina, Slug, Echinodermata

b) Puntius, Labeo, Cyprinus, Ctenopharyngodon, Hypopthalmichthys, Cirrihinus, Clarius, Anabas, Anguilla, Mystus, Mastocembalus, Hoplobatrachus, Polypedates, Rhacophorus, Euphlictys, Fejervarya, Moina, sparrow, Parrot, rabbit, Duckbill platypus, Bat, monkey, whale/dolphin

4. Survey and application of biodiversity indices on animal species (any one group)
5. Calculation of Pearson correlation coefficient, T test (One sample t-test, Two sample t-test, Paired t-test); Chi square test, ANOVA, Mann-Whitney test on supplied data.
6. Preparation of Taxonomic key, study of evolution through models/charts.
7. Representatives of Reptile viz. Xenochrophis, Amphiesma, Hemidactylus, Calotes and Chelonia

ZGBG6002: CELL BIOLOGY, GENETICS, PHYSIOLOGY AND BIOCHEMISTRY LAB

(2 credits)

1. Safety measures in labs: general safety measures, personal protection, chemical and other hazards, spillage, acid fume, waste disposal; Use and care and maintenance of common lab equipment (microscope, colorimeter/spectrophotometer, balance, pH meter, oven, incubator, microtome, electrophoretic apparatus, centrifuge, water bath etc.) and glass wares.
2. Study of structural arrangement of plasma membrane using model/chart.
3. Identification of various stages of mitosis and meiosis from prepared slides
4. Temporary squash preparation of onion root-tip/tadpole tail-tip cells to study stages of mitosis and Grasshopper/ Gryllotalpa testis to study meiotic stage of cell division.
5. Preparation of buffers of different pH using Henderson-Hasselbalch equation and its verification using pH meter.
6. Comparison of RBC and WBC in different groups of Vertebrate.
7. Quantitative estimation of amino acid using ninhydrin reagent.
8. Quantitative estimation of total protein by Lowry method.
9. Estimation of glucose in serum by glucose oxidase-peroxidase method/ tissue by Anthrone reagent
10. Micronuclei assay from blood cells to study genotoxicity.
11. Isolation of DNA from animal source.
12. Agarose gel electrophoresis of isolated genomic DNA.

ZGDB6003: DEVELOPMENTAL AND ENVIRONMENTAL BIOLOGY LAB

(2 Credits)

1. In vivo/in vitro culture and study of chick embryo.
2. Isolation of chick embryo and preparation of whole mount.
3. Study of developmental stages of Chick/Frog embryo from permanent slides.
4. Study of Chick/Frog embryo using vital staining.
5. Study of different stages of estrous cycle in mice.
6. Dissection of male/female reproductive system of cockroach.
7. Estimation of CO_2, DO, Nitrites, total alkalinity and hardness of water sample.
8. Study of zooplanktons and its role in a pond ecosystem.
9. Analysis of physical parameters of soil.
10. Study of different types of survey techniques
11. Field Visit.

ZGPR6004: PROJECT MANAGEMENT, REPORTING AND DOCUMENTATION

(2 Credits)

Objective: This course, which will be conducted as a short-term workshop, is designed to help the students to prepare a project proposal, learn the techniques of handling a project and prepare reports.

Objective	Help the student to understand Entrepreneurship, identification of qualities of a successful entrepreneur & how to develop it
Module	Entrepreneurship : Concept and Functions
Content	● Who is an entrepreneur? ● Entrepreneurial competencies(Initiative, Creativity and Innovation, Risk Taking and Risk Management, Problem Solving, Leadership, Persistence, Quality Performance, Information Seeking, Systematic Planning, Persuasion and Influencing Others, Enterprise Launching Competencies, Enterprise Management Competencies) ● Functions of an entrepreneur (Promotional functions: Innovation, Risk-taking, Organisation Building, Discovery of an idea, Detailed Investigation, Assembling the Requirements, Financing the Proposition. Managerial functions: Planning, Organizing, Staffing, Leadership, Supervision, Communication, Motivation, Controlling. Commercial Functions : Production, Finance, Marketing, Accounting) ● Types of entrepreneur (Innovative Entrepreneur, Imitative Entrepreneur, Fabian Entrepreneurs, Drone Entrepreneurs) ● Entrepreneurship: meaning and definition; types of entrepreneurship; entrepreneur and entrepreneurship ● Difference between entrepreneur and employee
Objective	Help the students to generate various business ideas and link the best one with them
Module	Generation of business ideas and linking
Contents	● EDP: Meaning, Need, Importance of EDP ● Necessity of generating ideas ● Ways to generate ideas, Area Assessment Survey – Modes (Desk Research, Field Work, Market Need Based Opportunities, Ideas from Existing Entrepreneurs) ● Methodology of Opportunity Identification & Profiling Business Ideas (Preparation of Personal Profile, Development of OS (decision making) Framework, Snap Investigation of ideas generated, Evaluation in terms of OS (decision making) Framework and Short-listing of Ideas, Pre-feasibility Studies, Errors in Selection, Final Opportunity Selection) ● Linking business ideas with the entrepreneur ● Preparation of business project plan and business project plan execution (Summary of the Project/Project at a Glance, General Information, Details of the Proposed Project, Market Potential, Manufacturing Process, Production Programme/Sales Revenue, Cost of Manufacturing and Profitability Projections)
Objective	To impart knowledge on social entrepreneurship
Module	Social entrepreneurship
Contents	● Who is a social entrepreneur (definition and case study) ● Difference between entrepreneurship and social entrepreneurship ● Characteristics of social entrepreneur (Social Catalysts, Socially aware, Opportunity-seeking, Innovative, Resourceful, Accountable) ● Examples and case study
Objective	To impart knowledge on preparation of DPR
Module	Preparation of Detailed Project Report (DPR) and financials of a DPR
	● Business plan : key questions ● Technical arrangement & Production process (Manufacturing process, Sources of technical know how, plant & machinery, Supplier identification & supplier selection, Raw materials, packaging, land requirement, utilities and manpower, financial viability) and Location selection (Layout, built up area etc)

Content	● Product and Market (Product description, Capacity, Market study and market demand, Product mix, Branding, Channels of distribution, Advertising and Promotion etc.) ● Project cost and means of finance (Land, site development, building and civil works, plant and machinery cost, other fixed assets, technical knowhow fees, preliminary and preoperative expanses, working capital margin, contingency and escalation) ● Income analysis (Capital utilisation and income estimate, Expenditure estimate, Profit estimate, income tax estimate, profitability ratios : TC ratio, cash flow estimate, risk analysis, sensitivity analysis etc.)
Objective	Impart knowledge on implementing, managing and monitoring the progress of the selected project
Module	Project implementation and management
Contents	● Understanding Total Quality Management (Acceptable Quality Level, Benchmarking, Deming Wheel, ISO 9000,Pareto Analysis, Quality Circles, Measures of Central Tendency and Dispersion, Geometric Moving Average, Statistical Process Control etc.) ● Goal Oriented Project Planning (Project Planning Matrix and Product Matrix) ● Project Activity Planning and Implementation (Gantt Charts, the Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM) of project scheduling) ● Soft skills for launching and managing a project (Creativity and Problem Solving, Interpersonal Communication, Persuasion and Use of Influence Strategy, Negotiation and Networking, Delegation of Authority and Work Effort, Efficiency Orientation As a Trait, Leadership, Concept of risk and risk taking, Legal Requirements, Types of business organisation) ● Managing Business Crisis – Starting and Liquidity Crisis
Objective	To impart the Knowledge of different component of Market
Module	Concept of market
Content	● Traditional market ● Emerging market : E commerce ● Analysing the market environment 4 ● Researching the market and market survey ● Marketing mix ● Product mix ● Promotion mix ● Price mix, method of pricing
Objective	To impart knowledge on Book Keeping
Module	Book keeping and Accountancy

	● Basic concept of Accounting (Management and financial accounting)
	● Basic books of accounts (Journal, Purchase book, Purchase return book, Sales book, Sales return book, ledger book, Cash book etc.)
	● Financial statement: Meaning, Importance
	  ○ Profit and loss account
	  ○ Balance sheet
	  ○ Depreciation and adjustment etc.
	● Interpretation of financial Statement (Liquidity, Current ratio, Profitability ratio, Inventory turnover ratio, Debtors turnover ratio, ROI etc)
	● Fund flow Analysis

Objective	To impart knowledge on Documentation and Reporting
Module	Documentation and Reporting
Content	Why to Document
	What is a Documentation Report
	When and How to prepare the Documentation Report
	Typical format of a Documentation report
	Layout of the Report
	Writing a Report

ZGSL6005: SPECIALIZATION LAB I

INSECT MORPHOLOGY, BIOCHEMISTRY AND ECONOMIC IMPORTANCE LAB
(2 Credits)

1. Study of insect collection and preservation
2. Study of different types of mouth parts
3. Study of different types of antenna
4. Study of different types of legs
5. Preparation of arolium, empodium and pollen basket
6. Preparation and identification of haemocytes, quantitative count of haemocytes.
7. Detection of chitin in insect cuticle
8. Detection of Uric acid in insects
9. Estimation of protein from haemolymph of insects.
10. Identification of Pests (Tea , Jute, Paddy stored grain)
11. Identification of insects of forensic importance and forest defoliator
12. Identification of Conservation importance insects(Butterfly, Honeybee and beetles)
13. Identification and anatomical studies of major vector species of Anopheles, Culex and Ades

CYTOLOGY AND IMMUNOLOGY LAB
(2 Credits)

1. Use of occulometer-standardization and measurements of cell height, nuclear diameters and tabular diameters
2. Use of occular grid- standardization and counting of cells or nuclei in cross section or epithelium
3. Demonstration of the use of different microscopes: Phase contrast microscope, fluorescence microscope and electron microscope.
4. Histology of biological tissues and sectioning by microtome
5. Preparation of salivary gland chromosomes from Drosophila /Chironomous larva and stain with acetocarmine/aceto-orcein/fuelgen
6. Preparation of mammalian chromosomes from bone marrow or testis and stain with Giemsa stain
7. Determination of pK value of buffer
8. Determination of relationship between absorption and various concentration of a solution using a colorimeter, spectrocolorimeter/spectrophotometer.
9. Preparation of standard curve for proteins, lipids and carbohydrates
10. Quantization of enzymes: End point techniques (alkaline and acid phosphatase) and Substrate - left over technique (LDH)
11. Permanent Slides: Types of cells (squamous, cuboidal, columnar epithelial cells, blood cells, nerve cells, muscle cells), connective tissues of various types, adipose tissue, mitotic & meiotic chromosomes and their different phases.
12. Preparation of emulsions- syringe method and hubbed needle method
13. Immunization routes: Intradermal, Subcutaneous, Intramuscular, Intraperitoneal, Intravenous, Foot Pad
14. Bleeding Schedules and collection of blood: Bleeding from ear, retro-orbital, cardiac puncture, branchial vein, external jugular vein
15. Separation and preservation of serum: Liquid Storage using preservative and by sterilization.

FISH TAXONOMY AND FISH HEALTH
2 Credits

1. Identification of commercially important fish species of northeast India representing all fish groups
2. Fish osteology — Alizarin preparation of fish skeleton.
3. Biological Analysis of fish samples for gut contents, maturity stages and fecundity
4. Dissecting out the pituitary gland and preparing the extract
5. Determination of length-weight analysis in fishes.
6. Determination of absolute and relative fecundity in fishes.

7. Determination of gonadosomatic index (GSI), hepatosomatic index (HSI), condition factor (CF), and fecundity.
8. External characters, types of scales, fins, types of teeth, structure of alimentary canal, gill rackers.
9. Visit to fish landing centre and fish farms and make Reports of visit

PLANT AND ANIMAL DIVERSITY & CONSERVATION

2 Credits

1. Identification of species of butterfly, fishes, amphibia, reptilia, aves and mammalia from collection/ model/photographs etc.
2. Identification of fish, amphibian and reptiles (local fauna) using Morphometric land marks
3. Mapping distribution of endangered animal fauna of northeast India
4. Study of nearby protected areas (forests and grasslands) under various management regimesand make a report
5. Time and Activity budgeting
6. Demonstration and uses of equipments-traps, remote drug delivery equipments, tags, collars, radio tracking equipment
7. Systematic study of common plants, Field and Herbarium techniques, Study of resident flora, Status of litter layer in various areas in the campus, Study of successional stages of various forest communities.
8. Measuring diversity using Diversity (Shannon Winner Index, Brillouin's index, simpson index) dominance (Simpson dominance index), species richness & refraction, similarity (Morisita'sindex,Sorenson's coefficient) & dissimilarity (Bray-Curtis) indices, Association index (Test of independence of attributes ,Chi square; Sorenson's andDice index, Jacard index, Ochiai index), comparing communities (Jaccard's index)

ZGPL6008: SPECIALIZATION LAB II

INSECT ANATOMY AND LIFE HISTORY

(2 Credits)

1. Histological study of foregut, midgut and hindgut of insect.
2. Reproductive system of cockroach
3. Prothoracic gland of cockroach
4. Alimentary canal of house fly with crop
5. Bacterial chamber of termite
6. Salivary gland of Cockroach
7. Pharyngeal, labial and thoracic salivary gland of honey bee
8. Sting apparatus of honey bee
9. Identification of aquatic, terrestrial and boring insects with specific adaptive characteristics.
10. Visit to agricultural field/tea garden and forest for on spot study of pest and damage caused by them
11. Preparation of Phylogenetic tree of Insect species
12. Study of Lifecycle of Mosquito, Housefly, Drosophila
13. Collection and identification of economically important insects and various stages of their life history.

CYTOCHEMISTRY AND IMMUNOLOGICAL TECHNIQUES LAB

(2 Credits)

1. Tissue homogenization and fractionation by differential centrifugation for isolation of mitochondria, nuclei and cytosol
2. Separation of proteins and DNA by agarose electrophoresis
3. Separation of proteins and isoenzymes on SDS-PAGE and PAGE
4. Electroeluting of proteins, DNA/RNA from electrophoretic gels
5. Separation of amino acids by paper chromatography
6. Separation of phospholipids by TLC
7. Separation of hemoglobin by column chromatography

8. Detection of Carbohydrate (a) PAS method (b) Alcian blue method
9. Detection of Proteins (a) Mercury bromophenol blue method (b) Ninhydrin method
10. Detection of Lipids (a) Phosphomolybic acid method (b) Copper phthalocynin n method
11. Detection of Nucleic acid (a) Feulgen method (b) Methyle green- Pyronin method.
12. Isolation of lymphocytes from sensitized animals from spleen, lymph nodes and from human blood-rossette formation
13. Purification of antibodies and antigens: (a) Insolubilization of antibodies and antigenic proteins using gluteraldehydates (b) Immuno-adsorption (c) Dissociation of absorbed material from immuno-adsorbents
14. Quantization of antibodies: (a) Precipitation techniques (b) Immunodiffusion method (c) Immunoelectrophoresis method
15. Immunoassay: Demonstration of the use of ELISA

LIMNOLOGY AND FISHERY

2 credits

1. Analysis of water samples for various physico-chemical parameters – pH, free CO_2,dissolved oxygen, alkalinity, chloride, hardness, nitrates, phosphates, BOD, COD
2. Estimation of primary productivity by light and dark method.
3. Composition and biomass of phytoplankton, Collection, enumeration and biomass of Zooplankton
4. Identification of important fish parasites (external and internal).
5. Identification of fishing gears and fish byproducts.
6. Fieldwork : Visit to freshwater bodies, study of physico-chemical and biological status and make a report
7. Visit to fish processing centers and make a report.

TECHNIQUES IN WILDLIFE STUDY

2 Credits

1. Ecological census techniques: mark recapture; point and line transects, belt transect, plot-less & quadrate samplings. Pug mark census, camera trap census; pellet group count
2. Animal sign & marks analysis
3. Scat/ Dung analysis: (parasite identification)
4. Analysis of Abundance Data
5. Preparation of conservation statements applicable to the state of Assam-through review of literature.
6. Extraction of DNA from biological sample, PCR amplification
7. Habitat (habitat suitability index), measuring habitat fragmentation (index of habitat proximity)
8. Canopy (cover &closer), leaf litter and ground cover measurements
9. Acoustic analysis of birds /amphibians

ZGIP6007: INTRODUCTION TO JOURNALISM AND PHOTOGRAPHY

2 Credits

Objective: This course, which will be conducted as a short-term workshop, is designed to help the students with hands on experiences in journalism and photography.

ZGTM6010: TEACHING METHODOLOGY AND CLASS ROOM MANAGEMENT

2 Credits

Objective: This course, which will be conducted as a short-term workshop, is designed to help the students to prepare for efficient teaching with skills of class room management.

Our Vision

"To mould intecllectually 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."

ASSAM DON BOSCO UNIVERSITY

Tapesia Gardens, Kamarkuchi Village | Airport Road, Azara
Sonapur - 782402 | Guwahati - 781017, Assam

+91 9435545754, 8011403982, 9476690950
www.dbuniversity.ac.in, contact@dbuniversity.ac.in