FACULTY OF SCIENCE

DEPARTMENT OF ZOOLOGY

M.Sc., ZOOLOGY
(FIVE YEARS INTEGRATED PROGRAMME)
PROGRAMME CODE : SZOO51

HAND BOOK
2019-2020
(Onwards)
These Regulations are common to all the students admitted to the Five Year Integrated Master’s Programmes in the Faculties of Arts, Science, Languages, Marine Sciences and Education from the academic year 2019-2020 onwards.

1. Definitions and Nomenclature

1.1 University refers to Annamalai University.

1.2 Department means any of the academic departments and academic centres at the University.

1.3 Discipline refers to the specialization or branch of knowledge taught and researched in higher education. For example, Botany is a discipline in the Natural Sciences, while Economics is a discipline in Social Sciences.

1.4 Programme encompasses the combination of courses and/or requirements leading to a Degree. For example, M.A., M.Sc.

1.5 Course is an individual subject in a programme. Each course may consist of Lectures/Tutorials/Laboratory work/Seminar/Project work/Experiential learning/Report writing/viva-voce etc. Each course has a course title and is identified by a course code.

1.6 Curriculum encompasses the totality of student experiences that occur during the educational process.

1.7 Syllabus is an academic document that contains complete information about an academic programme and defines responsibilities and outcomes. This includes course information, course objectives, policies, evaluation, grading, learning resources and course calendar.

1.8 Academic Year refers to the annual period of sessions of the University that comprises two consecutive semesters.

1.9 Semester is a half-year term that lasts for a minimum of 90 working days. Each academic year is divided into two semesters.

1.10 Choice Based Credit System A mode of learning in higher education that enables a student to have the freedom to select his/her own choice of elective courses across various disciplines for completing the Degree programme.

1.11 Core Course is mandatory and an essential requirement to qualify for the Degree.
1.12 **Elective Course** is a course that a student can choose from a range of alternatives.

1.13 **Value Added Courses** are optional courses that complement the students’ knowledge and skills and enhance their employability.

1.14 **Experiential Learning** is a process of learning through experience. It is specifically defined as “learning through reflection on doing”.

1.15 **Extension activities** are the activities that provide a link between the University and the community such as lab-to-land, literacy, population education, and health awareness programmes. These are integrated within the curricula with a view to sensitise the students about Institutional Social Responsibility (ISR).

1.16 **Credit** refers to the quantum of course work in terms of the number of class hours in a semester required for a programme. The credit value reflects the content and duration of a particular course in the curriculum.

1.17 **Credit Hour** refers to the number of class hours per week required for a course in a semester. It is used to calculate the credit value of a particular course.

1.18 **Programme Outcomes (POs)** are statements that describe crucial and essential knowledge, skills, and attitudes that students are expected to achieve and can reliably manifest at the end of a programme.

1.19 **Programme Specific Outcomes (PSOs)** are statements that list what the graduate of a specific programme should be able to do at the end of the programme.

1.20 **Learning Objectives (also known as Course Objectives)** are statements that define the expected goal of a course in terms of demonstrable skills or knowledge that will be acquired by a student as a result of instruction.

1.21 **Course Outcomes (COs)** are statements that describe what students should be able to achieve/demonstrate at the end of a course. They allow follow-up and measurement of learning objectives.

1.22 **Grade Point Average (GPA)** is the average of the grades acquired in various courses that a student has taken in a semester. The formula for computing GPA is given in Section 11.3.

1.23 **Cumulative Grade Point Average (CGPA)** is a measure of the overall cumulative performance of a student in all the semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters.

1.24 **Letter Grade** is an index of the performance of a student in a particular course. Grades are denoted by the letters S, A, B, C, D, E, and RA.

2. **Programmes Offered and Eligibility Criteria**

The Integrated Programme offered by the University and the eligibility criteria are detailed below.

| M.Sc. Zoology | A pass in H.S.E. (10+2 level) OR Equivalent thereto with a minimum aggregate of 40% marks under academic stream in the following subjects viz. Physics, Chemistry and Biology or Zoology and Botany. |
2.1 **In the case of SC/ST and Differently-abled candidates, a pass is the minimum qualification for all the above Programme.**

3. **Reservation Policy**  
   Admission to the various programme will be strictly based on the reservation policy of the Government of Tamil Nadu.

4. **Programme Duration**  
4.1 The Five Year Master’s Programme consist of five academic years and ten semesters.  
4.2 Each academic year is divided into two semesters, the first being from July to November and the second from December to April.  
4.3 Each semester will have 90 working days (18 weeks).

5. **Programme Structure**  
5.1 The Five Year Integrated Programme consists of Language Courses, Core Courses, Allied Courses, Elective Courses, Soft Skills, Experiential Learning and Project. Students shall also participate in Extension Activities as part of their curriculum.

5.2 **Language Courses**  
5.2.1 Each student shall take two languages of four courses each, one in each semester for the first two years of the programme.

5.2.2 Language-I shall be Tamil or another language such as Hindi or French.

5.2.3 Language-II shall be English.

5.3 **Core courses**  
5.3.1 These are a set of compulsory courses essential for each programme.

5.3.2 The core courses include both Theory (Core Theory) and Practical (Core Practical) courses.

5.4 **Allied Courses**  
5.4.1 Each student shall take courses in two disciplines allied to the main subject (Allied-I and Allied-II) of the programme in the first four semesters.

5.4.2 In Arts, Languages, and Education, there will be three Theory Courses each for Allied-I and Allied-II.

5.4.3 In Science and Marine Sciences, there will be two Theory courses and one Practical course each for Allied-I and Allied-II.

5.5 **Elective Courses**  
5.5.1 **Departmental Electives (DEs)** are the electives that students can choose from a range of Electives offered within the Parent Department offering the Programme.

5.5.2 **Interdepartmental Electives (IDEs)** are electives that students can choose from amongst the courses offered by other departments of the same faculty as well as by the departments of other faculties.
5.5.3 Students shall take a combination of both DEs and IDEs.

5.6 Soft Skills

5.6.1 Soft skills are intended to enable students to acquire attributes that enhance their performance and achieve their goals with complementing hard skills.

5.6.2 Soft skills include communication skills, computer skills, social skills, leadership traits, teamwork, development of emotional intelligence quotients, among others.

5.6.3 Each student shall choose four courses on soft skills from a range of courses offered from the First to the Sixth Semester.

5.7 Value Education

All students shall take a course on Value Education that includes human values, sustainable development, gender equity, ethics and human rights.

5.8 Experiential Learning

5.8.1 Experiential learning provides opportunities to students to connect principles of the discipline with real-life situations.

5.8.2 In-plant training/field trips/internships/industrial visits (as applicable) fall under this category.

5.9 Extension Activities

5.9.1 It is mandatory for every student to participate in extension activities.

5.9.2 All the students shall enrol under NSS/NCC/YRC/RRC or any other Service Organisation in the University.

5.9.3 Students shall put in a minimum attendance of 40 hours in a year duly certified by the Programme Co-ordinator.

5.9.4 Extension activities shall be conducted outside the class hours.

5.10 Project

5.10.1 Each student shall undertake a Project in the final semester.

5.10.2 The Head of the Department shall assign a Project Supervisor to the student.

5.10.3 The Project Supervisor shall assign a topic for the project and monitor the progress of the student periodically.

5.10.4 Students who wish to undertake project work in recognised institutions/industry shall obtain prior permission from the University. The Project Supervisor will be from the host institute, while the Co-Supervisor shall be a faculty in the parent department.

5.11 Value Added Courses (VACs)

5.11.1 Students may also opt to take Value Added Courses beyond the minimum credits required for the award of the Degree. VACs are outside the normal credit paradigm.
5.11.2 VACs enhance the students' employability and life skills. VACs are listed on the University website and in the Handbook on Interdepartmental Electives and VACs.

5.11.3 Each VAC carries 2 credits with 30 hours of instruction, of which 60% (18 hours) shall be Theory and 40% (12 hours) Practical.

5.11.4 Classes for VACs are conducted beyond the regular class hours and preferably in the VIII and IX Semesters.

5.12 Online Courses
5.12.1 The Heads of Departments shall facilitate enrolment of students in Massive Open Online Courses (MOOCs) platform such as SWAYAM to provide academic flexibility and enhance the academic career of students.

5.11.2 Students who successfully complete a course in the MOOC platform shall be exempted from one elective course of the programme.

5.12 Credit Distribution
The credit distribution is detailed in the Table.

<table>
<thead>
<tr>
<th>Semester I to VI</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language-I (Tamil or any other Language)</td>
<td>12</td>
</tr>
<tr>
<td>Language-II (English)</td>
<td>12</td>
</tr>
<tr>
<td>Core Courses</td>
<td>60-65</td>
</tr>
<tr>
<td>Allied-I</td>
<td>10</td>
</tr>
<tr>
<td>Allied-II</td>
<td>10</td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
</tr>
<tr>
<td>Soft skills</td>
<td>12</td>
</tr>
<tr>
<td>Environmental studies (UGC mandated)</td>
<td>2</td>
</tr>
<tr>
<td>Value Education</td>
<td>2</td>
</tr>
<tr>
<td>Experiential learning</td>
<td>4</td>
</tr>
<tr>
<td>Extension activities</td>
<td>1</td>
</tr>
<tr>
<td>Total Credits (Semester I to VI)</td>
<td>140-145</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester VII to X</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>65-75</td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
</tr>
<tr>
<td>Project</td>
<td>6-8</td>
</tr>
<tr>
<td>Total Credits (Semester VII to X)</td>
<td>90-95</td>
</tr>
<tr>
<td>Total Credits Semester I to X (Minimum requirement for the award of Degree)</td>
<td>*230-240</td>
</tr>
</tbody>
</table>
*Each Department shall fix the minimum required credits for award of the Degree within the prescribed range of 230-240 credits.

5.13 Credit Assignment
Each course is assigned credits and credit hours on the following basis:
1 Credit is defined as
1 Lecture period of one hour per week over a semester
1 Tutorial period of one hour per week over a semester
1 Practical/Project period of two or three hours (depending on the discipline) per week over a semester.

6 Attendance
6.1 Each faculty handling a course shall be responsible for the maintenance of Attendance and Assessment Record for students who have registered for the course.
6.2 The Record shall contain details of the students’ attendance, marks obtained in the Continuous Internal Assessment (CIA) Tests, Assignments and Seminars. In addition the Record shall also contain the organisation of lesson plan of the Course Instructor.
6.3 The record shall be submitted to the Head of the Department once a month for monitoring the attendance and syllabus coverage.
6.4 At the end of the semester, the record shall be duly signed by the Course Instructor and the Head of the Department and placed in safe custody for any future verification.
6.5 The Course Instructor shall intimate to the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students.
6.6 Each student should earn a minimum of 75% attendance in the courses of the particular semester failing which he or she will not be permitted to write the End-Semester Examination. The student has to redo the semester in the next year.
6.7 Relaxation of attendance requirement up to 10% may be granted for valid reasons such as illness.

7 Mentor-Mentee System
7.1 To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as a Mentor throughout their period of study.
7.2 The Mentors will guide their mentees with the curriculum, monitor their progress, and provide intellectual and emotional support.
7.3 The Mentors shall also help their mentees to choose appropriate electives and value-added courses, apply for scholarships, undertake projects, prepare for competitive
examinations such as NET/SET, GATE etc., attend campus interviews and participate in extracurricular activities.

8. **Examinations**

8.1 The examination system of the University is designed to systematically test the student's progress in class, laboratory and field work through Continuous Internal Assessment (CIA) Tests and End-Semester Examination (ESE).

8.2 There will be two CIA Tests and one ESE in each semester.

8.3 The Question Papers will be framed to test different levels of learning based on Bloom’s taxonomy, viz. Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation/Creativity.

8.4 **Continuous Internal Assessment Tests**

8.4.1 The CIA Tests shall be a combination of a variety of tools such as class tests, assignments, seminars, and viva-voce that would be suitable for the course. This requires an element of openness.

8.4.2 The students are to be informed in advance about the assessment procedures.

8.4.3 The pattern of question paper will be decided by the respective faculty.

8.4.4 CIA Test-I will cover the syllabus of the first two units while CIA Test-II will cover the last three units.

8.4.5 CIA Tests will be for one to three hours duration depending on the quantum of syllabus.

8.4.6 A student cannot repeat the CIA Test-I and CIA Test-II. However, if for any valid reason, the student is unable to attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

8.5 **End Semester Examinations (ESEs)**

8.5.1 The ESEs for the odd semester will be conducted in November and for the even semester in May.

8.5.2 A candidate who does not pass the examination in any course(s) will be permitted to reappear in such course(s) in the subsequent semester/year.

8.5.3 The ESE will be of three hours duration and will cover the entire syllabus of the course.

9 **Evaluation**

9.1 **Marks Distribution**
9.1.1. Each course, both Theory and Practical as well as Project/Internship/Field work/In-plant training shall be evaluated for a maximum of 100 marks.

9.1.2 For the theory courses, CIA Tests will carry 25% and the ESE, 75% of the marks.

9.1.3 For the Practical courses, the CIA Tests will constitute 40% and the ESE 60% of the marks.

### 9.2. Assessment of CIA Tests

9.2.1 For the CIA Tests, the assessment will be done by the Course Instructor

9.2.2 For the Theory Courses, the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I &amp; Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Seminar</td>
<td>5</td>
</tr>
<tr>
<td>Assignment</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
</tr>
</tbody>
</table>

9.2.3 For the Practical Courses (wherever applicable), the break-up of marks shall be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-I</td>
<td>15</td>
</tr>
<tr>
<td>Test-II</td>
<td>15</td>
</tr>
<tr>
<td>Viva-voce and Record</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
</tr>
</tbody>
</table>

### 9.3 Assessment of End-Semester Examinations

9.3.1 Double Evaluation for the ESE is done by the University Teachers.

9.3.2 In case of a discrepancy of more than 10% between the two examiners in awarding marks, third evaluation will be resorted to.

### 9.4 Assessment of Project/Dissertation

9.4.1 The Project Report/Dissertation shall be submitted as per the guidelines laid down by the University.

9.4.2 The Project Work/Dissertation shall carry a maximum of 100 marks.

9.4.3 CIA for Project will consist of Review of literature, experimentation/field work, attendance etc.

9.4.4 The Project Report evaluation and viva-voce will be conducted by a committee constituted by the Head of the Department.

9.4.5 The Project Evaluation Committee will comprise of the Head of the Department, Project Supervisor, and a senior faculty.
9.4.7 The marks shall be distributed as follows:

<table>
<thead>
<tr>
<th>Continuous Internal Assessment (25 Marks)</th>
<th>End Semester Examination (75 Marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review-I 10</td>
<td>Project / Dissertation Evaluation</td>
</tr>
<tr>
<td>Review-II: 15</td>
<td>Viva-voce</td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

9.5 Assessment of Value Added Courses
9.5.1 VACs shall be evaluated completely by Internal Examiners.
9.5.2 Two CIA Tests shall be conducted during the semester by the Department(s) offering VAC.
9.5.3 A committee consisting of the Head of the Department, faculty handling the course and a senior faculty member shall monitor the evaluation process.
9.5.4 The grades obtained in VACs will not be included for calculating the GPA.

9.6 Passing Minimum
9.6.1 A candidate is declared to have passed in each course if he/she secures not less than 40% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.
9.6.4 A candidate who has not secured a minimum of 50% of marks in a course (CIA + ESE) shall reappear for the course in the next semester/year.

10. Conferment of the Master’s Degree
A candidate who has secured a minimum of 50% marks in all courses prescribed in the programme and earned the minimum required credits shall be considered to have passed the Master’s Programme.

11. Marks and Grading
11.1 The performance of students in each course is evaluated in terms of Grade Point (GP).
11.2 The sum total performance in each semester is rated by Grade Point Average (GPA) while Cumulative Grade Point Average (CGPA) indicates the Average Grade Point obtained for all the courses completed from the first semester to the current semester.
11.3 The GPA is calculated by the formula

\[
GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}
\]

where, \( C_i \) is the Credit earned for the Course in any semester;
is the Grade Point obtained by the student for the Course and

is the number of Courses passed in that semester.

11.4 **CGPA** is the Weighted Average Grade Point of all the Courses passed starting from the first semester to the current semester.

\[
CGPA = \frac{\sum_{i=1}^{m} \sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{m} \sum_{i=1}^{n} C_i}
\]

where, \( C_i \) is the Credit earned for the Course in any semester; is the Grade Point obtained by the student for the Course and

is the number of Courses passed in that semester.

is the number of semesters.

11.5 Evaluation of the performance of the student will be rated as shown in the Table.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Points</th>
<th>Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>10</td>
<td>90 and above</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>80-89</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>70-79</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>60-69</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>55-59</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>50-54</td>
</tr>
<tr>
<td>RA</td>
<td>0</td>
<td>Less than 50</td>
</tr>
<tr>
<td>W</td>
<td>0</td>
<td>Withdrawn from the examination</td>
</tr>
</tbody>
</table>

11.6 **Classification of Results.** The successful candidates are classified as follows:

11.6.1 For **First Class with Distinction:** Candidates who have passed all the courses prescribed in the Programme *in the first attempt* with a CGPA of 8.25 or above within the programme duration. Candidates who have withdrawn from the End Semester Examinations are still eligible for First Class with Distinction (*See Section 12 for details*).

11.6.2 For **First Class:** Candidates who have passed all the courses with a CGPA of 6.5 or above.

11.6.3 For **Second Class:** Candidates who have passed all the courses with a CGPA between 5.0 to less than 6.5.
11.6.4 Candidates who obtain highest marks in all examinations at the first appearance alone will be considered for University Rank.

11.7 Course-Wise Letter Grades

11.7.1 The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

11.7.2 A candidate is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA.

11.7.3 A course completed successfully, cannot be repeated for the purpose of improving the Grade Point.

11.7.4 A letter grade RA indicates that the candidate shall reappear for that course. The RA Grade once awarded stays in the grade card of the student and is not deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the Odd/Even semester in which the student has re-appeared.

11.7.5 If a student secures RA grade in the Project Work/Field Work/Practical Work/Dissertation, he/she shall improve it and resubmit if it involves only rewriting/incorporating the clarifications suggested by the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.

12. Provision for Withdrawal from the End Semester Examination

12.1 The letter grade W indicates that a candidate has withdrawn from the examination.

12.2 A candidate is permitted to withdraw from appearing in the ESE for one or more courses in ANY ONE of the semesters ONLY for exigencies deemed valid by the University authorities.

12.3 Permission for withdrawal from the examination shall be granted only once during the entire duration of the programme.

12.3 Application for withdrawal shall be considered only if the student has registered for the course(s), fulfilled the requirements for attendance and CIA tests.

12.4 The application for withdrawal shall be made ten days prior to the commencement of the examination and duly approved by the Controller of Examinations. Notwithstanding the mandatory prerequisite of ten days notice, due consideration will be given under extraordinary circumstances.

12.5 Withdrawal is not granted for arrear examinations of courses in previous semesters (for which the student has secured RA Grade) and for the final semester examinations.
12.6 Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) in the subsequent semester.

12.7 Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the student to qualify for First Class with Distinction.

13. **Academic misconduct**
   Any action that results in an unfair academic advantage/interference with the functioning of the academic community constitutes academic misconduct. This includes but is not limited to cheating, plagiarism, altering academic documents, fabrication/falsification of data, submitting the work of another student, interfering with other students’ work, removing/defacing department library or computer resources, stealing other students’ notes/assignments, electronically interfering with other students’/ University’s intellectual property. Since many of these acts may be committed unintentionally due to lack of awareness, students shall be sensitised on issues of academic integrity and ethics.

14. **Transitory Regulations**
   Wherever there has been a change of syllabi, examinations based on the existing syllabus will be conducted for two consecutive years after implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that, the students will have to take up their examinations in equivalent subjects, as per the new syllabus, on the recommendation of the Head of the Department concerned.

15. **Notwithstanding anything contained in the above pages as Rules and Regulations governing the Five Year Integrated Master’s Programmes at Annamalai University, the Syndicate is vested with the powers to revise them from time to time on the recommendations of the Academic Council.**
PROGRAMME OUTCOMES

PO1. Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.

PO2. Resource Utilisation: Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge-base and stay abreast of recent developments.

PO3. Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.

PO4. Critical thinking and Problem solving: Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/solutions.

PO5. Project Management: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solutions. Exhibit organisational skills and the ability to manage time and resources.

PO6. Individual and team work: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.

PO7. Effective Communication: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.

PO8. Environment and Society: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.

PO9. Ethics: Commitment to professional ethics and responsibilities.

PO10. Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline.

Programme Specific Objectives (PSOs)

1. To ensure that the candidate after successfully completing the master’s degree in Zoology is well versed in subjects related to the programme and are able to impart knowledge to the concerned sections of the society.

2. To acquire skills in utilizing the fundamental knowledge gained in various fields of biological sciences in teaching learning activities.

3. To analyze biological problems professionally with a scientific temperament and research attitude and also to think logically in a scientific way to solve biological issues that they may come across.

4. To critically evaluate and interpret biological data and to acquire skills in modern tools and techniques in biological field to take up jobs in teaching/research/clinical/Biotechnology/animal husbandry and environment related establishments.

5. To analyze environmental issues and contribute to words environmental protection, bio-sustainability and biodiversity and also to apply the scientific knowledge in guiding the society in maintaining public health and hygiene and thereby avoiding spreading of diseases.
<table>
<thead>
<tr>
<th>Code code</th>
<th>Course Title</th>
<th>Hours/ Weeks</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>P</td>
</tr>
<tr>
<td><strong>Semester - I</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19ITAC11</td>
<td>Language – I/Paper I</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19IENC12</td>
<td>Language-II /Paper I</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19ICEC13</td>
<td>Civics, Environment awareness and Health science</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19IZOT14</td>
<td>Invertebrata I</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>19IBOA15</td>
<td>Ancillary I – Botany I</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Elective 1: Department Elective</strong></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
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**Semesters I-X Total Credits**

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**L- Lectures; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination**

**Note:**
1. **Students shall take both Department Electives (DEs) and Inter-departmental Electives (IDEs) from a range of choices available.**
2. **Students may opt for any Value-added Course listed in the University website.**
## DEPARTMENT ELECTIVES

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### Elective Courses offered to the Students of Other Department in VIII and IX Semesters

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### Value Added Course offered to Other Science Department (Combinedly offered by Department of Physics and Zoology)

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LEARNING OBJECTIVES

- To learn lower invertebrate diversity
- To learn the classification of lower invertebrate upto orders
- To learn the morphological features, physiology, and reproduction in invertebrates

Unit–1: Non- chordates
Principles of classification – salient features and classification upto orders in non-chordates. Structural organization in different classes of non-chordates.

Unit–2: Protozoa
Protozoa – salient features and classifications upto orders: Type study - Amoeba and Paramecium - Locomotion, osmoregulation, nutrition and reproduction.

Unit–3: Porifera
Porifera – salient features and classifications upto orders: Type study – Leucosolenia and Sycon Sponge, Origin of metazoa – metamerism and symmetry.

Unit–4: Coelenterata and Ctenophora
Coelenterata – salient features and classifications upto orders: Type study-Obelia and Aurelia- alternation of generation – Polymorphism in Hydrozoa.

Ctenophora - salient features and classifications upto orders: Type study – Pleurobranchia and Ctenoplana and affinities.

Unit–5: Platyhelminthes and Nemathelminthes
Platyhelminthes – salient features and classification upto orders: Type study - Tapeworm – reproduction and parasitic adaptations.

Nematoda – salient features and classifications upto orders: Type study – Ascaris.

PRACTICAL
1. Examination of Paramecium, Amoeba, Euglena
2. Study of specimens: Sycon, Hylonema and Spongilla -
4. Study of Specimens: Fasciola and Taenia
5. Study of Slides and specimen of Ascaris
TEXT BOOKS

REFERENCE BOOKS
2) Fatik Baran. 2012. Invertebrate Zoology. PHI.

Course outcome
At the end of the semester students shall be able to

CO1: Understand the diverse forms of lower invertebrates

CO2: Identify common protozoans

CO3: Identify common coelenterates and ctenophore

CO4: Understand common parasitic platyhelmithes and nematodes

CO5: Classify lower invertebrate upto orders based on morphological characters
19 IZOT 24: INVERTEBRATA- II

SEMESTER II

Credit Hours: 4

LEARNING OBJECTIVES

- To learn higher invertebrate diversity
- To learn the salient features of higher invertebrates
- To learn the classification of higher invertebrate up to orders
- To learn the various organ systems in higher invertebrates

Unit–1: Annelida

Annelida- Salient features - Classification up to orders: Type study- Earthworm, Nereis, Leech – Coelom and excretory system – adaptive radiation in polychaetes.

Unit-2: Onychopora

Onychopora – Salient features – Classification up to orders: Type study - Peripatus and affinities

Unit-3: Arthropoda

Arthropoda – Salient features – Classification up to orders: Type study- Palaemon and Grasshopper; Limulus and its affinities.

Unit-4: Mollusca

Mollusca- Salient features – classification up to orders: Type study- Fresh water Mussel and Sepia; Torsion in Mollusca, Foot in Mollusca, Shells in Mollusca.

Unit-5: Echinodermata

Echinodermata – Salient features - classification up to orders - Type study – Asterias – Echinoderm larvae and significance.

PRACTICAL

1. Dissection of Cockroach- Internal organs and mounting of mouth parts.
2. Dissection of Prawn- digestive system and Nervous system and mounting of appendages.
4. Pila – dissection of internal organs.
5. Transverse sections of Leech and Earthworm (slides).
8. Spiders, Ticks and Mites-specimen study.
TEXT BOOKS

REFERENCE BOOKS
2) Fatik Baran. 2012. Invertebrate Zoology. PHI.

Course outcomes
At the end of the semester students shall be able to
CO1: Understand the diversity and significance of higher invertebrates
CO2: Identify higher invertebrates upto order based on morphological features
CO3: Understand the various salient features of annelids
CO4: Identify and explain onychopora and arthropodes
CO5: Identify and differentiate various echinoderms

Outcome Mapping

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SECOND YEAR

19IZOT 33: CHORDATA – I

SEMESTER III

Credit Hours: 4

LEARNING OBJECTIVES

- To learn the origin, salient features of lower chordate
- To learn the classification of lower chordates
- To learn the structural organization of lower chordates
- To learn the classification of agnatha
- To study the general characters, behaviour and classification of fishes

Unit–1: Protochordata

General characters and phylogeny of Hemichordata, Urochordata, Cephalochordata
and their larval forms; Significance of protochordates, Type study: Balanoglossus, Herdmania
and Amphioxus.

Unit–2: Origin of Chordate

Theoris of origin of Chordates – Dipleurula concept– Echinoderm theory of chordates –
Origin of Hemichordata, Urochoradata and Cephalochordata – Barringtons hypothesis.

Unit–3I: Vertebrate

General characters of vertebrates and classification upto orders. Structural
organization in vertebrates – notochord – pharynx with pouches - slits – Nervous system –
Vertebral column.

Unit–4: Agnatha

General characters of Agnatha and classification of cyclostomes upto orders – Type
study‘- Petromyzon. Affinities and phylogenetic status of Cyclostomata.

Unit 5: Pisces

General Characters of Chondrichthyes and Osteichthyes. Pisces and Classification
upto orders. Comparison between Chondrichthyes and Osteichthyes. Types of Fishes, scales
and accessory respiratory organs of fishes. Migration in fishes, osmoregulation and parental
care.

PRACTICAL

1. Protochordata
   a) (Specimens and Slides): Balanoglossus, Herdmania, Branchiostoma, Colonial
      Urochordata. Ascidian
   b) Sections of Balanoglossus through proboscis and branchiogenital regions
   c) Sections of Amphioxus through pharyngeal, intestinal and caudal regions.
2. Agnatha (Specimens) Petromyzon , Myxine
3. Fishes (Specimens) : *Etroplus, Tilapia, Pristis, Torpedo, Chimaera, Notopterus, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Tetrodon, Diodon, Anabas, Flat Fish.*

4. Dissection: Fish digestive system and Reproductive system.

**TEXT BOOKS**


**REFERENCE BOOKS**


**Course outcomes**

At the end of the semester students shall be able to

CO1: Understand the diversity of lower chordates

CO2: Learn the salient features and classification of lower chordates

CO3: Know the structural organization of protochordata

CO4: Understand origin of chordate

CO5: Identify the structural organization of vertebrates

CO6: Understand general characters of agnatha
LEARNING OBJECTIVES

- To learn general characters and classification of higher chordates upto order
- To learn various types of snakes
- To learn various flying adaptations in birds and also flightless birds
- To learn various types of mammals and zoogeography

UNIT 1: Amphibia


UNIT 2: Reptilia.

Origin and evolution of reptiles, general characters and classification upto order. Type study – Calotes. Extinct reptiles, Poisonous snakes in India, identification of poisonous and non-poisonous snakes – biting mechanism.

UNIT 3: Birds


UNIT 4: Mammals

UNIT 5: Comparative anatomy

Comparative anatomy of vertebrates – integuments, lungs, heart, kidney, testis and ovary.

PRACTICAL


2. Reptiles:

   ii. Key for Identification of Poisonous and Non – Poisonous snakes.

3. Aves: Study of six common birds from different orders. Types of beakes and claws.

4. Mammals:
   Specimens: Raccoon, Bat (Insectivorous and Frugivorous) Scaly anteeater, Loris, Otter

5. Dissection of Frog: Digestive system and reproductive system –Demonstration

6. Dissection of Calotes: Digestive system and reproductive system–Demonstration

TEXT BOOKS


REFERENCE BOOKS

Course outcomes
At the end of the semester students shall be able to
CO1: Identify different types of higher chordates based on their morphology
CO2: Differentiate poisonous and non poisonous snakes and other reptiles
CO3: Understand flying adaptations in birds
CO4: Understand origin, ancestry and adaptive radiation among mammals
CO5: Differentiate the anatomical features of various internal organs.

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LEARNING OBJECTIVES

- To learn the structural organization of cell
- To learn the mechanism of endoplasmic reticulum and ribosomes
- To learn the structural organization of golgi apparatus and lysosome
- To learn the relation between nucleus and chromosomes
- To learn mechanism of cell division

Unit-1: Cell theory, Cellular organization and Cell Membrane

Discovery of cell, cell theory – protoplasm theory, organismal theory - Structural organization of prokaryote and Eukaryote - Virus - bacteria - Plasma membrane – Ultra structure models and functions

Unit-2: Endoplasmic Reticulam and Ribosomes.


Unit-3: Golgi apparatus and Lysosome


Unit-4: Nucleus and Chromosomes

Nucleus: Structure of interphase nucleus – Functions – nuclear envelope

Unit-5: Cell Division

Mitosis: Process of mitosis – Karyokinesis - General events in interphase, Prophase, metaphase, anaphase and telophase.

PRACTICAL
1. Light and compound microscopes – observation, principles and functions
2. Micrometry: a) Stage micrometer b) Ocular micrometer and c) Camera Lucida
3. Eukaryotic cell types – slides (Columnar Epithelial cell, Buccal Epithelial cell, Liver, Pancreas and muscle)
4. Observation of mitosis from onion root tip - squash
5. Observation of meiotic cell division stages from permanent slides
7. Identification of Barr body - Human Buccal smear

TEXT BOOKS:

REFERENCE BOOKS

Course outcomes ; At the end of the semester students shall be able to
CO1: Acquire knowledge on basic structure and functions of cells

CO2: Differentiate various cell organelles and their role

CO3: Identify nucleus and chromosomes

CO4: Identify various stages of cell divisions

CO5: Work in various research and clinical organization

Outcome Mapping
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19 IZOT 52: PRINCIPLES OF GENETICS

Semester V
Credit Hours: 4

LEARNING OBJECTIVES

- To learn the fundamental concepts of genetics
- To learn about human health related genetic problems
- To learn polygenic inheritance, linkage and crossing over
- To understand genetics of Sex determination and sex linked in heritance
- To study extranuclear in heritance gene structure and mutation.

Unit -1: Mendelism, Interaction of Genes and Multiple Alleles


Multiple Alleles: Coat Colur in rabbit- ABO Blood Group in man- Rh factor.

Gene Expression: Atavism – Lethality - Penetrance - Expressivity – Pleiotropism

Unit- 2: Polygenic inheritance, Linkage and Crossing Over

Polygenic inheritance: Kernal colour in wheat – Skin Colour in man

Linkage: Classical Views – Kinds of linkage –Linkage groups- Experimental examples.

Crossing over: Kinds of crossing over – Mechanisms – Theories – Experimental example.

Unit–3: Sex Determination and Sex – Linked Inheritance

Determination of Sex: Sex Determination in drosphila and man- Environmental Sex Determination – Gynandromorphs.

Sex linked inheritance in Drosphila and man – Y – linked gene – Sex influenced genes (Baldness in man) -sex limited genes (Sickle feathers in chicken)

Unit–4: Extranuclear inheritance, Gene structure and mutation


Mutation: Mutagens – point mutation – chromosomal aberration – polyploidy

Unit-5: Population Genetics and Human Genetics

Human Genetics- Human Pedigree – Eugenics –Euthenics and Euphenics-
Human Syndromes – (Downs, Edward, Patau, Klinefelter’s and Turner)

PRACTICAL
1. Mendelian Dihybrid cross – Illustrating with model (Peas/Beads)
2. Dominant Epistasis – illustrating with model
3. Polygenic inheritance – illustrating with human height
4. Blood Grouping in man
5. Identification of human finger prints
6. Identification of chromosomal disorder forms in human (Karyotyping).
7. Identification of sex and mutation in drosophila (eye colour)
8. Calculation of gene frequency & genotypic frequency

TEXT BOOKS

REFERENCE BOOKS

Course outcomes
At the end of the semester students shall be able to
CO1: Interpret phenotypic expressions based on genotype
CO2: Understand and interpret genetically linked diseases, Polygenic inheritance and crossing over
CO3: Perform blood grouping and test metabolic disorders
CO4: Work in clinical laboratories and take up researches
CO5: Interpret genetics of sex determination and inheritance
CO6: Interpret extra-nuclear inheritance and human pedigree
Outcome Mapping

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19 IZOT 53: COMPARATIVE ANIMAL PHYSIOLOGY

Semester V  Credit Hours: 4

LEARNING OBJECTIVE

- To learn nutritional requirements and metabolism
- To understand respiratory system
- To learn blood vascular system
- To learn physiology of respiration, excretion and neuronal functions
- To learn about the physiology of muscle, receptors and neurons

Unit-1: Digestion and Absorption


Unit-2: Respiration


Unit-3: Circulation

Unit-4: Excretion and Osmoregulation


Unit-5: Muscle, Receptors and Neuron


PRACTICAL:
1. Pattern of osmotic response of Crab in two different media
2. Effect of chemical substance on respiratory metabolism of fish
3. Comparative study of vertebrate and insect eyes.
4. Ciliary mode of feeding in freshwater mussel
5. Effect of pH and amount of substrate activity of salivary amylase
6. Study of ciliary and amoeboid movements
7. Test for Nitrogenous waste products in cock-roach and birds
8. Test for ammonia, urea and uric acid.

TEXT BOOKS:
2. Eckert.R. Animal Physiology and adaptation. W.H.Freeman and company

REFERENCE BOOKS

Course outcomes
At the end of the semester students shall be able to

CO1: Understand basic biochemical molecules and their roles

CO2: Appreciate the nutritional requirements and the roles of nutrition in physiology

CO3: Learn the functioning and roles of respiratory and circulatory system
CO4: Analyse the physiology of excretion and osmoregulation

CO5: Carry-out basic clinical tests

**Outcome Mapping**

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**19 IZOT 54: APPLIED ZOOLOGY**

**Semester V**

**Credit Hours: 4**

**LEARNING OBJECTIVE**

- To learn the methodology and significance of reproductive technologies
- To learn the basic of bioinformatics
- To learn the importance of aquaculture and vermicomposting
- To learn the Common practices in poultry science and dairy science

**UNIT-1: Bioinformatics**

Historical perspective on computer and their applications in biology-Introduction to programming-the internet and the biologists-data bases and information retrieval-genome information.

**UNIT-2: Reproductive Technologies**

Gametes technology-collection and preservation of economically important invertebrates and vertebrates, sperm function tests, semen analyses-embryo sexing-methods and principles.

**UNIT-3: Aquaculture**

Types of culture - general culture techniques-pond culture - polyculture. Integrated fish farming; farm construction and management; Induced breeding-hypophysation technique. Culture of ornamental fishes.
UNIT-4: Poultry Science

Introduction to poultry science – Important breeds of poultry – Desi – Chittagong and Leghorn – Layer house and Broiler house – Marketing of egg and Byproducts of poultry – Common diseases of poultry – Raniket, Coccidiosis and Coryza, Vaccination programme

UNIT-5: Dairy Science


PRACTICAL
1. Study about biological databases
2. Study about Genome informations
3. Histology of gametes (Testis and ovary)
4. Semen analysis
5. Hypophysation techniques-location and removal of Pituitary; Pituitary extract, Preparation and Preservation – Demonstration
6. Culture method of ornamental fishes
7. Charts – Important breads of poultry
8. Charts – Dairy breads of India
9. Charts – Exotic cow breads

TEXT BOOKS

REFERENCE BOOKS
**Course outcomes**
At the end of the semester students shall be able to
CO1: Perform basic computer operation and bio-informatics technologies
CO2: Get top opportunity in fertility clinics and technicians
CO3: Start entrepreneurial activities
CO4: Start poultry farming
CO5: Start Dairy operations

**Outcome Mapping**

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LEARNING OBJECTIVES

- To learn the various concepts of developmental biology
- To learn gametogenesis and process of fertilization
- To learn cleavage, gastrulation and early embryonic developments
- To learn the processes of embryogenesis, organ formation and differentiation
- To learn metamorphosis and regeneration

UNIT 1: Basic concepts of Embryology

Historical thoughts, concepts and scope of embryology. Theories – germplasm theory, mosaic theory, regulative theory, gradient theory and Speman’s theory of organizers.

UNIT 2: Gametogenesis

Reproductive organs – male and female reproductive system of frog, gametogenesis – spermatogenesis, oogenesis, perivitellogenesis and vitellogenesis.

UNIT 3: Fertilization and early development

Fertilization – biological role of fertilization, basic requirements of fertilization, physiological aspects of fertilization – entry of sperm – activation of egg.

UNIT 4: Cleavage, Gastrulation and Organogenesis


UNIT 5: Metamorphosis and Regeneration


PRACTICAL

1. Observation of different types of sperms – Amphibia, fish, frog, cock and man – slides/chart.
2. Observation of different types of eggs – Hen’s egg, fish, frog, hen and rat- slides.
3. Observation of early development in Amphioxus – 2,4,8 and16 celled stage – slides.
4. Observation of blastula, gastrula - Amphioxus – slides.
5. Observation of larval stage in invertebrates – radia, cercaria, zoea, mysis, bipinnaria, auricularia, dipleurula and ophiopluteus.
6. Observation of early development in frog tadpole – slides. Mouth open stage, external gill stage and opercular fold stage – slides.
7. Observation of developmental stages in chick – 20, 24, 33, 48, 72, and 96 – slides.

TEXT BOOKS

REFERENCE BOOKS

Course outcomes
At the end of the semester students shall be able to
CO1: Assimilate knowledge on reproduction and development
CO2: Differentiate between spermato genesis and oogenesis
CO3: Understand process of fertilization
CO4: Understand the whole process of embryogenesis
CO5: Interpret metamorphosis and regeneration
CO6: Take up jobs in fertility clinics

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SEMESTER VI  

LEARNING OBJECTIVES

- To learn the concepts of evolution
- To learn the origin of life and geological time scale and theories of evolution
- To learn the concepts of polymorphism, polyploidy and animal behaviors
- To learn about mechanisms of evolution
- To learn speciation and evolution man

UNIT-1: Origin of Life


UNIT-2: Theories of Organic Evolution


UNIT-3: Mechanism of Evolution


UNIT-4: Polymorphism and Population genetics


UNIT-5: Speciation, Isolation and Evolution of man


PRACTICAL

1. Homologous organs, Analogous organs, vestigial organs
2. Fossils: Trilobite, nautilus, Ammonite
3. Animals of evolutionary importance: Peripatus, Limulus and Archaeopteryx Darwin’s finches
4. Mimicry: leaf insects, Stick insects, Monarch and Viceroy butterfly
5. Adaptive colouration: Chamaeleon, Lycodon
TEXT BOOKS

REFERENCE BOOKS

Course outcome
At the end of the semester students shall be able to
CO1: Understand and appreciate the concept of organic evolution and origin of life
CO2: Differentiate between various theories of evolution
CO3: Interpret polymorphism and population genetics
CO4: Understand the role of isolation in species formation and evolution
CO5: Explain the various animal behavior patterns
CO6: Get employment in zoological museums, zoological survey of India and paleontological institutes

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LEARNING OBJECTIVES

- To analyse basic concepts in ecology
- To learn the role of Biotic factors ecosystem and biotic comment
- To learn the conserve ecological resources
- To learn ecological succession, population and ecological and adaption
- To learn biogeochemical cycles significance of natural resources and wildlife management
- To understand major ecological issues.

Unit-1: Basic Concepts and Abiotic factors

Definition of ecology and subdivisions – autecology and synecology. Major abiotic factors and their ecological significance - Air-general composition and ecological significances of oxygen and carbondioxide; water – source, types, hydrological cycle, hydrocoles, mesocoles and xerocoles; Light – spectral distribution of solar light, zonation of water bodies based on penetration of light - biological effects of light and bioluminescence; Temperature-diurnal variations, thermal stratification of water bodies - Thermal adaptations (homeotherms, poikilothersms, hibernation, aestivation and thermal migration).

Unit-2: Biotic Factors, Ecosystem and Biotic Community

Biotic environment: Types, mechanisms and significance of various interspecific relationships (mutuallism, commensalism, antibiosis, parasitism, predation and competition).

Ecosystem: Principal steps, components and structure, trophic levels, food chain, food web and ecological pyramids. Structure and functions of pond and forest ecosystems. Energy flow in an ecosystem.

Community: Definition, characteristics and community stratification in terrestrial, fresh water and marine habits, ecotone, edge effect, habitat, ecological niche, ecotypes and ecological indicators.

Unit-3: Ecological Succession, Population and Adaptations

Succession: Kinds, process and theories of succession. Patterns of succession – xerosere and hydrosere.

Population: characteristics of population, regulation of population (density independent and density dependent factors). Adaptations: fossorial, cursorial, arboreal, volant (flight) and desert adaptations.

Unit-4: Biogeochemical Cycles, Natural Resources and Wild Life Management

Unit-5: Major Ecological Issues

Environmental pollution: Major sources, causes, impacts and control measures of air, water, noise, radiation, thermal and land pollutions. Reasons, ecological consequences and remedial measures of green house effect, global warming, sea level rise, water scarcity and importance of water conservation.

PRACTICAL
1. Estimation of dissolved oxygen
2. Estimation of dissolved CO$_2$
3. Determination of salinity
4. Determination of nitrates
5. Determination of TDS.
6. Identification of planktons
7. Quantitative estimation of planktons
8. Food chain
9. Adaptations: Fossorial, cursorial, volant and desert adaptations
10. Inter specific interactions: Symbiosis, parasitism and predation.

TEXT BOOKS

REFERENCE BOOKS

Course outcomes
At the end of the semester students shall be able to
CO1: Analyse and appreciate the basic ecological concepts
CO2: Differentiate biotic factors and of biotic community
CO3: Critically evaluate the process of ecological adaptations and successions
CO4: Understand significance of natural resources and wildlife and their conservation
CO5: Critically analyse major ecological issues
19 IZOT 64: ANIMAL CULTURE TECHNIQUES

Semester VI  Credit Hours: 4

LEARNING OBJECTIVES

- To learn vermicomposting
- To learn apiculture
- To learn sericulture
- To learn aquaculture

Unit-1: Vermicomposting


Unit-2: Apiculture

Types of honey bees-bee colony-structural adaptation social life in honey bees - types of bee hives and other accessories - apiary - uses of honey.

Unit-3: Sericulture


Unit-4: Fish culture

Types of culture, types of ponds, general culture techniques - induced breeding - culture of edible fishes.
Unit–5: Oyster culture

   Seed production and collection – Feed and nutrition - edible oyster and pearl oyster – Predators and environmental factors affecting oyster culture.

PRACTICAL
1. Types of earthworms- Epigeic, Anaecic.
3. Mounting Legs, Sting, Mouth parts of honey bee.
4. Observation of life cycle of honey bee.
5. Study of beehive and its accessories.
6. Observation of Life cycle of silkworm.
7. Demonstration of silk gland.
8. Identification of carps- Catla, Rogu, Mrigal, Silver carp, Grass carp, Common carp.
10. Identification of brackish water prawns- Penaeus monodon, Litopenaeus vannamei and Fresh water Prawn – Macrobrachium rosenbergii.
11. Determination of Nitrite and Silicate in water.

TEXT BOOKS

REFERENCE BOOKS
5) Francis Francis. 2015. Fish Culture: A Practical guide to the Modern system of Breeding and Rearing Fish. Sagwan Press.

Course outcomes

At the end of the semester students shall be able to

CO1: Start entrepreneurial activities involving solid waste management and vermicomposting

CO2: Take up apiculture as a profession

CO3: Take up sericulture as a profession
CO4: Start aquaculture

CO5: Take up jobs in animal culture industry

### Outcome Mapping

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LEARNING OBJECTIVES
To understand and Structure and Functions of invertebrates and vertebrates
- To understand the organs of respiration and excretion and their functioning in invertebrates.
- To analyses the nervous systems in various groups of invertebrates.
- To evaluate the larval forms of invertebrates to acquire knowledge on various organ systems of vertebrates

Unit I: Respiration and Excretion of Invertebrates

Unit II: Nervous System of Invertebrates
Primitive nervous system: Coelenterata and Echinodermata – Advanced nervous system: Annelida, Arthropoda (crustacean and insecta) and Mollusca (cephalopoda) – Trends in neural evolution

Unit III: Invertebrata larvae
Larval forms of free living invertebrates – Larval forms of parasites – Strategies and evolutionary significance of larval forms – Minor phyla – Concept and significance – Organization and general characters

Unit IV: Skin and Skeletal System of Vertebrates
General structure and functions of skin and its derivatives – glands, scales, horns, claws, hail, hoofs, feather and hairs. Skeletal elements of the body – account of jaw suspensorium, vertebral column – limbs and girdles

Unit V: Respiratory system and Nervous system of Vertebrates
Respiratory system – characters of respiratory tissue – Internal and external respiration – comparative account of respiratory organ. Nervous system – Anatomy of the brain and spinal cord in relation to their functions – Nerves -cranial – peripheral and autonomous nervous system
PRACTICALS

1. Dissections:
   - Dissection of Cockroach – Digestive and Nervous system,
   - Dissection of Prawn- Nervous system and mounting of appendages.
   - Dissection of Fish – Nervous system, Respiratory system and Digestive system.

2. Observation and Classification of the following Specimens by giving reasons:
   - Paramecium, Sycon, Obelia, Taenia solium, Neries, Prawn, Freshwater mussel,
   - Amphioxus, Hyla, Calotes, Rat.

3. Study of Adaptations to the mode of life: Trypanosoma, Corals, Ascaris, Wuchereria

4. Biological Significance of the following forms: Peripatus, Sea anemone, Anabas, Arius,
   - Exocoetus, Eel, Amblystoma, Woodpecker, Anteater, Lingular, Sagitta and Phoronis.

5. Relative structure and function of the following forms: Taenia, Scolex, Nereis-
   - Parapodium, Ctenoid and Quill feather of pigeon

TEXT BOOKS

   - S. Chand & Co., Ltd., New Delhi.

REFERENCE BOOKS

   - Ltd., New Delhi.
4) Richard C. Brusca, Wendy Moore and Stephen M. Shuster. 2016. Invertebrates. OUP,
   - USA.

Course outcomes

At the end of the semester students shall be able to

CO1: Understand the morphological features and physiological features like Respiration,
   - reproduction and nervous system of invertebrates and Vertebrates

CO2: Understand the various salient features of higher invertebrates and Vertebrates

CO3: Differentiate the patterns of functioning of various organ systems in invertebrates and
   - vertebrates

CO4: Know the structural organization and functioning of various organs in
   - invertebrates and vertebrates
19 IZOT 72: DEVELOPMENTAL BIOLOGY

Semester VII  Credit Hours: 4

LEARNING OBJECTIVES

- To understand the various concepts of development
- To study gametogenesis and process of fertilization
- To learn the processes of embryogenesis, organ formation and differentiation
- To analyse the embryonic induction and teratogenesis
- To critically explore assisted reproductive technologies for human welfare

UNIT 1: Introduction to Embryology


UNIT 2: Embryonic adaptations and Parthenogenesis.


UNIT 3: Organogenesis and Differentiation

Organogenesis - development of brain, eye and heart of mammals (Rabbit). Differentiation, types, chemical basis, selective action of genes, changing pattern of protein synthesis and sequence of gene action in development – stem cells, role of micro environments in differentiation.

UNIT 4: Embryonic induction and Teratogenesis

UNIT 5: Reproductive Technology for Human Welfare


PRACTICAL

1. Demonstration of male and female reproductive system in mammals (rat) - specimens
2. Dissection and mounting of chick blastodem to identify different stages in chick development.
3. Observation of early development of frog – two celled stage, 4 celled stage, 8 celled stage and sixteen celled stage, blastula, gastrula and yolk plug stage.
5. Observation of metamorphosis in insects.
6. Observation of different types of placenta – slides.
8. Histology of mammalian testis and ovary – slides.

TEXT BOOKS


REFERENCE BOOKS

Course outcomes

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

CO1: Acquire knowledge on reproduction and development

CO2: Understand process of fertilization

CO3: Understand the whole process of embryogenesis

CO4: Acquisition of skills in common methods and practices followed in developmental biology related laboratory activities

CO5: Take up jobs in fertility clinics and research labs

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19 IZOT 73: CELL AND MOLECULAR BIOLOGY

Semester VII  Credit Hours: 4

LEARNING OBJECTIVES

- To understand the molecular basis of cell structure and functions
- To learn the structure, functions and organization of cell membrane.
- To learn bioenergetic and biogenesis
- To learn structure and replication of DNA
- To learn various molecular techniques

Unit–1: Cell structure and Cell membrane

Cell Structure: Introduction – Structural organization of prokaryotic and eukaryotic cells; structural differences of prokaryotic and eukaryotic cells.

Unit–2: Organelles

Lysosome: Characteristics of lysosomal membrane and enzymes -Polymorphism of lysosome – functions of lysosome.

Endoplasmic recticulam and ribosomes: morphology and functions of endoplasmic recticulam -Structure of ribosomes and rRNAs- - Organization of ribosomes – Role of ribosomes in protein synthesis.

Unit–3: Organalles of Bioenergetics & Biogenesis
Organalles of Bioenergetics: Mitochondria -Ultrastructure - respiratory chain complex; chemical composition and enzyme distribution – role in metabolism for cellular energetic- Anaerobic glycolysis, Pasteur effect - Kreb cycle – Formation of ATP. Chemical and conformation coupling hypothesis; shuttle system – Glycerophosphate and malate shuttle.


Unit-4: DNA Structure and Replication
Structure, Chemical composition- Types and their importance- Properties of DNA - Denaturation, Renaturation and Hybridization.

DNA replication: Prokaryotic and eukaryotic DNA replication – Semi- conservative replication mechanism, enzymes and necessary proteins- origin, initiation, termination - DNA polymerases, telomerase and mode of action- replication factors

Unit-5: RNAs Structure and Transcription
Structural features of RNAs: Structure of rRNA in prokaryotes and eukaryotes – structure of tRNA and anti codon features – structure of mRNA in prokaryotes and eukaryotes.


PRACTICAL
1. Light Microscope – components, use and principles
2. Mounting of polytene chromosomes from salivary gland of Chironomus larva
3. Squash preparation of different stages of meiosis in grasshopper testis
4. Squash Preparation of mitosis in onion root tips
5. Study of Micrometry: a) Camera lucida b) Stage micrometer c) Ocular micrometer
6. Determination of Nucleo – Cytoplasmic index
7. Identification of drumstick chromosome from human blood smear preparation
8. Identification of Barr body from buccal smear preparation
9. Histochemical Localization of DNA and RNA
10. Estimation of DNA and RNA of the samples.

TEXT BOOKS

REFERENCE BOOKS

Course outcomes

At the end of the semester students will be able to
CO1: Interpret the structural and functional significances of DNA and RNA
CO2: Perform molecular biological techniques
CO3: Take up research career in molecular biology
CO4: Take up jobs in molecular biology labs and clinical labs

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LEARNING OBJECTIVES

- To learn the significance of food and physiology of digestion
- To understand the significance of excretory and osmoregulation system.
- To study the functioning of cardiovascular system
- To study respiratory and nervous systems including various receptors

Unit–1: Food and Digestion


Unit–2: Excretion and Osmoregulation


Unit–3: Circulation

Major types of body fluids - circulation of body fluids and their regulations - Composition of blood – blood groups – clotting mechanism –buffer system of blood - Circulation of blood in vertebrates - Open and Closed systems – Arthropod heart – Chambered hearts and booster pumps. Structure of mammalian heart, origin, conduction and regulations of heart beat – cardiac cycle and ECG.

Unit–4: Respiration


Unit–5: Nervous system, Muscle and Sense organs


Muscle: Types and Structure - chemical composition – mechanism of muscle contraction.

PRACTICAL

1. Effect of enzyme concentration on the activity of salivary amylase
2. Effect of substrate concentration on the activity of salivary amylase
3. Effect of pH concentration on the activity of salivary amylase
4. Oxygen consumption of fish.- Unit metabolism
5. Effect of thyroxin on the respiratory metabolism of fish.
6. Counting of blood cells (RBC and WBC).
9. Biochemical analysis of protein, Carbohydrates and Lipids (Qualitative).

TEXT BOOKS


REFERENCE BOOKS


Course outcomes
At the end of the semester students will be able to
CO1: Understand the normal physiological functions and necessity to maintain a healthy life
CO2: Get an opportunity to understand various factors that could lead to altered physiological functions and thereby health problems
CO3: Perform various physiological experiments and observations
CO4: Take up jobs in clinical labs and research institutes
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19 IZOT 82: GENETICS

Semester VIII

Credit Hours: 4

LEARNING OBJECTIVES

- To learn the fundamental concepts of genetics
- To study human health related genetic problems, quantitative traits and population genetics
- To learn the structure genes and their regulation
- To acquire skills in chromosomal alterations, gene mutations and cancer.
- To learn application of genetics concepts in microbial genetics and genetic engineering.

Unit-1: Principles and Concepts of Gene and Gene mapping


Unit-2: Quantitative, Population and Human Genetics


Unit-3: Fine Structure of Gene and Regulation of Gene action


Unit-4: Chromosomal Alterations, Gene Mutation and Oncogens

**Unit-5: Microbial Genetics and Genetic Engineering**


**PRACTICAL**

1. Experiments on Mendelian inheritance
2. Experiments on polygenic inheritance
3. Human traits survey and data collection
4. Gene frequency calculations in population - Autosomal, multiple alleles and sex linked genes.
5. Testing the significance of genetic data - Chi-square test.
6. Human pedigree construction to study the inheritance of autosomal character.
7. Human pedigree for sex linked character and counseling
8. Culturing and maintenance of Drosophila in lab - Demonstration.
9. Identification of sex and mutant characters in *Drosophila*
11. Identification of human syndromes from karyotyping

**TEXT BOOKS**


**REFERENCE BOOKS**


**Course outcomes**

At the end of the semester students will be able to

CO1: Interpret phenotypic expressions based on genotype

CO2: Understand and interpret genetically linked diseases
CO3: Perform blood group analysis and test metabolic disorders

CO4: Working clinical laboratories and take up researches

Outcome Mapping

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19IZOT 83: IMMUNOLOGY

Semester VIII

Credit Hours: 4

LEARNING OBJECTIVES

1. To learn the basic concepts, principles and mechanisms involved in Immunology
2. To develop awareness regarding the molecules, cells and organ system involved in immunological and their significances in up keeping the organism.
3. To learn the various types of antigen and antibodies
4. To acquire skills in the methodologies of antigen antibody interactions
5. To gain knowledge regarding the application of immunological techniques.

Unit-1: Overview and Scope of Immunology


Unit-2: Molecules, Cells and Organs of Immune System

Brief description of molecules of immunity (Lysozyme, interferon, complements, cytokines and chemokines). Haematopoietic stem cells: Myeloid and lymphoid progenitors and their derivatives – mononuclear phagocytes and granulocytic cells (monocytes, \(T_H\) Cells,
Tc cells, B Cells, NK cells, mast cells, dendritic cells, neutrophils, eosinophils, basophils) and their immunological significance. Primary lymphoid organs: thymus, bone marrow and bursa of Fabricious. Secondary lymphoid organs: lymph nodes, spleen and MALT.

Unit-3 : Immunogen and Antigen

Unit-4: Antibodies

Unit-5 Antigen – Antibody Interactions

PRACTICAL
1. Demonstration of lymphoid organs
2. Cell imprinting of lymphoid organs
3. Histology of lymphoid organs -slides
4. Study of bone marrow cells
5. Identifications of leucocytes in human blood smear.
6. Differential count of W.B.C. from blood smear preparation
7. Human blood grouping
8. Antigen antibody interaction- Demonstration
9. Rapid plasma reagent (RpR) test for syphilis

TEXT BOOKS

REFERENCE BOOKS

Course outcomes
At the end of the semester students shall be able to
CO1: Analyse the various immunological issues
CO2: Apply immunological principles for various immunological testing procedures
CO3: To Interpret the results of immunological experiments
CO4: Carry out immunological investigation
CO5: Take up jobs in clinical labs and related institutions
CO6: Equip themselves for higher studies in Immunology

Outcome Mapping

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FIFTH YEAR

19IZOT 91: EVOLUTION

Semester: IX  Credit Hours: 4

Learning Objectives
- To gain awareness about the origin of life
- To understand the roles of variations, polymorphisms and polyploidy in evolution
- To familiarize the role of isolation and speciation in evolution
- To understand the various types of adaptations and mimicry
- To learn the evolution of mankind

Unit 1: Origin
i. Environment: nature and origin of life - proteins, nucleic acids, Container membrane - Molecular interactions - Pool origin - Volcanic origin - Meteoric origin - Chemical Evolution

Theories
i. Theories of organic evolution: Lamarck’s Evolutionary propositions - Critical analysis of Lamarck’s propositions - Neo-Lamarckism.

Natural Selection and process:
 ii) The concept of natural selection - Darwinism - Fitness - Selection against recessive homozygotes - selection against dominante and selection without dominance. Selection and mutation - Estimation of mutation rates- selection against heterozygotes - Frequency – Dependent selection

Unit 2: Mechanism
 i) Variation and evolution

The mechanism of natural selection by internal characters- selection by environmental factos.

Direction of selection – centripetal selection – Centrifugal selection.

ii) Polymorphism and evolution:
Transient polymorphism and industrial melanism - Balanced and neutral polymorphism - genetic polymorphism - chromosomal polymorphism - criticism of the polymorphism concept - Evolutionary significance of polymorphism
iii) Polyploidy and evolution
Polyploidy in animals and plants- types of polyploids- direct effect of Polyploidy-origin – polyploidy and the origin of higher categories in plants – practical significance.

Unit 3 : Evolution
i) Isolation and evolution:
Premating isolation mechanism- Geographical- Ecological seasonal- ethological – physiological and mechanical isolation.


ii) Speciation and evolution:
Species concept morphological- Genetic- Sterility based – Biological sibling concepts- Monotypic and polytypic – Sub-species categories.
Types of speciation: Mechanism of speciation-allopatric speciation sympatric-speciation-quantum evolution- evolutionary significance.

Unit 4
i) Adaptation Mimicry and colouration:
Mimicry – Protective-aggressive- conscious sound and scent mimicry- Batesian and Mullerian mimicry- Experimental proof of mimicry – evolution of mimicry- significance.

Colouration: Chemical colours- physical colours- indifferent colours- valuable colours- Symoathetic- cryptic ot concealing colouration- standard faunal colours – warning or revealing colours- mimetic colouration – confusing and sexual colouration.

Unit 5:
i) Trends and rates
Evolutionary rates: Morphological rate of evolution-Taxonomic rate- Molecular rate- the role of extinction in macro evolution-measuring of extinction rate.

ii) Mankind evolution
Past evolution: Fossil history of mankind- the primate- the apes-Hominid evolution, early and history middle phase of hominid ancestor- the earliest humans; towards modern human; modern humans.

Present evolution: Cultural and social evolution of hominids.

Future evolution: Biological future of mankind-positive and negative eugenics-mankind and the organic world evolution – biochemical evolution.

Practicals:
1. Genetics drift in small and large population using dummy materials
2. Sexual selection(a) Secondary sexual characters ,e.g.Chimeroid fish(male) (b) Brooding organs- Eg. Sea Horse(male) (c) Sepecial sound producing organs E.g ciccada insect (male)(d) Special using Rhinoceros beetle (male).
3. Plymorphism- (a) Transient Polymorphism e.g. industrial melanism (b) Neutral Polymorphism e.g. Umbonium shells (c) Balanced Polymorphism
4. Genetic Assimilation – in Drosophila
5. Identification of male and female Drosophila
   Warning mimicry-Viceroy and Monarch butterfly Batesian and Mullerian mimicry.
8. Osteology: Evolution of reptilian skull and its interrelationship

Text book:


Reference:

3. Dobzhansky,Th.Et Al:Evolution,Surjeet Pub., Delhi,

Course outcome
After successful completion of the course students shall be able to
CO1. Analyse the evolutionary history of biological organisms
CO2. Critically assess the evolutionary relationship among various phyla
CO3. Identify the role of natural selection in the survival of the species
CO4. Understand the various mechanism involved in evolution.

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Learning Objectives

- To gain awareness about the basic concepts of environment and ecology
- To create a mindset for conservation of biodiversity
- To familiarize the concept of environmental impact assessment
- To understand the significance of natural resources and sustainable development
- To create awareness about environmental pollution and its prevention
- To learn the phenomenon of global warming and its prevention

Unit 1: Basic concepts and environmental impact assessment


Unit 2: Natural resource and sustainable development

Non-renewable and renewable natural resources and their conservation. Forest resources and types of forests in India. Use and over exploitation of forests. Deforestation and afforestation, land degradation, landslides, soil erosion and desertification. Food resources, world food problems, effect of modern agriculture and overgrazing. Concept of sustainable development and brundt land report.

Unit 3: Environmental pollution and disaster management

Cause, effects and remedial measures of air, water, noise thermal, radioactive and agriculture pollution. Disasters caused by floods, earthquake and cyclones and their management. Solid waste issues and its management.

Unit 4: Biodiversity and its conservation

Types of biodiversity, species richness and heterogeneity and significance of biodiversity. Threats to biodiversity and biodiversity crisis. Socio economic and political
causes of loss of biodiversity. Conservation of biodiversity: in situ and ex situ conservation and biodiversity hospitals. Endangered faunal species of India

Unit 5: Global warming and water conservation

Global warming: Concept, causes and impacts, Green house effect, Green house gases, their sources and control measures of global warming. Acid rain and Ozone depletion. Impact of over utilization of surface and ground water. Water conservation, rain water harvesting and watershed management,

Practicals:

1. Estimation of dissolved Oxygen content of water samples
2. Determination of Oxygen sag curve from river
3. Estimation of dissolved Carbon – Dioxide
4. Estimation of Hydrogen sulphide in water samples
5. Estimation of Residual chlorine in water samples
6. Estimation of total dissolved solids of water samples
7. Determination of sulphate in water samples
8. Determination of iron in water samples
9. Determination of silicate in water samples
10. Determination of nitrate/Nitrate in water samples
11. Field visits to areas of environmental and biodiversity significance
12. Behavioural changes of organisms in polluted environment
13. Food chain and bioaccumulation

Text books:

Reference Books:
3. Mehta M (2010) understanding environmental science. Discovery publishing house, New Delhi, India
Course outcome

After successful completion of the course students shall be able to
CO1. Analyse and appreciate the basic ecological concepts
CO2. Critically assess environmental disasters and suggest counter measures
CO3. Develop a mind set to safeguard natural resources and take forward the concept of sustainable development
CO4. Protect the environment by acting against pollution

Outcome Mapping

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19IZOT 93: ANIMAL BEHAVIOURS

Semester: IX  Credit Hours: 4

Learning Objects

- To gain awareness about the basic concepts of animal behaviour
- To create a mindset for conservation
- To understand the genetic principles behind behavioral patterns
- To familiarize the concept of sociobiology
- To understand the significance of Territoriality

Unit 1: Introduction
Introduction to ethology, Principles and mechanism of animal behaviour (Ethology) four propositions of Nikolaas Tinbergen-Adaptive values of behaviour – instinct verses learning – circadian and circadian rhythm in animal behaviour.

Unit 2: Communication behaviour

Unit 3: Behavioural genetics
Fundamentals of behavioural genetics – Genetic basis of behaviour – Mutations – knockout genes- genetic mosaic fruit flies- multiple genes – polygenic effects on behaviour – genes effect on physiological – Feeding behaviours of animals
**Unit 4: Social behaviour**


**Unit 5: Territoriality**


**Practicals**

1. Study of behavioural adaptations of Cursorial animals
2. Study of behavioural adaptations of Arboreal animals
3. Study of behavioural adaptations of Volant animals
4. Study of behavioural adaptations of Aquatic animals
5. Reflex behaviour in animals
6. Mimicry
7. Polymorphism

**Text Book**


**Reference Books**


**Course outcomes**

At the end of the semester students shall be able to

CO1: Master the theoretical as well as practical knowledge in the field of animal behaviour

CO2: Interpret the genetic basis of behavioral patterns

CO3: Appreciate the socio-biological elements in the behavior of various animal groups and their significance.

CO4: Understand the impact of hormones in the manifestation of various behaviours

**Outcome Mapping**

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LEARNING OBJECTIVES

- To learn the basic concepts in biotechnology
- To learn the various techniques used in biotechnology
- To acquire biotechnological knowledge related to medical, agricultural and environmental disciplines

Unit 1: Basic Biotechnology
Definition – Scope – Achievements of Biotechnology – Enzymes in genetic engineering - Restriction Enzymes, DNA ligases, DNA polymerase of Cloning vectors – Plasmids-Bacteriophage, Cosmids, Yeast plasmids- Genomic DNA libraries, cDNA libraries.

Unit 2: Techniques in Biotechnology
Southern blotting, Northern blotting, Western blotting, In-situ hybridization, DNA sequencing, PCR, DNA finger printing, DNA probes, site – directed mutagenesis, particle gun, microinjection, electroporation.

Unit 3: Medical Biotechnology
rDNA Technology- Insulin, Somatotrophin, Somatostatin-hormone production, vaccines, interferons, gene therapy, monoclonal antibodies, Prenatal diagnosis, In-vitro Fertilization Technology (IVF) in Human beings, Human Genome Project (HGP).

Unit 4: Agricultural Biotechnology

Unit 5: Microbial and Environmental Biotechnology
Ethical issues and Biosafety regulations, Intellectual Property Right (IPR) and Protection (IPP).

PRACTICALS

1. Methods of sterilization
2. Preparation of culture media
3. Preparation of Agar slants
4. Estimation of microflora of milk by MBR test
5. Estimation of microflora of milk by RESAZURINE Test.
6. C.S. of stem and root nodule of leguminous plants
7. Isolation, Identification and enumeration of bacteria from soil
8. Isolation, Identification and enumeration of fungi from soil
9. Isolation, Identification and enumeration of actinomycetes from soil
10. Counting of soil microbial population by Quebec colony counter
11. Gram staining of Bacteria
12. Identification of algal Bio-fertilizers
13. Identification of bacterial bio-fertilizers
14. Agarose Gel Electrophoresis - Demonstration
15. Study of Biogas Plant - Demonstration

TEXT BOOKS


REFERENCE BOOKS


Course outcomes

At the end of the semester students shall be able to

CO1: Master the theoretical as well as practical knowledge in various field of biotechnology

CO2: Perform various experiments related to biotechnology

CO3: Carry out biotechnological applications in the fields of medicine, agriculture and environmental fields

CO4: Equip the students to take up jobs in various biotechnological companies and labs
19IZOT 101: BIOCHEMISTRY

Semester: X Credit Hours: 4

LEARNING OBJECTIVES

- To learn classification and metabolism of carbohydrates
- To understand the structure and metabolism of protein
- To learn the structure and functions of lipids
- To acquire knowledge about various enzymes and hormones and their actions
- To acquire knowledge about the significance of vitamins

Unit 1: Buffers and Carbohydrate.

i). PH and buffers – Water, carbondioxide and oxygen, properties, outlines of Biochemical energies.

ii). Carbohydrates:
Methods of study of intermediary metabolism of Carbohydrates;

A general account of classification – Structure and properties of mono and polysaccharides- metabolism of carbohydrates glycolysis, Citric acid cycle Gluconeogenesis; defect in carbohydrate metabolism.

Unit 2 : Proteins:
Classification and isolation - The fundamental structure of amino acids, peptides and proteins- protein metabolism – Metabolism of amio acids in general.

Unit 3: Lipids:
Classification of lipids- Structure and chemistry of single and compound lipids; metabolism of fats and fatty acids- Defects in lipid metabolism

Unit 4: Enzymes and Hormones

i). Enzymes:
Classification – Enzyme kinetics-Effects of substrate concentration –Inhibition and mechanism of enzyme action- Co-enzymes.
ii). Hormones:
Classification, biosynthesis and function – Pancreatic and thyroid hormones

Unit 5: Nucleic acids and Vitamins
Composition and structure of nucleic acids; RNA and DNA - Major pathways in the synthesis of RNA and DNA

Vitamins – occurrence- grouping- deficiency diseases.

Text books
1. Firley Jems, L. and Gardon L. Kilgour. 1971 Essentials of Biological chemistry, Affiliated East West press UK

References:
3. Segal,I.H 2015 Biochemical Calculations John Wiley and Sons
4. Creighton, T.E 2012 Protein Structure and Molecular properties W.H. Freeman & Co

Practicals:

1. Qualitative tests for carbohydrates, Amino acids, proteins lipids and nucleic acids; amines urea;( thiourea).
2. Determination of the molecular weight of a mococarboxylic aminoacid by soresson formal titration
5. Estimation of RNA and DNA in tissues.
6. Kinetics or enzyme action-effect of substrate concentration (Calculation of M), temperature (calculation of energy of activation)
8. Paper chromatography of sugars and amino acids-column chromatography of separation of amino acids

**Course outcomes**

At the end of the semester students shall be able to

CO1: Able to understand various micro and macro molecules and their significance

CO2: Able to discriminate various metabolic disorders

CO3: To take up jobs in clinical labs

CO4: To analyze biological samples of bio-chemical importance

**Outcome Mapping**

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**19IZOT 102: ENDOCRINOLOGY**

**Semester: X**

**Credit Hours: 4**

**LEARNING OBJECTIVES**

- To learn general concepts of hormones and pituitary gland
- To understand structure and functions of thyroid and parathyroid gland
- To learn the structure and functions of pancreas and adrenal glands
- To acquire knowledge in the endocrinological basis of vertebrate reproduction
- To understand endocrinology of insects and crustaceans.

**Unit 1: General concept of Hormones and pituitary Gland**


Unit 2: Thyroid gland and parathyroid gland

Thyroid gland – structural organization – Biosynthesis of thyroid hormones- biological function of thyroid hormones – Thyroid dysfunction

Parathyroid – structure and functions of parathyroid hormone – hormonal regulation of calcium and phosphorus metabolism.

Unit 3: Pancreas and adrenal glands

Structure of pancreas – function of insulin – Biosynthesis and regulation of the secretion of insulin – Biological action of insulin – function of glucagon – Biological action of glucagon.


Unit 4: Vertebrate Reproductive Endocrinology


Unit 5: Insect and Crustacean Endocrinology


PRACTICAL
1. Dissection of endocrine organs in vertebrates
2. Dissection of reproductive systems in vertebrates- Demonstration
3. Histological study of pituitary, adrenal, testis, ovary, corpus luteum, pancreas and thyroid gland
4. Dissection of reproductive systems in insects.
5. Dissection of neuroendocrine complex in insects.
6. Histology of ovary, accessory glands, corpus allatum and brain in insects
7. Parabiosis in cockroach
8. Dissection of ovarietectomy in cockroach
9. Vaginal smear showing various stages of estrus cycles in mice.
10. Study on influence of insulin in blood glucose level.
TEXT BOOKS

REFERENCE BOOKS

Course outcomes
At the end of the semester students shall be able to

CO1: Master the theoretical and practical aspects of endocrinology across various phyla

CO2: Apply the endocrinological methods and procedures for higher studies and research

CO3: To take up jobs in clinical labs

CO4: To analyze biological samples of endocrinological importance

Outcome Mapping

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FIFTH YEAR : TENTH SEMESTER
19 IZO PR 104: PROJECT
DISSERTATION AND VIVA-VOCE
MEDICAL ENTOMOLOGY

LEARNING OBJECTIVES

- To acquire Knowledge of the Classification of Arthropod Vectors insects in Medical Entomology.
- To study the life Cycles of Vector Insects.
- To Learn Various Vector borne diseases - transmission and Control Measures.

UNIT - 1 : Introduction
Scope of Medical Entomology- Classification of Arthropoda. Classification of Arthropods of Medical and Public Health importance. Mechanism of Transmission of diseases by Arthropods- Mechanical and Biological; Metamorphosis – Complete and Incomplete. Insect Mouth Parts – Chewing and Sucking.

UNIT - 2 : Mosquitoes and Louse
LOUSE :- Morphology - Life cycle- Difference between Head&Body - Public Health importance – Control Measures

UNIT - 3 : Tsetse fly and Sand fly
TSETSE FLY: Morphology - Life history - Public Health importance - Control Measures.
SAND FLY :- Morphology –Difference between Male and Female - Life history - Public Health importance – Control Measures.

UNIT - 4 : Fleas and House fly
FLEAS: Morphology –Difference between Male and Female - Life history - Public Health importance – Control Measures.
HOUSE FLY:- Morphology – Life history - Public Health importance – Control Measures.
UNIT - 5: Other Arthropod vectors

Ticks: Morphology - Life cycle - Difference between Hard and Soft ticks - Public Health importance – Control Measures.

MITES: Morphology – Life history - Public Health importance – Control Measures.

Text Books:
1) D.B. Tembhare 2012, Morden Emtomology, Second Revised & Enlarged Edition – Chennai
2) Dr. B.K. Tyagi, 2012 Medical Entomology, Scientific publishers. Chennai

Reference Book
2) Vasantharaj Devid, and V.V. Ramamurthy, 2011, Elements of Economic Entomology. Namrutha Publications, Chennai -600116

Course outcomes
At the end of the semester students shall be able to

CO1: Identify insects based on morphological features
CO2: Start entrepreneurial activities in sericulture and apiculture
CO3: Take up jobs in vector control and public health departments
CO4: Take up integrated pest management activities

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LEARNING OBJECTIVES

- To refresh knowledge of basics biophysics
- To appreciate how various laws of physics are applicable in biological system
- To understand movements and dynamics properties of molecules in biological systems
- To gain the knowledge on physical properties of molecules in structural and physiological process
- To apply physical principles in chemical reactions and physiological systems

Unit – 1: Introduction

Introduction to Biophysics - Application of Physics in Biological Sciences - Biophysics of water - Molecular structure of water - Hydrogen bonds - physical properties of water.

Thermodynamics - Laws of thermodynamics and its applications to biology

Unit – 2: States of matter


Unit – 3: Membrane Biophysics


Determination of molecular weight of macro molecules by Chemical composition, Sedimentation – Molecular sieving – Light scattering – Osmotic pressure methods.

Units of measurement of solutes in solution – normal, molar, molal, milli equivalents and milli osmol, ionic strength.
Unit – 4: Biophysical basis

Biophysical basis for gaseous exchange in lungs and tissues – Partial pressure of CO₂ (pCO₂) and O₂ (pO₂) – Influence of O₂ and CO₂ in RBC and body fluids during respiration – Physiological curve of formation and dissociation of oxyhaemoglobin (HbO₂) and carbon dioxide haemoglobin (HbCO₂) – Various physiological factors in these curves


Unit – 5: Bioenergetics

Physics behind vision mechanism of accommodation, visual activity, Ophthalmoscope, colour vision, perimetry), hearing (hearing mechanics and abnormality) and mechanism of conduction of nerve impulse.


Text Books


Reference Books


Course outcomes: At the end of the semester students shall be able to

CO1: To analyze the various forces responsible of biological molecular structure
CO2: To gain the knowledge of cellular permeability
CO3: To understand the dynamics of biological systems
CO4: To correlate the biomolecular structure to its specific functions

Outcome Mapping

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LEARNING OBJECTIVES

- To acquire knowledge about the importants of aquaculture
- To know the different types culture
- To obtain knowledge about aquarium keeping
- To gather information about mariculture
- To learn the role of organizations involved in aquaculture

Unit -1

Unit - 2
Different types of cultures, Monoculture, Poly culture. Composite fish culture, Cage culture, Pen culture, Race way culture- Extensive and intensive culture.

Unit - 3
Aquarium – Setting – requirements. Major aquarium fishes (Guppy, Gold fish, fighter fish, Gourami and Zebra fish) and their biology.

Unit - 4
Mariculture – pearl oyster culture- pearl production, laboratory phase and farm phase; Shrimp culture- PL stocking in pond maintenance and management culture ponds; seaweed culture.

Unit - 5
Economics of Aquaculture. Organizations involved and their role of aquaculture – CIBA, RGCA, CIFA, CIFE, MPEDA and CMFRI.

Reference Books:
2. Keshav Kumar Jha. 2010 Aquaculture, Daya publishing, Delhi.

**Course outcomes**

At the end of the semester students shall be able to

**CO1:** Master the theoretical and practical aspects of fisheries across different species

**CO2:** Apply the Aquaculture methods and procedures for higher studies and research

**CO3:** To take up jobs in Aquaculture farms

**CO4:** To analyze biological samples of Aquaculture ponds

**Outcome Mapping**

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Course Objectives

- To generate interest in culturing fish for human consumption
- To create awareness about common cultivable fishes
- To learn various breeding techniques in fishes
- To acquire knowledge regarding various fish diseases
- To learn management of fish farm
- To develop skills in common methods of fish harvesting, preservation and processing

Unit – 1: Scope of Pisciculture and Common Cultivable Fishes

Definition, overview and scope of finfish culture in India. Desirable characteristics of cultivable fishes. Biology of Indian major carps: *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*. Biology of exotic carps: Grass carp, Silver carp and Common carp.

Unit – 2: Fish Breeding Techniques


Unit – 3: Fish Farm and its Management


Unit – 4: Common Fish Diseases and Their Management

Unit – 5 : Fish Harvesting and Post Harvesting Technologies


Text Book

References Books

Course Outcome
After successful completion of the course the candidate shall be able to:

1. Take up employment in commercial fish farms
2. Start entrepreneurship in fish farming sector.
3. Identify common cultivable fishes
4. Identify and manage common fish diseases
5. Take up employment in industrial fisheries sector
6. Start entrepreneurship involving harvesting and post harvesting technologies

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LEARNING OBJECTIVES

- To make the students to understand about Bioinformatics and its scope.
- To search and retrieve information from primary and secondary databases
- To work with the sequence alignment tools available in internet
- To gain the knowledge about various tools and applications of genomics and proteomics.
- To know about the applications of bioinformatics in various fields.

UNIT 1: Overview of Bioinformatics

UNIT 2: Bioinformatics Databases

UNIT 3: Sequence Alignment Tools
Search engines – Entrez, SRS, STAG. Sequence similarity search – Pairwise alignment – BLAST, FASTA, Multiple sequence alignment – Clustal W – Clustal X.

UNIT 4: Genomics and Proteomics
Genomics – DNA sequencing – Applications. Proteomics – Protein structure classifications – Tools and applications – Metabolomics – Tools and applications,

UNIT 5: Applications of bioinformatics
Industrial applications – Clinical and research applications – ethical and legal issues in bioinformatics – accuracy and error – appropriate uses and users.

Course outcome:
CO1: This course is designed to introduce future biologists to know about bioinformatics tools and analysis methods.
CO2: Students will become familiar with a variety of currently available genomic and proteomic databases.
CO3: Students should be more comfortable working with the vast amounts of biomedical and genomic data and online tools that will be relevant to their work in the coming decades.

CO4: This course is designed to give students both a theoretical background and a working knowledge of the techniques employed in bioinformatics.

Text Books:

Reference Books:

Course outcomes
At the end of the semester students shall be able to

CO1: Master the theoretical and practical aspects of Bio-informatics
CO2: Apply the Bio-uinformatical methods and procedures for higher studies and research
CO3: To take up jobs in medical industries
CO4: To analyze biological samples through bioinformatical importance

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86
LEARNING OBJECTIVES
The basic aim is to provide knowledge for performing laboratory investigation related to diagnosis and treatment.

Unit –1 Introduction and scope
Introduction and scope of the subject - Design of a lab - GLP, lab grades (level 1,2,3,4) - Cleaning, maintenance and care of glassware - Sterilization - physical and chemical method - Disposal of specimens and infected materials

Unit – 2 Collection of Sample

Unit – 3 Analysis
Liver Function Test- Enzymes SGOT, SGPT, Liver Pigments - Urine - collection - physical and chemical parameters routinely analyzed - Pregnancy test - Analysis of stool, semen, cerebrospinal fluid - Pathology tests for viral diseases - measles, poliomyelitis, hepatitis, HIV I

Unit – 4 Diagnosing

Unit – 5 Reporting
Records and preparation of reports
Text Books

Reference Books

Course outcomes: At the end of the semester students shall be able to

CO1: Master the theoretical and practical aspects of endocrinology across various phyla
CO2: Apply the endocrinological methods and procedures for higher studies and research
CO3: To take up jobs in clinical labs
CO4: To analyze biological samples of endocrinological importance

Outcome Mapping

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LEARNING OBJECTIVES

- To learn various insects and their classification
- To learn the morphological, anatomical and physiological systems in insects
- To learn knowledge in agricultural entomology as well as beneficial insects
- To learn vector insects and their role in public health
- To learn knowledge on pest management

Unit–1: Insect Morphology

Unit–2: Insect Physiology
Structure and Physiology of integumentary, Digestive system: Foregut, Mid gut, Hind gut, Salivary gland and Physiology of digestion.

Circulatory system: Components of Circulatory system, Haemocoel –Haemolymph of – types of haemocytes, Functions of fatbody and Physiology of circulation.

Excretory system: - Types-excretory organs – accessory excretory organs – Physiology of excretion.


Respiratory system: Trachea – Spiracles-types – terrestrial respiration – Aquatic respiration – Endoparasitic respiration

Unit–3: Agricultural Entomology
Insect pest- pest outbreak – assessment of insect population- Identification, seasonal history, biology, nature of damage and control measures of major pests of paddy, sugarcane, Vegetables (Brinjal).
Unit–4: Principles and methods of Pest Management


Unit–5: Beneficial insects and Vector insects

Sericulture: Biology of silk worm, silk gland, cultivation of mulberry plants, rearing of silkworm and uses of silk – Apiculture: types of bees, bee colony, life history, Structural adaptations - Social organization - Beekeeping accessories - composition of honey and uses of honey. Useful insects - Biology and control measures of important insect vector – mosquitoes.

TEXT BOOKS

REFERENCE BOOKS

Course outcomes
At the end of the semester students shall be able to

CO1: Identify insects based on morphological features

CO2: Start entrepreneurial activities in sericulture and apiculture
CO3: Take up jobs in vector control and public health departments

CO4: Take up integrated pest management activities

**Outcome Mapping**

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LEARNING OBJECTIVES

- To learn important vector borne diseases of human being
- To understand diseases caused by protozoans
- To acquire knowledge in diseases caused by helminthes
- To learn common air, food and water borne disease.

Unit-1: Introduction to Important Disease to Human Beings
Mosquito borne diseases – malaria, filariasis and chikungunya – symptoms and treatments. Morphology, life cycle and control measures of vector mosquitoes - Anopheles, Culex and Aedes species and vector management.

Unit-2: Vector borne Diseases to Human Beings
Vector borne diseases – Kala - azar, typhoid, amoebic dysentery, cholera and sleeping sickness- Symptoms and treatments - Morphology, life cycle and control measures of sand flies, House flies and Tsetse fly.

Unit-3: Protozoan Diseases to Human Beings
Protozoan diseases – Trypanosomiasis, Leishmaniasis and Trichomoniasis symptoms and treatments - Morphology, life cycle and control measures of Trypanosoma, Leishmania and Trichomona.

Unit-4: Helminthes Diseases to Human Beings
Helminthes diseases - Taeniasis, Schistosomiasis and Ascariasis – symptoms and treatments - Morphology, life cycle and control measures of Taenia solium, Schistosoma and Ascaris.

Unit-5: Air, Food and Water – borne diseases

TEXT BOOKS
Parastitology.S.Viswanathan Printers and Publication Pvt., Ltd.

REFERENCE BOOKS


Course outcomes

At the end of the semester students shall be able to

CO1: Analyse various common vectors and diseases, causing organisms

CO2: Impart skills the general Public for public health and hygiene

CO3: Work in clinical labs

CO4: Take up research on issues related to public health and hygiene

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LEARNING OBJECTIVES
- To learn the principles and practices followed in Inland fisheries and aquaculture
- To learn biology and fisheries potential of marine fisheries
- To acquire skills in culturing fin fishes
- To develop skill non fin fish culture
- To learn fish harvesting and post harvesting technology

Unit-1: Inland fisheries
Biology and commercial importance of major inland fishes of India: Indian major carps; air breathing fishes-Channa, Clarias, Common carp, grass carp, silver carp, trouts, mahaseer and English carp. Food and feeding habits of cultivable fishes. Age and growth determination: Scale reading, length-weight relationship.

Unit-2: Marine Fisheries
Brief out line of inshore, coastal, offshore and deep sea fishery potential of India. Biology of commercially important fishes: Hilsa, oil sardine, Mackeral and Bombay duck. Crustacen fisheries: prawns, shrimps and crabs. Molluscan fisheries: edible oyster, mussels and cephalopodes (Sepia and Loligo)

Unit-3: Fin Fish culture

Unit-4: Shell fish and sea weed culture

Unit-5: Harvesting and Post harvest technology and Economics of Aquaculture
Fish finding devices: Sonars and Echosounder. Fishing gears: Nets and seines –gill nets, fyke net, pound net, dip net, casting net; hooks and lines. Fish preservation: Common
principles of fish preservation and major methods of fish preservation. Fishery products and by products: Fish liver oil, fish body oil, fish meal, fish flour, fish silage, fish manure and guano, fish sausage, fish glue, isinglass, fish leather, fish macroni. Fish and prawn economics of aquaculture – Fish and prawn marketing.

TEXT BOOKS

REFERENCE BOOKS

Course outcomes
At the end of the semester students shall be able to

CO1: Understand and analyse various issues related to fisheries and aquaculture

CO2: Take up jobs in fisheries and aquaculture sectors

CO3: Start aquaculture activities on their own

CO4: Take up jobs in marine product export sectors

CO5: Take up research activities in various fisheries institutions and Universities

Outcome Mapping

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LEARNING OBJECTIVES

- To learn the concepts and processes involved in toxicology
- To understand the various methods of absorption and distribution of toxicology
- To study the biotransformation and excretion of toxicants
- To learn the impacts of toxicants and human beings.
- To learn the application of antidotes and biomonitoring

UNIT-1: Introduction to Toxicology

UNIT-2: Exposure Route, Absorption and Distribution of Toxicants

UNIT-3: Biotransformation and Excretion of Toxicants
UNIT- 4: Toxic effects on Human


UNIT- 5: Antidotes and Biomonitoring

Antidotes: Classification of antidotes– Mechanism of action of antidotes-Specific antidotes for metals and pesticides.


TEXT BOOKS

REFERENCE BOOKS

Course outcome

At the end of the semester students shall be able to
CO1: Carry out toxicological analysis of various environmental samples

CO2: Make observations and biochemical analysis of biological samples

CO3: Carry out toxicological testing using live specimen to determine toxicity of toxicants

CO4: Take up jobs in toxicological research institutions and clinical labs

**Outcome Mapping**

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ANCILLARY - I

INTEGRATED M.Sc ZOOLOGY (5 Years) SYLLABUS FOR ANCILLARY PAPER OPTED
BY OTHER SCIENCE DEPARTMENT

19IZOA15: ANCILLARY ZOOLOGY- I (ANIMAL DIVERSITY-I)

LEARNING OBJECTIVES

- To lean the principles of animal taxonomy
- To learn the classification of animals upto orders
- To learn the salient features and various systems of different phyla

UNIT- 1

Principles of classification-salient features and classification upto orders in non-chordates. Protozoa- Type study Entamoeba. Porifera and coelenterata-Type Sycon sponge, Obelia

UNIT- 2

Platyhelminthes and Nemathelminthes-Type study-Planaria- parasitic adaptations. Ascaris- Annelida –Salient features-Type study-Earthworm,. 

UNIT- 3

Arthropoda-Salient features-Cockroach- Molluscs-Salient features Type study-Fresh water mussel- torsion in mollusca- Echinodermata-Salient features Asterias-Echinoderm larvae-their significance.

UNIT- 4

Orgin and salient features of chordates. Agnatha - salient features-Type study-affinities Fishes- parental care ,respiratory organs, migration. Amphibians- Salient features -parental care

UNIT- 5


PRACTICALS

1. Examination of paramecium, amoeba, euglena.
2. Study of sycon, hylonema and spongilla from slides and specimens
3. Slides and specimens of hydra, obelia, aurelia, sea-anemone, 4. Slides and specimens of Fasciola and Taenia
5. Slides and specimens of ascaris
6. Cockroach – demonstration of digestive system and mounting of mounth parts
7. Prawn- demonstration and mounts: Mounts of Radula, ctenidium
8. Echinoderm -specimen study.
10. Reptiles- museum specimens.
11. Aves-mounts and museum specimens.
12. Mammals- museum specimens

TEXT BOOKS:
   S.Viswanathan Printers and publishers, Pvt.Ltd.,Madras

REFERENCE BOOKS

Course Outcomes
CO1: Identify a fauna based on morphological character
CO2: Identify poisonous and non-poisonous snakes

CO3: Identify extinct fauna

CO4: Distinguish primitive mammals

CO5: Understand origin of chordates

**Outcome Mapping**

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LEARNING OBJECTIVES

- To learn the cytological details of cells
- To learn anatomical details of human
- To learn the basic principles of genetics
- To learn the developmental process in frog
- To learn basic concepts of evolution

Unit 1: Cell Biology

Introduction: Microscopy and Cytological techniques.


Unit 2: Human Anatomy


Unit 3: Genetics

Introduction - Multiple alleles - Quantitative inheritance – Sex determination - Sex linked inheritance - Pleiotropy-Hardy Weinberg law- Population genetics.

Unit 4: Developmental Biology

Introduction - Types of eggs - Cleavage and types - Frog’s egg - Gastrulation in frog embryo - Organogenesis in frog-Development of eye and heart in frog.

Unit 5: Origin of life

Theories - Geological time scale - Fossils - Extinct animals – Mass extinction-Evidences for evolution-Comparative anatomy-Embryology- Physiology-Vestigeal organs-Geographical distribution.

Practicals:
1. Study of microscope-Light Microscope
2. Preparation of mitosis in onion root tip
3. Identification of blood group
4. Experiments on mendelian inheritance
5. Vital staining chick blastoderm
6. Study of animal adaptation

Text Books:


Reference Books


Course outcomes
At the end of the semester students shall be able to

CO1: Identify various organelles and their functions
CO2: Correlate developmental patterns in animals
CO3: Understand evolutionary process taking place in biological world
CO4: Analyse the anatomical details of human
CO5: Critically evaluate genetic principles involved in multiple alleles and sex determination

**Outcome Mapping**

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ELECTIVE COURSES OFFERED TO THE STUDENTS OF OTHER DEPARTMENT
IN VIII SEMESTER

19IZOOX815 : ANIMAL CULTURE TECHNIQUES

LEARNING OBJECTIVES

- To learn vermicomposting
- To understand epiculture
- To study sericulture
- To learn aquaculture

Unit-1: Vermicomposting

Unit-2: Apiculture
Types of honey bees-bee colony-Structural adaptation and social life in honey bees - types of bee hives and other accessories - apiary -uses of honey.

Unit-3: Sericulture

Unit-4: Fish culture
Types of culture, types of ponds, general culture techniques - induced breeding - culture of edible fishes.

Unit–5: Prawn culture
Prawn culture: Cultivable species – characteristics – Types of culture, shrimp farming prawn culture – harvesting, marketing – indirect breading.

TEXT BOOKS
REFERENCE BOOKS
5) Francis Francis. 2015. Fish Culture: A Practical guide to the Modern system of Breeding and Rearing Fish. Sagwan Press.

Course outcomes
At the end of the semester students shall be able to
CO1: Start entrepreneurial activities involving solid waste management and Vermicomposting
CO2: Take up apiculture as a profession
CO3: Take up sericulture
CO4: Start aquaculture

Outcome Mapping

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ELECTIVE COURSES OFFERED TO THE STUDENTS OF OTHER DEPARTMENT

IN IX SEMESTER

19IZOOX915 : ENVIRONMENTAL SCIENCE

LEARNING OBJECTIVE

- To study basic environment and its problems
- To understand natural resources and conservation
- To learn various aspects of biodiversity
- To understand biosphere degradation
- To learn EIA, Climate change and global warming.

UNIT-1: Basics of Environment


UNIT -2: Natural Resources and Their Conservation

Definition and classification of natural resources: Based on chemical nature, abundance, occurrence and origin. Causes of depletion of natural resources - Uneven distribution, population growth, industrial development, over exploitation for economic development. Conservation of natural resources. Equitable use of resources and sustainable development.

UNIT -3: Biodiversity and its Conservation


Unit -4: Biosphere Degradation

Environmental pollution: Sources, effects and control measures of air, water, noise and radiation pollutions. Issues and challenges of solid wastes and their management.
Pollution case studies in India – Bhopal gas tragedy, Ganga river pollution and Tajmahal pollution issue.

**Unit- 5 :EIA, Climate Change And Global Warming**


**TEXT BOOKS**

**REFERENCE BOOKS**

**Course outcomes**

At the end of the semester students shall be able to

CO1: Identify environmental issues

CO2: Appreciate wild life and natural resources

CO3: Develop talent to conserve nature

CO4: Provide basic environmental education to the society

**Outcome Mapping**

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VALUE ADDED COURSE

(Combindly offered by Department of Physics and Zoology)

19IPHYX915.1:BIO- MEDICAL INSTRUMENTATION

LEARNING OBJECTIVE

- To understand the basic structural and functional elements of human body
- To learn separation technique for biomolecules
- To learn bio-electric and biopotential
- To learn imaging instruments

Unit 1: Basic Elements of human Body


Unit 2: Separation techniques for Bio-molecules


Chromatography: Principles, methods and application of paper chromatography, thin layer chromatography (TLC), Gas chromatography (GC) Gas liquid chromatography (GLC), High performance liquid chromatography( HPLC), Ion-Exchange chromatography.

Unit 3: Bio-Electric Potentials

Unit 4: Bio- Potential Electrodes


Unit 5: Imaging Equipments


Text Books and References:

Course outcomes

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

CO1: Understand the structure and physiological functioning of various organ systems of human body
CO2: Master the common bio-separation techniques used for clinical applications
CO3: Operate various medical equipments working on the principles of bio-electric Potentials
CO4: Understand the basic principles and operations of various imaging equipments used in the clinical field
CO5: Takeup jobs in various clinical labs, hospitals and related institutions

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