FACULTY OF SCIENCE
DEPARTMENT OF ZOOLOGY
UGC-SAP and DST-FIST Sponsored

M.Sc. ZOOLOGY
(TWO YEARS PROGRAMME)
PROGRAMME CODE: SZOO 21

HAND BOOK
Regulations & Curriculum-2019

2019-2020
(Onwards)
These Regulations are common to all the students admitted to the Two-Year Master’s Programmes in the Faculties of Arts, Science, Indian Languages, Education, Marine Sciences, and Fine Arts 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 the 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 duration of 90 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 **Credit** refers to the quantum of course work in terms of 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.

1.15 **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.

1.16 **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.

1.17 **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.

1.18 **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.

1.19 **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.

1.20 **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

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

1.22 **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, RA, and W.

2. **Programme Offered and Eligibility Criteria**

<table>
<thead>
<tr>
<th>Faculty of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Sc. Zoology</td>
</tr>
</tbody>
</table>

2.1 In the case of SC/ST and Differently-abled candidates, a pass is the minimum qualification for the above Programme.

3. **Reservation Policy**

   Admission to the programme will be strictly based on the reservation policy of the Government of Tamil Nadu.

4. **Programme Duration**

   4.1 The Two Year Master’s Programme consists of two academic years.

   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 Two Year Master’s Programme consists of Core Courses, Elective Courses (Departmental & Interdepartmental) and Project.

5.2 Core courses
5.2.1 These are a set of compulsory courses essential for each programme.

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

5.3 Elective courses
5.3.1 Departmental Electives (DEs) are the Electives that students can choose from a range of Electives offered within the Department.

5.3.2 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.

5.3.3 Students shall take a combination of both DEs and IDEs.

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

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

5.4.3 Experiential learning is categorised as Core.

5.5 Project
5.5.1 Each student shall undertake a Project in the final semester.

5.5.2 The Head of the Department shall assign a Research Supervisor to the student.

5.5.3 The Research Supervisor shall assign a topic for research and monitor the progress of the student periodically.

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

5.6 Value added Courses (VACs)
5.6.1 Students may also opt to take Value added Courses beyond the minimum credits required for award of the Degree. VACs are outside the normal credit paradigm.

5.6.2 These courses impart employable and life skills. VACs are listed in the University website and in the Handbook on Interdepartmental Electives and VACs.

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

5.6.4 Classes for a VAC are conducted beyond the regular class hours and preferably in the II and III Semesters.
5.7 **Online Courses**
5.7.1 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.

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

5.8 **Credit Distribution**

The credit distribution is organised as follows:

<table>
<thead>
<tr>
<th></th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>65-75</td>
</tr>
<tr>
<td>Elective Courses</td>
<td>15</td>
</tr>
<tr>
<td>Project</td>
<td>6-8</td>
</tr>
<tr>
<td>Total (Minimum requirement for award of Degree)</td>
<td>90-95*</td>
</tr>
</tbody>
</table>

*Each Department shall fix the minimum required credits for award of the Degree within the prescribed range of 90-95 credits.*

5.9 **Credit Assignment**

Each course is assigned credits and credit hours on the following basis:

1. Credit is defined as
2. 1 Lecture period of one hour per week over a semester
3. 1 Tutorial period of one hour per week over a semester
4. 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 candidates 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 shall have a minimum of 75% attendance in all 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, representing the University in extracurricular activities and participation in NCC/NSS/YRC/RRC.

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 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 to 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 two 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 (ESE)
8.5.1 The ESE for the first/third semester will be conducted in November and for the second/fourth semester in May.

8.5.2 A candidate who does not pass the examination in any course(s) of the first, second and third semesters will be permitted to reappear in such course(s) that will be held in April and November 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, 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>05</td>
</tr>
<tr>
<td>Assignment</td>
<td>05</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 Evaluation for the ESE is done by both External and Internal examiners (Double Evaluation).

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 a Review of literature survey, 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 the Head of the Department, Project Supervisor, and a senior faculty.

9.4.6 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 Assessment of VACs shall be internal.

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 student 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 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 \( i \) in any semester; \( G_i \) is the Grade Point obtained by the student for the Course \( i \) and \( n \) 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.

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

where, \( C_i \) is the Credit earned for the Course \( i \) in any semester; \( G_i \) is the Grade Point obtained by the student for the Course \( i \) and \( m \) is the number of courses.

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 and 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 student 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 successfully completed 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 candidate has appeared for clearance of the arrears.

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 course or 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), and 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 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) when the course(s) are offered next.

12.7 Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the candidate 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 library or computer resources, stealing other students’ notes/assignments, and 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 Two Year 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.**
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>L</th>
<th>P</th>
<th>C</th>
<th>Inter. Mark</th>
<th>Exter. Mark</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I SEMESTER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>19ZOO101</td>
<td>Structure and functions of Invertebrates and Vertebrates</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
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<tr>
<td>19ZOO102</td>
<td>Developmental Biology</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
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<tr>
<td>19ZOO103</td>
<td>Cell and Molecular biology</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>19ZOOD104</td>
<td>Core Practical –I Pre lab Discussion ( 1 hour)</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practical I (11 hours) (Covering ZOOC 101,102 &amp; 103)</td>
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<td></td>
<td>12</td>
<td>6</td>
<td>40</td>
<td>100</td>
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<tr>
<td></td>
<td><strong>Elective 1: Interdepartmental Elective</strong></td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
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<td></td>
<td></td>
<td></td>
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<td>II SEMESTER</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>19ZOO201</td>
<td>Animal Physiology</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
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<tr>
<td>19ZOO202</td>
<td>Genetics</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
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<tr>
<td>19ZOO203</td>
<td>Immunology</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
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<tr>
<td>19ZOOD204</td>
<td>Core Practical- II Pre lab Discussion ( 1 hour)</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
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<tr>
<td></td>
<td>Practical II (11 hours) (Covering ZOOC 201,202 &amp; 203)</td>
<td></td>
<td></td>
<td>12</td>
<td>6</td>
<td>40</td>
<td>100</td>
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<tr>
<td></td>
<td><strong>Elective II – Department Elective</strong></td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Elective III – Interdepartmental Elective</strong></td>
<td>3</td>
<td>3</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
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<td></td>
<td><strong>Total</strong></td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>600</td>
</tr>
<tr>
<td>III SEMESTER</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>19ZOO301</td>
<td>Evolution</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
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<tr>
<td>19ZOO302</td>
<td>Environment &amp; Biodiversity conservation</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<td>19ZOO303</td>
<td>Animal Behaviours</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
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<td>Biotechnology</td>
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<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
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<td>19ZOOD305</td>
<td>Core Practical -III Pre lab Discussion ( 1 hour)</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practical III (11 hours) (Covering ZOOC 301,302,303 &amp; 304)</td>
<td></td>
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## IV SEMESTER

<table>
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<th>Int. Ass. Marks 25</th>
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<tr>
<td>19ZOOE401</td>
<td>Bio-chemistry</td>
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<td>19ZOOE402</td>
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<td>19ZOOE403</td>
<td>Core Practical- IV Pre lab Discussion (1 hour) Practical IV (11 hours) (Covering ZOOC 401 &amp; 402)</td>
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<td>19ZOOPJ404</td>
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**Total** 20 400

**TOTAL CREDITS** 93

**Value Added Courses**

Online Courses(SWAYAM, MOOC, NPTEL)

---

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

**Note:**

1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available.
2. Students may opt for any Value-added Courses listed in the University website.

### DEPARTMENT ELECTIVES

#### II and III Semester

<table>
<thead>
<tr>
<th>Semester &amp; Course Code</th>
<th>Course Title</th>
<th>L</th>
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<tbody>
<tr>
<td>II Semester Elective II</td>
<td>Entomology (or) Public Health and Hygiene</td>
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## Elective Courses offered to the students of Other Departments in II and III Semesters (Inter-Department Electives)

<table>
<thead>
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<th>Semester &amp; Course Code</th>
<th>Course Title</th>
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<td>III Semester 19ZOOX316-1</td>
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## Value Added Courses offered to Other Science Department (Combinedly offered by Department of Physics and Zoology)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
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<td>Bio-Medical Instrumentation</td>
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## POs for Science Faculty

<table>
<thead>
<tr>
<th>PO</th>
<th>Category</th>
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<tbody>
<tr>
<td>PO1</td>
<td>Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.</td>
</tr>
<tr>
<td>PO2</td>
<td>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</td>
</tr>
<tr>
<td>PO3</td>
<td>Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.</td>
</tr>
<tr>
<td>PO4</td>
<td>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.</td>
</tr>
<tr>
<td>PO5</td>
<td>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.</td>
</tr>
<tr>
<td>PO6</td>
<td>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.</td>
</tr>
<tr>
<td>PO7</td>
<td>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.</td>
</tr>
<tr>
<td>PO8</td>
<td>Environment and Society: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.</td>
</tr>
<tr>
<td>PO9</td>
<td>Ethics: Commitment to professional ethics and responsibilities.</td>
</tr>
<tr>
<td>PO10</td>
<td>Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline</td>
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</table>
## Programme Specific Objectives (PSOs)

<table>
<thead>
<tr>
<th>PSO1</th>
<th>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.</th>
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<tbody>
<tr>
<td>PSO2</td>
<td>To acquire skills in utilizing the fundamental knowledge gained in various fields of biological sciences in teaching learning activities.</td>
</tr>
<tr>
<td>PSO3</td>
<td>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.</td>
</tr>
<tr>
<td>PSO4</td>
<td>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.</td>
</tr>
<tr>
<td>PSO5</td>
<td>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.</td>
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</table>
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 if various groups if invertebrates.
- To evaluate the larval forms of invertebrates to acquire knowledge on various organ system 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, featter and hairs. Skeletal elements of the body – account of jaw suspensrorium, vertebral column – limbs and girdles.

Unit V: Respiratory system and Nervous system of Vertebrates

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

**TEXT BOOKS**

**REFERENCE BOOKS**

**Course outcomes**

At the end of the semester students shall be able to

CO1: Understand the morphological features and physiological features like respiration and 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
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 I: Introduction to Embryology


UNIT II: Embryonic adaptations and Parthenogenesis.


UNIT III: 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 IV: Embryonic induction and Teratogenesis


UNIT V: Reproductive Technology for Human Welfare


PRACTICAL

1. Demonstration of male and female reproductive system in mammals (rat) - specimens
2. Dissection and mounting of chick blastoderm 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

Outcome Mapping

<table>
<thead>
<tr>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
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<th>PSO2</th>
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</table>
LEARNING OBJECTIVES

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

Unit–I: Cell structure and Cell membrane

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


Unit–II: Organelles of Endomembrane


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–III: 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.

Organalle of Biogenesis: Chloroplast – Ultrastructure- photochemical reaction in biogenesis - Light reaction and Dark reaction – Role of CO₂ and H₂O in photosynthesis – 'Z' scheme.

Unit-IV: DNA Structure and Replication

Structure, Chemical composition- Types and their importance- Properties of DNA - Denarturatin, 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-V: 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: Aquire knowledge on cellular structure and functions.

CO2: Understand the process of energetic and genesis in cells
CO3: Interpret the structural and functional significances of DNA and RNA

CO4: Take up jobs in molecular biology labs and clinical labs

<table>
<thead>
<tr>
<th>Outcome Mapping</th>
<th>CO/PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
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FIRST YEAR : SECOND SEMESTER

19 ZOO C 201: ANIMAL PHYSIOLOGY

LEARNING OBJECTIVES
- To learn the significance of food and physiology of diagram
- 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–I: Food and Digestion

Unit–II: Excretion and Osmoregulation

Unit–III: 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–IV: Respiration
Unit–V: Nervous system, Muscle and Sense organs


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

Sense Organs Mehanoreceptors – chemoreceptors - photoreceptors – phonoreceptors – equilibrium receptor - Bioluminescence.

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
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-I: Principles and Concepts of Gene and Gene mapping


Unit-II: Quantitative, Population and Human Genetics


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


Unit-IV: Chromosomal Alterations, Gene Mutation and Oncogens


Unit-V: 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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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-I: Overview and Scope of Immunology

Unit-II: 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, TH 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-III: Immunogen and Antigen

Unit-IV: Antibodies
Organ specific – insulin-dependent diabetes mellitus and Graves’ disease; systemic – rheumatoid arthritis and multiple sclerosis.

**Unit-V Antigen – Antibody Interactions**


**PRACTICAL**

1. Demonstration of lymphoid organs
2. Cell imprinting of lymphoid organs
3. Histology of lymphoid organs
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 in immunological issues
- **CO2:** Apply immunological procedures 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 institution
- **CO6:** Equip themselves for higher studies
SECOND YEAR : THIRD SEMESTER

19ZOOC301: EVOLUTION

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 I: Origin


Theories

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


Natural Selection and process:


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

Unit II: Mechanism

i) Variation and evolution

Basic units of variability – effect and types. Geni mutations-chromosomal rearrangements –change in chromosome number chromosome segregation and recombination- crossing over- mutation and its role in 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 polymer-phism 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 animal and plants- types of polyploids- direct effect of Polyploidy-origin – polyploidy and the origin of higher categories in plants – practical significance.

Unit III
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- Monotypie and polytypic – Sub-species categories .
Types of speciation: Mechanism of speciation-allopatric speciation sympatric-speciation- quantum evolution- evolutionary significance.

Unit IV
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.

Unit V:
i) Trends and rated
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 of 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.
Text book:

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

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- E.g. Sea Horse (male) (c) Special sound producing organs E.g seale insect (male) (d) Special using Rhinoceros beetle (male).
3. Polymorphism- (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

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 I: Basic concepts and environmental impact assessment


Unit II: 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 Brundtland report.

Unit III: 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 IV: Biodiversity and its conservation


Unit V: 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
CO5. Take up employment in environment related agencies and institution
CO6. Spear head the measure against global warming
CO7. Educate the public regarding the importance of rain water harvesting and water conservation.
19ZOOC303: ANIMAL BEHAVIOURS

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 I: 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 rhymes in animal behaviour.

Unit II: Communication behaviour

Unit III: Behavioural genetics
Fundamentals of behavioural genetics –Genetic basis of behaviour – Mutations – knockout genes- genetic mosaic fruitflies- multiple genes – polygenic effects on behaviour – genes effect on physiological – Feeding behaviours of animals

Unit IV: Social behaviour

Unit V: 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

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19ZOOC304: BIOTECHNOLOGY

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

Unit–IV: Agricultural Biotechnology

Unit–V: Microbial and Environmental Biotechnology

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

Outcome Mapping

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SECOND YEAR
FOURTH SEMESTER
19ZOOC401: BIOCHEMISTRY

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 I: Buffers and Carbohydrate.
  i). PH and buffers – Water, carbon dioxide 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 II: Proteins:
Classification and isolation - The fundamental physiochemical principles and structure of amino acids, peptides and proteins- protein metabolism – Metabolism of amino acids in general.
Unit III: Lipids:
Classification of lipids- Structure and chemistry of single and compound lipids; metabolism of fats and fatty acids- Defects in lipid metabolism

Unit IV: 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 V: 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

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:
Preparation and use of buffers.

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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19ZOOC402: ENDOCRINOLOGY

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–I: General concept of Hormones and pituitary Gland


Pituitary gland – structural organization – anterior pituitary, Pars intermedia and neurohypophysis - Hypothalamic control of pituitary function. Pituitary hormones – functions - neurohormonal peptides-diuresis and antidiuresis-

Unit- II: 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–III: 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-IV: Vertebrate Reproductive Endocrinology


Unit-V: Insect and Crustacean Endocrinology


PRACTICAL
1. Dissection of endocrine organs in vertebrates
2. Dissection of reproductive systems in vertebrates
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. Dissection of parabiosis in cockroach
8. Dissection of ovariectomy in cockroach
9. Vaginal smear showing various stages of estrus cycles.
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

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ZOO PJ 416: PROJECT
DISSERTATION AND VIVA-VOCE
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–I: Insect Morphology


Unit–II: 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–III: 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–IV: Principles and methods of Pest Management


Unit–V: 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 adaptions - 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-I: 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-II: 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-III: Protozoan Diseases to Human Beings
Protozoan diseases – Trypanosomiasis, Leishmaniasis and Trichomoniasis symptoms and treatments - Morphology, life cycle and control measures of Trypanosoma, Leishmania and Trichomonas.

Unit-IV: 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-V: Air, Food and Water – borne diseases

TEXT BOOKS
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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ELECTIVE IV - DEPARTMENT ELECTIVE
IN THIRD SEMESTER

19ZOOE315-1: FISHERIES AND AQUACULTURE

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 skills in non-fin fish culture
- To learn fish harvesting and post-harvesting technology

Unit- I: 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-II: Marine Fisheries

Brief outline of inshore, coastal, offshore and deep sea fishery potential of India. Biology of commercially important fishes: Hilsa, oil sardine, Mackeral and Bombay duck. Crustacean fisheries: prawns, shrimps and crabs. Molluscan fisheries: edible oyster, mussels and cephalopodes (Sepia and Loligo)

Unit-III: Fin Fish culture


Unit-IV: Shell fish and sea weed culture

Culture of fresh water prawn - Macrobrachium rosenbergii. Culture of brakishwater prawn Litopenaeus vannamei. Culture of pearl oyster (Pinctada fucata), green mussel (Perna viridis), lobster (Panulirus homarus). Culture of sea weed.

Unit-V: 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 – process.

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
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19ZOOE315-2: TOXICOLOGY

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-I: Introduction to Toxicology

UNIT-II: Exposure Route, Absorption and Distribution of Toxicants
Route of exposure of Toxicants: Dermal route – Inhalation route – Ingestion route.

UNIT-III: Biotransformation and Excretion of Toxicants
Excretion of Toxicants: Urinary excretion – Biliary excretion - Lungs and other routes.

UNIT-IV: TOXIC EFFECTS ON HUMAN
UNIT-V: 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

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INTERDEPARTMENTAL ELECTIVE

IN II SEMESTER

19ZOOE216-1 : ANIMAL CULTURE TECHNIQUES

LEARNING OBJECTIVES

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

Unit-I: Vermicomposting

Unit-II: 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-III: Sericulture

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

Unit–V: 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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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 I: Basics of Environment

UNIT II 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 III: Biodiversity and its Conservation
Concept and types of biodiversity: Genetic, species, ecosystem, point, alpha, gamma and epsilon diversity. Biodiversity hotspots of India. WCU (I.U.C.N.) Red Data Book- extinct, extinct in wild, critically endangered, endangered and vulnerable species. Factors contributing to biodiversity crisis. Conservation of biodiversity – In-Situ conservation and Ex-situ conservation

Unit IV: 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 V: 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

(Combinedly offered by Department of Physics and Zoology)

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 I: Basic Elements of human Body


Unit II: 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 III: Bio-Electric Potentials


Unit IV: Bio- Potential Electrodes


Unit V: 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

Outcome Mapping

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