ANNAMALAI UNIVERSITY

Accredited with "A+" Grade by NAAC

FACULTY OF SCIENCE

DEPARTMENT OF ZOOLOGY

(UGC-SAP AND DST-FIST SPONSORED)

M.Sc. ZOOLOGY TWO YEAR PROGRAMME

PROGRAMME CODE: SZOO 21

These Rules and Regulations shall govern the Two Year Post graduate studies leading to the award of degree of **Master of Science in Zoology** in the Faculties of Science. These academic Regulations shall be called **Annamalai University, Faculty of Science M.Sc. Zoology (Two Year) Regulations 2023.** They shall come into force with effect from the academic year 2023-2024.

1. Definitions and Nomenclature

1.1 **University** refers to Annamalai University.

1.2 **Department** means any of the academic departments and academic centers 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.

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 **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.

1.12 **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.

1.13 **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.

1.14 **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.

1.15 **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.

1.16 **Expected Course Outcomes** 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.

1.17 **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

1.18 **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 and is given in section 11.4.

1.19 **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

The Department of Zoology offers M.Sc. Zoology Two Year Programme. A pass in Bachelor's Degree with Zoology as major subject and Botany and Chemistry as ancillary subjects (or) B.Sc. (Hons) with Zoology, Botany and Chemistry as subjects with not less than 50% of marks in Part III.

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 various programmes 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

The Two Year Master's Programme consists of Core Courses, Elective Courses (Discipline Centric/Generic), Project, Skill Enhancement Courses, Internship/Industrial visit and Extension activity.

5.1. Core courses:

5.1.1. Core Course is mandatory and an essential requirement to qualify for the Degree.

5.1.2 These are a set of compulsory courses essential for each programme.

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

5.2. Elective courses: Generic/ Discipline Centric is a course that a student can choose from a range of alternatives.

5.3. Project with viva voce

5.3.1 Each student shall undertake a Project and submit a dissertation as per guidelines in the final semester.

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

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

5.3.4 Students who wish to undertake project work in recognized institutions/industry shall obtain prior permission from the University. The Research Supervisor will be from the host institute.

5.4 Skill Enhancement Courses: SEC is a course designed to provide value-based or skill-based knowledge. The main purpose of these courses is to provide students with life-skills in the hands-on mode to increase their employability.

5.5. Industry/Entrepreneurship

This course is to introduce students to the activity of setting up a business or businesses, taking on financial risks in the hope of profit.

5.6. Experiential Learning- Internship / Industrial activities

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

5.6.2 In-plant training/field trips/internships/industrial visits fall under this category.

5.6.3 Experiential learning is categorized as non-Core Course.

5.7. Extension Activity

5.7.1 t is mandatory for every student to participate in extension activities.

5.7.2 All the students shall enroll under NSS/NCC/YRC/RRC or any other Service organisation in the University.

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

5.7.4 Extension activities shall be conducted outside the class hours

5.7.5 Extension activities is categorized as Non-Core Course.

5.8 Value added Courses (VACs)

5.8.1 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.

5.8.2 These courses impart employable and life skills.

5.9 Online Courses

5.9. 1 The Heads of Departments shall facilitate enrolment of students in Massive Open Online Courses (MOOCs) platform such as SWAYAM and NPTEL to provide academic flexibility and enhance the academic career of students.

5.10. Credit Distribution: The credit distribution is organized as follows:

Component	Courses	Credits
Part - A	Core (Theory)	**44**
	Core (Practical)	**13**
	Project with Viva-Voce	**07**
Part – B (i)	Electives (Generic/Discipline Centric)	**18**
Part – B (ii)	Internship/ Industrial Activity	**02**
Part – B (ii)	Skill Enhancement Course	**06**
Part – C	Extension Activity	**01**
	Total Credits	**91**

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree.

5.11. 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 Practical/Project period of two or three hours per week over a semester.

6. Attendance

6.1. Each Course teacher 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 organization of lesson plan of the Course teacher.

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 placed in safe custody for any future verification.

6.5. The Course teacher 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 repeat 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 Course teacher 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. 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 question paper will be set by the respective course teacher using bloom taxonomy.

8.4.4 CIA Tests will be for two or three hours duration depending on the quantum of syllabus.

8.4.5 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.

8.4.6 For the CIA Tests, the assessment will be done by the Course teacher.

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 Candidates who failed in any course will be permitted to reappear in failed course in the subsequent examinations.

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 and project, CIA Tests will carry 25% and the ESE 75% of the marks.

9.1.3. For the Practical courses, the CIA Tests will carry 25% and the ESE 750% of the marks.

9.2. Assessment of CIA Test

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

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

CIA for Theory	Marks
Test-I & Test-II	15
Seminar	5
Assignment	5
Total	25

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

CIA for Practical	Marks
Test-I	10
Test-II	10
Record	05
Total	25

9.3. Assessment of End-Semester Examinations

9.3.1 Evaluation for the ESE is done by Internal examiner.

9.4. Assessment of Project/Dissertation

9.4.1. The Project Report/Dissertation shall be submitted as per the guidelines.

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:

Continuous Internal Assessment (25 Marks)		End Semester Examination (75 Marks)		
Review - I	Review - II	Project/Dissertation Evaluation	Periodical Presentation	Viva - Voce
10	15	50	15	10

9.5. **Passing Minimum**

9.5.1 A student is declared to have passed in each course if he/she secures not less than 50% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.

9.5.2 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.

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, $\boldsymbol{C_i}$ is the Credit earned for the Course $\boldsymbol{i}$ in any semester;

$\boldsymbol{G_i}$ is the Grade Point obtained by the student for the Course $\boldsymbol{i}$ and

$\boldsymbol{n}$ 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.

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

where, $\boldsymbol{C_i}$ is the Credit earned for the Course $\boldsymbol{i}$ in any semester;

$\boldsymbol{G_i}$ is the Grade Point obtained by the student for the Course $\boldsymbol{i}$and

$\boldsymbol{n}$ is the number of Courses passed in that semester.

$\boldsymbol{m}$ is the number of semesters

11.5. Evaluation :

11.5.1. Performance of the student for each course will be rated as shown in the Table.

Range of Marks	Grade Points	Letter Grade
90 and above	10	S
80-89	9	A
70-79	8	B
60-69	7	C
55-59	6	D
50-54	5	E
Less than 50	0	RA
Withdrawn from the examination	0	W

11.5.2. A ten point rating scale is used for evaluation of the performance of the student to provide overall grade for the Master's Programme.

CGPA	**CLASSIFICATION OF FINAL RESULT**
8.25 and above	First Class with Distinction
6.5 and above but below 8.25	First Class
5.0 and above but below 6.5	Second Class
0.0 and above but below 5.0	Re-appear

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 overall highest CGPA in all examinations in 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 sheet 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.

12.4. 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.

12.5. 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.

12.6. Withdrawal is not granted for arrear examinations of courses in previous semesters and for the final semester examinations.

12.7. Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) when the course(s) are offered next.

12.8. 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 sensitized 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.

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DEPARTMENT OF ZOOLOGY

(UGC-SAP and DST-FIST Sponsored)

M.Sc. ZOOLOGY (TWO YEAR PROGRAMME)

Programme Code: SZOO 21

CURRICULA AND SCHEME OF EXAMINATIONS (2023 – 2024 onwards)

Course Code	Course Title	Credit	Hours/ Week	Marks		
				CIA	ESE	Total
	Semester - I					
23ZOOC101	Core - I: Structure and function of Invertebrates	5	7	25	75	100
23ZOOC102	Core - II: Comparative Anatomy of Vertebrates	5	7	25	75	100
23ZOOP103	Core - III: Practical – I: Lab Course in Invertebrates & Vertebrates	4	6	25	75	100
23ZOOE104 23ZOOE105 23ZOOE106	Elective - I : Discipline Centric: Molecules and their Interaction relevant to Biology / Medical Entomology Sericulture	3	5	25	75	100
23ZOOE107 23ZOOE108 23ZOOE109	Elective - II :Generic Centric: Biostatistics / Toxicology/ Apiculture	3	5	25	75	100
	Total	20	30			500
	Semester - II					
23ZOOC201	Core - IV: Cellular and Molecular Biology	5	6	25	75	100
23ZOOC202	Core - V: Developmental Biology	5	6	25	75	100
23ZOOP203	Core - VI: Practical – II : Lab Course in Cell Biology & Developmental Biology	4	6	25	75	100
23ZOOE204 23ZOOE205 23ZOOE206	Elective - III : Discipline Centric: Economic Entomology / Biodiversity and Conservation/ Vermiculture	3	4	25	75	100
23ZOOE207 23ZOOE208 23ZOOE209	Elective - IV : Generic Centric: Research Methodology / Basic Biotechnology/ Biocomposting	3	4	25	75	100
23ZOOS210	Skill Enhancement Course (SEC) – I : Poultry Farming	2	4	25	75	100
	Total	22	30			600

	Semester - III					
23ZOOC301	**Core - VII: Genetics**	**5**	**6**	**25**	**75**	**100**
23ZOOC302	**Core - VIII: Evolution**	**5**	**6**	**25**	**75**	**100**
23ZOOC303	**Core - IX: Animal Physiology**	**5**	**6**	**25**	**75**	**100**
23ZOOP304	**Core - X: Practical – III: Lab Course in Genetics, Evolution & Animal Physiology**	**4**	**6**	**25**	**75**	**100**
23ZOOE305 **23ZOOE306** **23ZOOE307**	**Elective - V : Discipline Centric:** **Stem cell Biology/** **Aquaculture/** **Endocrinology**	**3**	**3**	**25**	**75**	**100**
23ZOOS308	**Skill Enhancement Course (SEC) – II: Dairy Farming**	**2**	**3**	**25**	**75**	**100**
23ZOOI309	**Internship/ Industrial Activity**	**2**	**-**	**25**	**75**	**100**
	Total	**26**	**30**			**700**
	Semester - IV					
23ZOOC401	**Core - XI: Immunology**	**4**	**5**	**25**	**75**	**100**
23ZOOC402	**Core - XII: Ecology**	**4**	**5**	**25**	**75**	**100**
23ZOOP403	**Core : Practical – IV:** **Lab Course in Immunology & Ecology**	**2**	**2**	**25**	**75**	**100**
23ZOOD404	**Project with Viva-Voce**	**7**	**10**	**25**	**75**	**100**
23ZOOE405	**Elective ((Industry / Entrepreneurship):** **Medical Laboratory Techniques**	**3**	**4**	**25**	**75**	**100**
23ZOOS406 **23ZOOS407**	**Skill Enhancement Course (SEC) - III:** **Animal Behaviour/** **Professional Competency Course IPR- Intellectual Property Rights**	**2**	**4**	**25**	**75**	**100**
23ZOOX408	**Extension Activity**	**1**	**-**	**25**	**75**	**100**
	Total	**23**	**30**	**175**	**525**	**700**
	Grand Total	**91**	**120**			**2500**

ELECTIVE COURSES

Course Code	Course Title	Credit	Hours/ Week	Marks		
				CIA	ESE	Total
	Semester - I					
23ZOOE104 23ZOOE105 23ZOOE106	Elective - I : Discipline Centric: Molecules and their Interaction relevant to Biology / Medical Entomology Sericulture	3	5	25	75	100
23ZOOE107 23ZOOE108 23ZOOE109	Elective - II :Generic Centric: Biostatistics / Toxicology/ Apiculture	3	5	25	75	100
	Semester - II					
23ZOOE204 23ZOOE205 23ZOOE206	Elective - III : Discipline Centric: Economic Entomology / Biodiversity and Conservation/ Vermiculture	3	4	25	75	100
23ZOOE207 23ZOOE208 23ZOOE209	Elective - IV : Generic Centric: Research Methodology / Basic Biotechnology/ Biocomposting	3	4	25	75	100
	Semester - III					
23ZOOE305 23ZOOE306 23ZOOE307	Elective - V : Discipline Centric: Stem cell Biology/ Aquaculture/ Endocrinology	3	3	25	75	100
	Semester - IV					
23ZOOE405	Elective ((Industry / Entrepreneurship): Medical Laboratory Techniques	3	4	25	75	100

SKILL ENHANCEMENT COURSES

Course Code	Course Title	Credit	Hours/ Week	Marks		
				CIA	ESE	Total
Semester - II						
23ZOOS210	Skill Enhancement Course (SEC) – I : Poultry Farming	2	4	25	75	100
Semester - III						
23ZOOS308	Skill Enhancement Course (SEC) – II: Dairy Farming	2	3	25	75	100
Semester - IV						
23ZOOS406 23ZOOS407	Skill Enhancement Course (SEC) - III: Animal Behaviour/ Professional Competency Course IPR- Intellectual Property Rights	2	4	25	75	100

Core Courses	**12 = 57**
Project	**1 x 7 = 07**
Elective (Discipline / Generic Centric)	**6 x 3 = 18**
Skill Enhancement Course - SEC -	**1 x 2 = 06**
Internship/ Industrial Activity	**1 x 2 = 2**
Extension Activity	**1 x 1 = 1**
Total Credits	**91**

Component wise Credit Distribution

Credits	Semester				Total
	I	II	III	IV	
Part A	**14**	**14**	**19**	**17**	**64**
Part B **(i) Elective – Discipline/ Generic Centric**	**6**	**6**	**3**	**3**	**18**
(ii) Skill Enhancement Course		**2**	**2**	**2**	**02**
(iii) Internship / Industrial Activity			**2**		**02**
Part C **Extension Activity**				**1**	**01**
Total	**20**	**22**	**26**	**23**	**91**

Method of Evaluation: Internal 25; External 75; Total 100

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree.

Written Examination: Theory Paper (Bloom's Taxonomy based): Question paper Model

Intended Learning Skills	**Maximum75 Marks** **Passing Minimum: 50%Duration:Three Hours**
	Part–A (**10x2 =20 Marks**) Answer ALL questions **Each Question carries 2 marks**
Memory Recall/ Example/ Counter Example/ Knowledge about the Concepts/ Understanding	Two questions from each UNIT
	Question 1 to Question 10
	Part– B (5x5 =25Marks) Answer ALL questions **Each questions carries 5 Marks**
Descriptions/ Application (problems)	**Either-or Type** Both parts of each question from thesame UNIT
	Question 11(a) or 11(b) To **Question 15(a) or 15(b)**
	Part-C (3x 10 = 30 Marks) Answer any THREE questions Each question carries 10 Marks
Analysis/Synthesis/Evaluation	There shall be FIVE questions covering all the Five units
	Question 16 to Question 20

Each question should carry the course outcome and cognitive level For instance,

1. [CO1:K2] Question xxxx
2. [CO3:K1] Question xxxx

PROGRAMME OUTCOMES (POs)

At the end of the programme, the student will be able to

PO1:	**Problem Solving Skill:** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.
PO2:	**Decision Making Skill:** Foster analytical and critical thinking abilities for data-based decision-making.
PO3:	**Ethical Value:** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.
PO4:	**Communication Skill :** Ability to develop communication, managerial and interpersonal skills.
PO5:	**Individual and Team Leadership Skill:** Capability to lead themselves and the team to achieve organizational goals.
PO6:	**Employability Skill:** Inculcate contemporary business practices to enhance employability skills in the competitive environment.
PO7:	**Entrepreneurial Skill:** Equip with skills and competencies to become an entrepreneur.
PO8:	**Contribution to Society:** Succeed in career endeavors and contribute significantly to society.
PO9:	**Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective.
PO10:	**Moral and ethical awareness/reasoning:** Ability to embrace moral/ethical values in conducting one's life.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

After the successful completion of the M.Sc. Zoology (Two year) Degree Programme, the graduates will be able to

PSO1:	**Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.
PSO2:	**Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.
PSO3:	**Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.
PSO4:	**Contribution to Business World:** To produce employable, ethical and innovative professionals to sustain in the dynamic business world.
PSO5:	**Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

M.Sc. Zoology-Syllabus

Semester-I

Part	List of Courses	Credit	No. of Hours
	Core Course - I	5	7
	Core Course - II	5	7
	Core Course - III	4	6
	Discipline Centric Elective - I	3	5
	Generic Elective - II	3	5
		20	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
	Core Course - IV	5	6
	Core Course - V	5	6
	Core Course - VI	4	6
	Discipline Centric Elective - II	3	4
	Generic Elective - II	3	4
	SEC - I	2	4
		22	**30**

Semester-III

Part	List of Courses	Credit	No. of Hours
	Core Course- VII	5	6
	Core Course-VIII	5	6
	Core Course-IX	5	6
	Core Course-X	4	6
	Discipline Centric Elective - III	3	3
	SEC - II	2	3
	Internship / Industrial Activity [Credits]	2	-
		26	**30**

Semester-IV

Part	List of Courses	Credit	No. of Hours
	Core Course-XI	5	6
	Core Course-XII	5	6
	Project with VIVA VOCE	7	10
	Elective ((Industry / Entrepreneurship):	3	4
	Skill Enhancement Course - III	2	4
	Extension Activity	1	
		23	**30**

Credit Distribution for all PG Courses

Courses	Credits
Core Courses	**57**
Project with Viva-Voce	**07**
Electives (Generic/Discipline Centric)	**18**
Internship/ Industrial Activity	**02**
Skill Enhancement Course	**06**
Extension Activity	**01**
Total Credits	**91**

Method of Evaluation:

Test I	Test II	Assignment	End Semester Examination	Total
10	10	5	75	100

FIRST YEAR

Semester	23ZOOC101: CORE COURSE - I STRUCTURE AND FUNCTION OF INVERTEBRATES	H/W	C
I		**7**	**5**

Course Objectives

The main objectives of this course are:

1	To understand the concept of classification and their characteristic features of major group of invertebrates.
2	To realize the range of diversification of invertebrate animals.
3	To enable to find out the ancestors or derivatives of any taxon.
4	To know the functional morphology of system biology of invertebrates.

UNIT - I: Structure and function in invertebrates: Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy

UNIT - II: Organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomia; Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata

UNIT - III: Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca and Echinodermata. Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments; Mechanism of respiration

UNIT - IV: Excretion: Organs of excretion: coelom, coelomoducts, Nephridia and Malphigian tubules; Mechanisms of excretion; Excretion and osmoregulation. Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda); Trends in neural evolution

UNIT - V: Invertebrate 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

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.
2	Understand the evolutionary process. All are linked in a sequence of life patterns.
3	Apply this for pre-professional work in agriculture and conservation of life forms.
4	Analyze what lies beyond our present knowledge of life process.
5	Evaluate and to create the perfect phylogenetic relationship in classification**.**

TEXT BOOKS

1. Arumugam, N., T. Murugan, B. Ramanathan and M.G. Ragunathan. (2019). A Text Book of Invertebrates, Saras Publications, Nagercoil, Tamil Nadu.
2. Ekambaranatha Ayyar, M. (1973). A Manual of Zoology – Part I: Invertebrata.S.Viswanathan (Printers and Publishers) Pvt., Ltd. Madras.
3. Ekambaranatha Ayyar, M. (1973). A Manual of Zoology Part – II: Chordata.
   S.Vishvanathan Printers and Publishers, Pvt. Ltd., Madras.
4. Jordan, E. L. and P. S. Verma, (2017). Chordate Zoology and Elements ofAnimal Physiology, S. Chand & Co., Ltd., New Delhi.
5. Jordon, E. L. and P.S Verma, (2015). Invertebrate Zoology. S. Chand and Co. Ltd., New Delhi.
6. Saxena, R.K. and S. Saxena. (2015). Comparative Anatomy of Vertebrates,M.V.Learning, UK.
7. Wells, H.G. (2018). Text Book of Biology, Part 1: Vertebrata, CreatespacePublishing Company, USA.

REFERENCE BOOKS

1. Arumugam, N. (2014). Animal diversity Volume - 1 – Invertebrata. Saras Publication, Nagercoil, Tamil Nadu.
2. Arumugam, N. (2014). Animal diversity Volume - 2 – Chordata. SarasPublication, Nagercoil, Tamil Nadu.
3. Barrington E. J. W. (2012). Invertebrate structure and function. Affiliated EastWest Press Pvt. Ltd., New Delhi.
4. Brusca, R.C., W. Moore and S.M. Shuster. (2016). Invertebrates. Oxford University Press, USA.
5. Kent, G.C. (2015). Comparative Anatomy of the Vertebrates. McGraw Hill, NewYork.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	S	S	M	M	S	S
CO4	S	M	S	M	S	S	M	M	S	M
CO5	S	M	S	M	S	S	M	M	S	M

S - Strong; M - Medium; L – Low

Semester	23ZOOC102: CORE COURSE - II COMPARATIVE ANATOMY OF VERTEBRATES	H/W	C
I		**7**	**5**

Course Objectives

The main objectives of this course are:

1	Exemplifying the vertebrate origin and the intermediary position of Prochordates between invertebrates and vertebrates.
2	Acquires the knowledge on evolution and adaptive radiation of Agnatha and Pisces.
3	Understanding knowledge about the first terrestrial vertebrates and the adaptive radiation of land animals
4	Imparting conceptual knowledge about the animal life in the air and their behaviours.
5	Understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates.

UNIT - I: Origin of vertebrates: Concept of Protochordata; The nature of vertebrate morphology; Definition, scope and relation to other disciplines; Importance of the study of vertebrate morphology

UNIT - II: Origin and classification of vertebrates; Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.

UNIT -III: General plan of circulation in various groups; Blood; Evolution of heart; Evolution of aortic arches and portal systems. Respiratory system: Characters of respiratory tissue; Internal and external respiration; Comparative account of respiratory organs

UNIT - IV: Skeletal system: Form, function, body size and skeletal elements of the body; Comparative account of jaw suspensorium, Vertebral column; Limbs and girdles; Evolution of Urinogenital system in vertebrate series

UNIT – V: Sense organs: Simple receptors; Organs of Olfaction and taste; Lateral line system; Electroreception. Nervous system: Comparative anatomy of the brain in relation to its functions; Comparative anatomy of spinalcord; Nerves-Cranial, Peripheral and Autonomous nervous systems

Expected Course Outcome

On the successful completion of the course, student will be able to:

1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.
2	Understand the evolutionary process. All are linked in a sequence of life patterns.
3	Apply this for pre-professional work in agriculture and conservation of life forms.
4	Analyze what lies beyond our present knowledge of life process.
5	Evaluate and to create the perfect phylogenetic relationship in classification.

TEXT BOOKS

1. Wells, H.G. (2018). *Text Book of Biology, Part 1: Vertebrata,* Createspace Publishing Company, USA.
2. Ekambaranatha Ayyar, M. (1973). *A Manual of Zoology Part – II: Chordata*. S. Vishvanathan Printers and Publishers, Pvt. Ltd., Madras.
3. Jordan, E. L. and P. S Verma, (2017). *Chordate Zoology and Elements of Animal Physiology,* S. Chand & Co., Ltd., New Delhi.
4. Saxena, R.K. and S. Saxena. (2015). *Comparative Anatomy of Vertebrates*, M.V.Learning, UK.
5. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.
6. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.
7. Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
8. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

REFERENCE BOOKS

1. Arumugam, N. (2014). *Animal diversity Volume - 2 – Chordata*. Saras Publication, Nagercoil, Tamil Nadu.
2. Kent, G.C. (2015). *Comparative Anatomy of the Vertebrates*. McGraw Hill, New York, USA.
3. Swayam Prabha https://www.swayamprabha.gov.in/index.php/program/archive/9
4. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.
5. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-600.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	L	S	M	S	M	S	M	S
CO2	S	L	L	S	M	S	M	M	M	M
CO3	S	M	L	S	M	S	M	L	M	M
CO4	S	L	L	S	L	S	M	L	M	L
CO5	S	M	L	S	S	S	M	S	M	M

S - Strong; M - Medium; L - Low

Semester	23ZOOP103: CORE COURSE - III PRACTICAL - I: INVERTEBRATES AND VERTEBRATES	H/W	C
I		6	4

Course Objectives

The main objectives of this course are:

1	Understand the structure and functions of various systems in animals
2	Learn the adaptive features of different groups of animals
3	Learn the mounting techniques
4	Acquire strong knowledge on the animal skeletal system
5	Understand the structure and functions of various systems in animals

INVERTEBRATES

Dissection

Earthworm : Nervous system
Pila : Digestive and nervous systems
Sepia : Nervous system
Cockroach : Nervous system
Grasshopper : Digestive system and mouth parts
Prawn : Appendages, nervous and digestive systems
Crab : Nervous system

Study of the following slides with special reference to their salient features and their modes of life

1. *Amoeba*
2. *Entamoeba histolytica*
3. *Paramecium*
4. *Hydra* with bud
5. Sporocyst – Liver fluke
6. *Cercaria* larva
7. *Tape worm (Scolex)*
8. *Ascaris* T. S.
9. Mysis of prawn

Spotters

1. Scorpion
2. *Penaeus indicus*
3. *Emerita* (*Hippa*)
4. *Perna viridis*

Mounting

Earthworm : Body setae
Pila : Radula
Cockroach : Mouth parts
Grasshopper : Mouth parts

VERTEBRATES

Study the nervous system of Indian dog shark - Dissection

1. Nervous system of *Scoliodon laticaudatus* – 5th or Trigeminal nerve
2. Nervous system of *Scoliodon laticaudatus* – 7th or Facial nerve
3. Nervous system of *Scoliodon laticaudatus* – 9th and 10th or Glossopharyngeal & Vagus nerve

Study of the following specimens with special reference to their salient features and their modes of life

1. *Amphioxus* sp. (Lancelet)
2. *Ascidia* sp. (sea squirt)
3. *Scoliodon laticaudatus* (Indian dog shark)
4. *Trygon* sp. (Sting ray)
5. *Torpedo* sp. (Electric ray)
6. *Arius maculatus* (Cat fish)
7. *Belone cancila*(Flute fish)
8. *Exocoetus poecilopterus* (Flying fish)
9. *Mugil cephalus* (Mullet)
10. *Tilapia mossambicus* (Tilapia)
11. *Rachycentron canadum* (Cobia)
12. *Tetrodon punctatus* (Puffer fish)
13. *Dendrophis* sp. (Tree snake)

Study of the different types of scales in fishes

1. Cycloid scale
2. Ctenoid scale
3. Placoid scale

Study of the frog skeleton system (Representative samples)

1. Entire skeleton
2. Skull
3. Hyoid apparatus
4. Pectoral girdle and sternum
5. Pelvic girdle
6. Fore limb
7. Hind limb

Mounting

1. Weberian ossicles of fish

Expected Course Outcome

On the successful completion of the course, student will be able to:

1.	Understand the structure and functions of various systems in animals
2.	Learn the adaptive features of different groups of animals
3.	Learn the mounting techniques
4.	Acquire strong knowledge on the animal skeletal system

Text Books:

1. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
2. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication, pp-416.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

Reference Books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	S	M	S	M	S
CO2	S	M	L	S	M	S	M	M	M	M
CO3	M	M	L	S	L	S	M	L	M	M
CO4	S	S	L	S	L	S	M	L	M	L
CO5	S	S	M	L	M	S	M	S	M	M

S - Strong; M - Medium; L - Low

Semester	23ZOOC201: CORE COURSE - IV CELLULAR AND MOLECULAR BIOLOGY	H/W	C
II		6	5

Course Objectives

The main objectives of this course are:

1	To understand the molecular basis of cell structure and functions
2	To learn the structure and functions of various organization and cell membrane.
3	To learn bioenergetics and biogenesis
4	To learn structure and replication of DNA
5	To learn various molecular techniques

UNIT - I: General features of the cell: Basic structure of prokaryotic and eukaryotic cells - Protoplasm and deutroplasm - cell organelles; cell theory; Diversity of cell size and shapes.

UNIT - II Cellular organization: Membrane structure and functions - Structure of model membrane, lipid bilayer and membrane proteins. Membrane transport: diffusion, osmosis, ion channels, active transport, ion pumps, mechanism and regulation of intracellular transport, electrical properties of membranes. Structure and functions of Intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles and chloroplasts.

UNIT - III Cell division and Cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle. Molecular biology of cell: Structure of DNA and RNA; Process of DNA replication, transcription and translation in pro- and eukaryotic cells; Genetic maps.

UNIT - IV: Cell communication and cell signalling: Membrane- associated receptors for peptide and steroid hormones - signalling through G-protein coupled receptors, signal transduction pathways. General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and non-cellular structures

UNIT - V: Cancer cells: Characteristic features of normal and cancer cells; Carcinogens: types and cancer induction; Metastasis; Oncogenes and tumor suppressor genes, apoptosis; therapeutic interventions of uncontrolled cell growth.

Expected Course Outcome

On the successful completion of the course, student will be able to:

1	Understand the general concepts of cell and molecular biology.
2	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.
3	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.
4	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.
5	Understand the general concepts of cell and molecular biology.

TEXT BOOKS

1. De Robertis E.D.D and De. Robertis E.M.F. (2017). *Cell and Molecular Biology.* Lippincott Williams & Wilkins , USA.
2. Pollard, T.D., W.C. Earnshaw, J.L .Schwartz and G. Johnson. (2017). *Cell Biology,* Elsevier.
3. Verma P.S. and V.K. Agarwal, (2015): *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand and Company, New Delhi.
4. Gupta. P.K., (2003). *Cell and Molecular Biology*, Rastogi Publication, Meerut, India.
5. Lodish. H, Berk. A, Zipursky. SL, Matiudaira. P, Baltimore. D and Darnell J. (2000). *Molecular Biology of the cell,* W.H. Freeman and company, New York.
6. Lewin.B, (2000). *Gene VII,* Oxford University Press, London.
7. Karp, G. 2010. Cell Biology (Sixth Edition), John Wiley & Sons, Singapore, pp-765.
8. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007, Cell and Molecular Immunology (Sixth Edition), Saunders, Philadelphia, pp-566
9. Loewy, A.G., P. Siekevitz and J. R. Menninger, *et al*., 1991, Cell Structure and Function (Third Edition), Saunders, Philadelphia, pp-947.
10. Watson, J. D., N.H. Hopkins, J.W. Roberts, *et al*., 1987, Molecular Biology of the Gene (Fourth Edition), Benjamin/Cummings, California, pp-1163 .
11. Han, S. S. and J. Holmstedt. 1979, Cell Biology, McGraw Hill, pp-319.
12. Alberts, B., A. Johnson, J. Lewis, *et al*., 2015, Molecular Biology of the Cell (Sixth Edition), Garland Science, New York, pp-1342.
13. Clark, D.P., 2005. Molecular Biology, Elsevier, China, pp-784.
14. Tropp, B. 2008. Molecular Biology Genes to Proteins (Third Edition), Jones & Bartlett, US, pp-1000

REFERENCE BOOKS

1. Verma P.S. and V.K. Agarwal. (2016). *Cell Biology*. S. Chand & Co., New Delhi.
2. Arnold Berk, Chris A. Kaiser and Harvey Ledish. (2016). *Molecular Cell Biology*. WH Freeman, USA.
3. Malathi, V. (2012). *Essentials of Biology*. Pearson Education, Chennai, India.
4. Bruce Alberts, Alexander D. Johnson and Julian Lewis. (2014). *Molecular Biology of the Cell*. W.W. Norton & Co., USA.
5. Geoffrey M.Cooper and Robert E. Hausman. (2013).*The Cell: A Molecular Approach*. Sinauer Associates Inc., USA.
6. Plopper, G., D. Sharp, and E. Sikorski. 2015. Lewin's Cells (Third Edition), Jones & Bartlett, New Delhi, pp-1056.
7. Plopper, G. 2013. Principles of Cell Biology, Jones & Bartlett, Maryland, pp-510.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	L	L	L	S	S	S	M	M	M
CO2	M	M	M	S	S	S	S	M	S	M
CO3	S	S	S	M	M	S	M	M	L	S
CO4	M	M	S	L	S	S	L	M	S	S
CO5	S	M	M	S	S	S	S	M	S	S

S - Strong; M - Medium; L - Low

Semester	23ZOOC202: CORE COURSE - V DEVELOPMENTAL BIOLOGY	H/W	C
II		6	5

Course Objectives

The main objectives of this course are:

1	Define the concepts of embryonic development
2	Observe various stages of cell divisions under microscope
3	Understand the formation of zygote
4	Differentiate the blastula and gastrula stages
5	Learn the distinguishing features of three different germ layers and formation of various tissues and organs

UNIT - I Pattern of animal development: Chief events in animal development; History of thoughts and conceptual developments. Gametogenesis: Origin of germ cells, spermatogenesis - Sperm morphology in relation to the type of fertilization, Oogenesis - Oogenesis in insects and amphibians; Composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates; Genetic control of vitellogenin synthesis in amphibians

UNIT - II: Fertilization: Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitating in mammals, Acrosome reaction. Sperm – egg interaction. Sperm entry into the egg - Egg activation - Intracellular calcium release - Cortical reaction - Physiological polyspermy - Fusion of male and female pronuclei - Post fertilization metabolic activation – Parthenogenesis

UNIT - III: Cleavage and gastrulation: Pattern of embryonic cleavage, mechanisms of cleavage, mid blastula transition - Determinate and regulatory embryos, Factors affecting gastrulation, mechanisms and types of gastrulation in respective animal embryos (Sea urchin, *Amphioxus*, Amphibians, Aves, Mammals); Fate maps - (Amphibian and Chick),Epigenesis and preformation – Formation of primary germ layers.

UNIT – IV: Embryonic Development; Embryonic development of fish and birds, formation of extra embryonic membranes in mammalian – Organogenesis - Development of endodermal, mesodermal and ectodermal derivatives. Embryonic Induction and neurulation; Formation and migration of neural crest cells - types of neural crest cells and their patterning - primary and secondary neurulation. Gene and development; Anterior- posterior axis in determination in drosophila, Maternal effect genes - *Bicoid* and *Nanos* proteins; Generation of dorsal - ventral polarity- Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes

UNIT - V: Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Endocrine control of moulting and growth in crustaceans and insects - Neoteny and pedogenesis. Regeneration: Formation of ectodermal cap and regeneration blastema – Types of regeneration in planaria, Regenerative ability in different animal groups, Factors stimulating regeneration – Biochemical changes assosciated with regeneration. Aging and senescences: Biology of senescences- cause of aging- mechanism involved in apoptosis. Experimental Embryology: Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Endocrine changes associated with normal pregnancy, Induced ovulation in humans – Cryopreservation of gametes/embryos - Ethical issues in cryopreservation

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Define the concepts of embryonic development
2	Observe various stages of cell divisions under microscope
3	Understand the formation of zygote
4	Differentiate the blastula and gastrula stages
5	Learn the distinguishing features of three different germ layers and formation of various tissues and organs

TEXT BOOKS

1. Verma, P.S. and V.K. Agarwal. (2017). *Chordate Embryology (Developmental Biology),* S. Chand and Co., New Delhi.
2. Arora, P. Mohan, (2014). *Embryology*, Himalaya publishing House, New Delhi.
3. Arumugam, N. (2014). *A Text Book of Embryology (Developmental Biology)*, Saras Publications, Nagercoil, Tamil Nadu.
4. Balinsky, B.I. (2012). *An Introduction to embryology*, 4th Edition, Saunder's College Publishing Ltd, New York
5. Philip Grant (1977). *Biology of development systems,* University of Oregon
6. Berrill, N.J., and G. Karp. (1978). *Development Biology,* Tata McGraw Hill Publishing Co., Ltd, New Delhi
7. Wilt, F.H. and N.K. Wessel. 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
8. Slack J.M.W. 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
9. Mari-Beffa, M. and J. Knight. 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404

REFERENCE BOOKS

1. Madhavan K. S. (2018). *Developmental Biology.* Arjun Publishing House.
2. Subhadra Devi, V. (2018). *Inderbir Singh's Human Embryology,* Jaypee Brothers Medical Publishers, New Delhi.
3. Berry A.K. (2016). *An Introduction to Embryology*. Emkay Publications, New Delhi.
4. Lewis Wolpert, Cheryll Tickle and Alfonso Martinez Arias. (2015). *Principles of Development*. *Oxford University Press*, USA.
5. Jain P.C. (2013). *Elements of Developmental Biology*. Vishal Publishing Co., Punjab.
6. Carlson, B.M. (2014). *Pattens foundations of Embryology*, McGraw Hill
7. Sastry K.V. and Vinita Shukal. (2012). *Developmental Biology.* Rastogi Publication, Meerut, Uttar Pradesh.
8. Gilbert. S. F. 2006. Developmental Biology, 8th Edition, INC Publishers, USA, pp-785.
9. Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
10. Subramoniam, T. 2011. Molecular Developmental Biology (2nd Edition), Narosa Publishers, India, pp-364.
11. www.easybiologyclass.com › developmental-biology-e
12. www.studocu.com › document › lecture-notes › view
13. *ocw.mit.edu* › courses › 7-22-developmental-biology-f.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	L	S	M	L	M
CO2	S	S	S	S	S	L	S	S	S	S
CO3	S	M	S	S	S	S	S	L	L	M
CO4	S	S	S	S	S	M	S	S	S	L
CO5	S	S	S	M	S	S	S	L	L	M

S - Strong; M - Medium; L – Low

Semester	23ZOOP203: CORE COURSE – VI PRACTICAL – II: CELL AND MOLECULAR BIOLOGY AND DEVELOPMENTAL BIOLOGY	H/W	C
II		6	4

Course Objectives

The main objectives of this course are:

1	Acquire knowledge to differentiate the cells of various living organisms and become aware of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryo development.
2	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.
3	Develop handling - skills through the wet-lab course.
4	Learn the method of culturing of *Drosophila* and identification of their wild and mutant strains
5	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities

CELL AND MOLECULAR BIOLOGY

1. Determination of cell size using micrometer
2. Mitosis in root meristematic cells of plants
3. Identification of various stages of meiosis in the testes of grasshopper
4. Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus
5. Detection of sex chromatin
6. Identification of blood cells in the haemolymph of the of the cockroach
7. Isolation of genomic DNA from eukaryotic tissue
8. Isolation of total RNA from bacterial cells/tissues
9. Agarose gel electrophoresis of DNA
10. SDS-Polyacrylamide gel electrophoresis

DEVELOPMENTAL BIOLOGY

1. Gametogenesis - Observation of gametes from gonadal tissue sections

   i. Oogenesis:

   - ✓ Section through ovary of shrimp, fish, frog and mammals

   ii Spermatogenesis:

   - ✓ Section through testis of shrimp, fish, calotes and mammals

2. Fertilization

   iii Induced spawning in polycheate worm *Hydroids elegans*

   iv *In vitro* fertilization and development in a polycheate worm *Hydroids elegans*

   v Observation of egg developmental stages in *Emerita emeritus*

3. Embryogenesis

   vi Observation and whole mount preparation of the chick blastoderm - 18 hours of development

   vii Chick embryonic stage - 24 hours of development

   viii Chick embryonic stage - 48 hours of development

   ix Chick embryonic stage - 72 hours of development

   x Chick embryonic stage - 96 hours of development

4. Histological observation: Section through various developmental stages in chick embryo

5. Experimental Embryology

6. Regeneration in Frog Tadpoles

   xi Blastema formation

   xii Demonstration of regenerative process in tadpole

7. Metamorphosis

   xiii Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine

.8. Cryopreservation

   xiv Demonstration of cryopreservation of gametes of fin fish/shell fish

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1.	Acquire knowledge to differentiate the cells of various living organisms and become awares of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryo development.
2.	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.
3.	Develop handling - skills through the wet-lab course.
4.	Learn the method of culturing of *Drosophila* and identification of their wild and mutant strains
5.	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	S	S	L	L	M
CO2	S	S	S	S	S	M	M	M	M	M
CO3	S	S	M	S	S	L	S	M	L	M
CO4	M	M	L	M	L	M	M	S	M	L
CO5	S	S	M	L	S	M	L	S	S	S

S - Strong; M - Medium; L – Low

SECOND YEAR

Semester	23ZOOC301: CORE COURSE - VII GENETICS	H/W	C
III		6	5

Course Objectives

The main objectives of this course are:

1	Understanding DNA as genetic material, fine structure of DNA & RNA molecules, as well as physico-chemical properties of macromolecules.
2	Gain insight into sequential events occurs during protein synthesis.
3	Learn the structure and function of chromosome and chromosomal basis of genetic disorders.
4	To acquire knowledge about microbial genetics
5	To provide information about rDNA technology and its application.

UNIT - I: Structure, properties and functions of genetic materials: DNA as the genetic Materials - Basic structure of DNA and RNA, alternate and unusual forms of DNA - Physical and Chemical properties of nucleic acid, base properties, denaturation and renaturation, Tm and cot values, hybridization.

UNIT - II: Genetic code - Methods of deciphering the genetic code and general features of the code word dictionary. Chromosomal genetics: Molecular structure of chromosomes - Variation in chromosome number and structure - Chromosome nomenclature - Chromosomal syndromes.

UNIT - III: Microbial Genetics: Genetics of Virus - Viral chromosome, Lytic cycle, Lysogenic cycle - Bacterial genetics -Bacterial genome - Gene transfer mechanisms in bacteria and virus - conjugation, transduction and transformation

UNIT - IV: Recombinant DNA technology:: Overview - Tools for Recombinant DNA Technology – Vectors - types - Techniques used in recombinant DNA technology - generation of DNA fragments - Restriction endonucleases, DNA modifying enzymes, Ligases

UNIT - V: Introduction of rDNA into host cell - calcium chloride mediated gene transfer - *Agrobacterium* mediated DNA transfer, electroporation, microinjection, liposome fusion, particle gun bombardment - Selection and screening of transformed cells - Expression of cloned gene; Application of rDNA technology in human welfare - Environment, Medicine and Agriculture

Expected Course Outcome

At the end of the course, the student will be able to

1	Explain the organization and functions of genetic material in the living system.
2	Understand various sequential processes in protein synthesis
3	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.
4	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.
5	Understand the principle and application of rDNA technology for the welfare of human being.

TEXT BOOKS

1. Snustad, D.P. and M. J. Simmons. (2017). *Principles of Genetics,* John Wiley & Sons Inc., India.
2. Verma P. S. and V. K. Agarwal, (2015): *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand and Company, New Delhi.
3. Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick. (2015). *Lewins's Genes XI*, Jones and Bartlett Publishers, Inc., USA.
4. Karvita B. Aluwalia, (1991). '*Genetics'*, Wiley Eastern Ltd., New Delhi.
5. Robert H. Tamirin, (2004). *'Principles of Genetics'* Tata McGraw-Hill Publishing Company Ltd. New Delhi.
6. Sarin, C., (1990). '*Genetics'*. Tata McGraw-Hill Publishing Co. Ltd, New Delhi.
7. Griffiths, A. J. F., H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart. 2012. An Introduction to Genetic Analysis. 11th Edition, W. H. Greeman. New York.
8. Watson, J. D., T. A. Baker, S. P. Bell, Alexander Gann, Michael Levine, Richard Losick. 2003. Molecular Biology of the Gene, (5th Edition). Cold Spring Harbor Laboratory Press, pp-912.
9. Klug, W. S. and M. R. Cummings, C. A. Spencer. 2005. Concepts of Genetics, Benjamin - Cummings Publishing Company.
10. Harti, D. L. 2002. Essential Genetics, A Genomic Perspective, Jones & Bartlet.
11. Krebs, J. E., E.S. Goldstein, S.T. Kilpatrick. 2018. Lewin's Genes XII, Jones & Bartlet Publisher, pp-613.
12. Watson, J. D., T. A. Baker S. P. Bell, A. Cann, M. Levine and R. Losick, 2014. Molecular Biology of Gene 7th Edition, Pearson Education RH Ltd. India.

REFERENCE BOOKS

1. Gangane S. D. (2017). *Human Genetics*. Elsevier, India.
2. Robert Tamarin. (2017). *Principles of Genetics.* McGraw Hill, New York, USA.
3. James D. Watson, A. Baker Tania and P. Bell Stephen. (2017). *Molecular Biology of the Gene*. Pearson, UK.
4. Weaver, R.F. and P.W.Hedrick. (2015). *Genetics*, Brown (William C.) Co., U.S.

5. William S. Klug, Michael R. Cummings and Chariotte A. Spencer. (2016). *Concept of Genetics.* Pearson, UK.
6. Peter D. Snustad and Michael J. Simmons. (2011). *Genetics*. John Wiley & Sons, India.
7. Gardner, E. J., M. J. Simmons and D.P. Snustad. 2006. Principles of Genetics. 8th Edition, John Wiley & Sons. INC. New York, pp-740.
8. Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th Edition, McGraw Hill Publsiher, pp-880.
9. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd Edition). Pearson/Benjamin Cummings, San Francisco, pp-850.
10. https://onlinecourses.swayam2.ac.in/cec21_bt02/preview https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-rna-and-protein-synthesis/a/the-genetic-code

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	L	L	S	S	S	L	M	S
CO2	S	M	M	M	S	M	M	M	L	S
CO3	M	S	L	L	M	S	M	L	S	L
CO4	S	M	S	M	M	S	S	S	S	S
CO5	S	S	S	M	E	S	M	S	M	M

S - Strong; M - Medium; L - Low

Semester	19ZOOC302: CORE COURSE - VIII EVOLUTION	H/W	C
III		6	5

Course Objectives

The main objectives of this course are:

1	To critically analyze the concepts of evolution.
2	Understand the factors responsible for origin and generation of diversity among living beings and
3	To develop strategies for sustenance of life on this planet
4	To critically analyze the concepts of evolution in order to

UNIT - I: Emergence of evolutionary thoughts: Lamarck and Darwin – concepts of variation, adaptation, struggle, fitness and natural selection – Mendelism - Spontaneity of mutations - The evolutionary synthesis

UNIT – II: Origin of cells and unicellular evolution:Origin of basic biological molecules - Abiotic synthesis of organic monomers and polymers - Concept of Oparin and Haldane - Experiment of Miller (1953) - The first cell - Evolution of prokaryotes - Origin of eukaryotic cells - Evolution of unicellular eukaryotes - Anaerobic metabolism, photosynthesis and aerobic metabolism

UNIT – III: Paleontology and evolutionary history:The evolutionary time scale - Eras, periods and epoch - Major events in the evolutionary time scale - Origins of unicellular and multi cellular organisms - Stages in primitive evolution including *Homosapiens*

UNIT – IV: Molecular evolution: Molecular divergence - Molecular tools in phylogeny, classification and identification - Protein and nucleotide sequence analysis - Origin of new genes and proteins - Gene duplication and divergence

UNIT - V: Evolutionary mechanisms: Population genetics - Populations, Gene pool, Gene frequency - Hardy-Weinberg Law - concepts and rate of change in gene frequency through natural selection, migration and random genetic drift - Adaptive radiation - Isolating mechanisms – Speciation - Allopatricity and Sympatricity - Convergent evolution - Sexual selection - Co-evolution - Altruism and evolution

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	To understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.
2	Study the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.
3	Understand the major events in the evolutionary time scale; Origins of unicellular and multi-cellular organisms.
4	Comprehend the origin of new genes and proteins; Gene duplication and divergence.
5	Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift

Text Books:

1. Carl T. Bergstrom, and Lee Alan Dugatkin, (2016). *Evolution (Second Edition),* W.W. Norton and company, New York, USA.
2. Hall, B.K. and B.Hallgrimson. (2014). *Strickbergers Evolution,* Jones and Bartlett Publishers ltd., New Delhi.
3. Arumugam, N. (2014). *Organic Evolution*. Saras Publication. Nagercoil, Tamil Nadu.
4. Verma P. S. and V. K. Agarwal, (2015). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand and Company, New Delhi.
5. Verma P. S. and V. K. Agarwal, (2007). *Evolution*, S. Chand and Company, New Delhi.
6. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.
7. Hall B. K. and B. Hallgrimsson. 2014. Strickberger's Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642.
8. Barton, N.H., D. Briggs, J.A. Eisen David, D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833.

Reference Books :

1. Darwin, C. The Origin of species, Te. Pup. Desmond Morries, (1990). *Animal Watching* (Field Guide), Crown Pup Co., London.
2. Dobzhansky,T. (1951), *Genetics and the origin of species,* Columbia University Press, USA.
3. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution, Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756.
4. Jobling, M., E. Hollox, M. Hurles, T. Kivisild and C. T. Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650.

5. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590.
6. https://www.flipkart.com/books/evolution~contributor/pr?sid=bks
7. http://www.evolution-textbook.org/
8. https://onlinelibrary.wiley.com/journal/15585646
9. http://darwin-online.org.uk/

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	L	S	M	L	M
CO2	S	S	L	S	S	L	S	S	S	S
CO3	S	M	S	S	S	S	S	L	L	M
CO4	S	S	S	S	S	M	S	S	S	L
CO5	S	S	S	M	M	S	S	L	L	M

S - Strong; M - Medium; L - Low

Semester	23ZOOC303: CORE COURSE - IX	H/W	C
III	ANIMAL PHYSIOLOGY	6	5

Course Objectives

The main objectives of this course are:

1	Understand the functions of different systems of animals
2	Learn the comparative anatomy of heart structure and functions
3	Know the transport and exchange of gases, neural and chemical regulation of respiration
4	Acquire knowledge on the organization and structure of central and peripheral nervous systems

UNIT - I: Blood and circulation: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular system : Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above

UNIT - II: Respiratory system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration

UNIT - III: Nervous system: Neurons, action potential, gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs: Vision, hearing and tactile response

UNIT - IV: Digestive system: Digestion, absorption, energy balance, BMR. **Excretory system:** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance, acid-base balance

UNIT - V: Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation. Thermoregulation: Comfort zone, body temperature- physical, chemical, neural regulation, acclimatization: Stress and adaptation

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Understand the normal physiological functions and necessity to maintain a healthy Life.
2	Get an opportunity to understand various factors that could lead to altered physiological functions and thereby health problems
3	Perform various physiological experiments and observations
4	Take up jobs in clinical labs and research institutes

TEXT BOOKS

1. Arumugam, N. and A. Mariakuttikan . (2017). *Animal Physiology,* Saras Publications, Nagercoil, Tamil Nadu.
2. Rastogi, S.C. (2016). *Essentials of Animal Physiology,* New Age International Publishers, New Delhi.
3. Verma, P. S., B. S. Tyagi and V. K. Agarwal, (2015). *Animal Physiology.* S. Chand & Company Ltd, New Delhi.
4. William S. Hoar, (1966). *General and Comparative Physiology*. Prentice Hall of India, New Delhi.
5. Wilson. A, (1979). *Principles of Animal Physiology*. Macmillan Publishing Co., Inc. New York.
6. Leon Goldstein, (1977). *Introduction to Comparative Physiology*. Holt, Rinehart and Winston, New York.
7. Prosser, L. and A. Brown, (1965). *Comparative Physiology*. Saunders Company, London.
8. Shepherd, G. M. 1994. Neurobiology, OUP USA Publsiher, pp-774.
9. Hainsworth , F.R. 1981. Animal Physilogy: Adaptation in function, Addison Wesley Longman Publishers, pp-669.
10. Mcfarland, D. 1999. Animal Behaviour: Psychobiology, Ethology and Evolution, Longman Publisher, pp-592.
11. Gorden, M.S. *et al.,* 1977. Animal Physiology: Principles and Adaptation, New York, Third Edition.
12. Ahearn, G.A. *et al*., 1988. Advances in Comparative and Environmental Physiology – 2, Springer Publishers, pp-252.
13. Hill, R.W. 1976. Comparative Physiology of Animals: Environmental Approach, Longman Higher Education Publisher, pp-656.
14. Withers, P.C. 1992. Comparative Animal Physiology, Brooks/Cole Publisher, pp-900.

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1. Mohan P. Arora. (2018). *Animal Physiology*. Himalaya Publishing House Pvt. Ltd., New Delhi
2. Tomar B.S. and Neera Singh. (2016). *Animal Physiology*. Pragati Prakashan, Meerut, Uttar Pradesh.
3. Sobti R.C. (2011). *Animal Physiology*. Narosa Publishing House, New Delhi.

4. Sandeep Saxena. (2012). *Animal Physiology*. Oxford University Press, USA.
5. Arumugam N. (2014). *Animal Physiology*. Saras publications. Nagercoil, Tamil Nadu.
6. Randall, D., W. Burggren, K. French and R. Eckert. 2001, Animal Physiology Mechanisms and Adaptations, New York : W.H. Freeman and Co., pp-
7. Nelson K. S. 1997. Animal Physiology: Adaptation and Environment, Cambridge University Press, pp- 617.
8. Dantzler, W.H. 1997. Comparative Physiology (Handbook of Physiology), Volumes I and II. Edited by William H. Dantzler. pp - 1824 Published for the American Physiological Society by Oxford University Press Inc., New York. Oxford University Press Canada, Toronto.
9. https://swayam.gov.in/nd1_noc20_bt42/preview
10. https://www.classcentral.com/course/swayam-animal-physiology-12894
11. https://swayam.gov.in/nd1_noc20_hs33/preview.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	L	S	M	S	S
CO2	S	S	M	S	S	S	S	M	S	S
CO3	S	M	S	S	S	M	L	S	M	S
CO4	S	S	S	S	S	L	M	S	S	M
CO5	S	S	S	M	M	M	M	L	L	M

S - Strong; M - Medium; L - Low

Semester	23ZOOP304 : CORE COURSE –X	H/W	C
III	PRACTICAL - III: GENETICS, EVOLUTION AND ANIMAL PHYSIOLOGY	6	4

Course Objectives

The main objectives of this course are:

1	Acquire knowledge on various types genetics inheritance.
2	Learn the method of culturing of *Drosophila* and identification of their wild and mutant strains
3	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities
4	Understand the animal evolution
5	Learn the various physiological processes

PRACTICALS - Genetics

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*
10. Karyotyping of normal man using metaphase chromosomal plate.
11. Identification of human syndromes from karyotyping

Practicals: Evolution

1. Genetic drift in small and large population using dummy materials
2. Sexual selection(a) Secondary sexual characters, e.g. Chimeroid fish (male), (b) Brooding organs- Sea Horse (male), (c) Special sound producing organs - scale insect (male), (d) 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
6. Mimicry and Colouration- Concealing mimicrying, e.g. Kallima butterfly, Geometrid moth, Stick insect, Leaf insect.
7. Warning mimicry-Viceroy and Monarch butterfly, Batesian and Mullerian mimicry.
8. Paleontology: Invertebrate fossil - Trilobite, Vertebrate Fossil - Archaeopteryx.
9. Osteology: Evolution of reptilian skull and its interrelationship

10. Evolution of mankind- similarities and differences between apes and man. Evolution of human skull

PRACTICAL – Animal Physiology

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).
7. Quantitative estimation of haemoglobin.
8. Quantitative estimation of proteins.
9. Biochemical analysis of protein, Carbohydrates and Lipids (Qualitative).

Expected Course Outcome (CO)

On the successful completion of the course, student will be able to**:**

1	Acquire knowledge on various types genetics inheritance.
2	Learn the method of culturing of *Drosophila* and identification of their wild and mutant strains
3	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities
4	Understand the animal evolution
5	Learn the various physiological processes

Outcome Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	L	S	M	S	S
CO2	S	S	M	S	S	S	S	M	S	S
CO3	S	M	S	S	S	M	L	S	M	S
CO4	S	S	S	S	S	L	M	S	S	M
CO5	S	S	S	M	M	M	M	L	L	M

S - Strong; M - Medium; L - Low

Semester	23ZOOC401: CORE COURSE - XI IMMUNOLOGY	H/W	C
IV		5	4

Course Objectives

The main objectives of this course are:

1	Various basic concepts in immunology and organization of immune systems**.**
2	Mechanisms of immune response in health and their defects in various diseases.
3	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.
4	Vaccinology and its importance in disease management
5	To gain knowledge regarding the application of immunological techniques

UNIT - I: Introduction to Immunology: An overview; Scope of immunology, recognition of self and non-self as a basic functional feature of immune system; Concepts of external and internal defense systems; External (first line / innate) defense system: components, distribution, salient functions; Internal (second line / acquired) immune system: cellular and humoral immune components- distribution, salient functions- primary and secondary immune responses; Immune tissues / organs: types, anatomical location, structure and development; lymphocyte traffic during development; Types of immunity: innate and acquired - types, functional features; concept of adaptive immunity

UNIT - II: Antigens: Definition, characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: definition, types and applications

UNIT - III : Major effector components of cellular immune system:Lymphocytes - types, morphology, clones; sub-populations, distribution, B and T cell receptors, B and T cell epitopes, Toll-like receptors; Antigen presenting cells: antigen processing and presentation, MHC molecules and their immunologic significance.

UNIT - IV: Major effector components of humoral immune system: Antibodies **-** Primary structure, classification, variants and antigen-antibody interactions; Structural and functional characteristics of various antibody classes; Generation of diversity; Monoclonal antibodies: definition, production and applications; Antibody engineering and its applications. Complement system **-** Components, three major activation pathways, and immune functions including anaphylaxis and inflammation. Cytokines -Definition and salient functional features; Interleukins: definition, types (lymphokines and monokines), and functions. Interferons **-** Origin, types and functions

UNIT - V Diseases and immune responses: Hypersensitivity: definition, Types I to IV and immune manifestations; Auto-immune diseases: onset, spectrum of diseases, and major immune responses; Immunodeficiency diseases: types including SCID and consequences; Viral (HIV), bacterial (tuberculosis) and parasitic (malaria) diseases: etiology, host immune responses and evasion by pathogens; Vaccines: types, preparations, efficacies and recent developments

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Various basic concepts in immunology and organization of immune systems.
2	Mechanisms of immune response in health and their defects in various diseases.
3	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.
4	Vaccinology and its importance in disease management

TEXT BOOKS

1. Kannan, I. (2019). *Immunology,* MJP Publications, Chennai, Tamil Nadu.
2. Kinndt, T.J. Goldsby, R. A. and Osborne, B. A. (2007). *Immunology*, 6th Ed. W.H. Freeman and Company, New York.
3. Murphy, K.M. and C. Weaver. (2017). *Janeway`s Immunology,* W. W. Norton & Company.
4. Nair, N.C., S.Leelavathy, N.Soundarapndian, T.Murugan an, N.Arumugam. (2015). *A text book of Immunology,* Saras Publications, Nagercoil, Tamil Nadu.
5. Madhavee, L.P. (2012). *A text book of Immunology*, S. Chand and Co., New Delhi.
6. Rao. C.V. (2011). *Immunology,* A Text Book. 2nd Ed. Narosa Publishing House, New Delhi.

REFERENCE BOOKS

1. Jenni Punt, Sharon Stranford, Patricia jones and Judith A Owen. (2018). *Kuby Immunology*. WHFreeman, USA.
2. Ramesh S. R. (2017). *Immunology.* McGraw-Hill, New York, USA.
3. Abul K. Abbas, Andrew H. Lichtman and Shiv Pillai. (2017). *Cellular and Molecular Immunology.* Elsevier, India.
4. Peter J. Delves, Seamus J. Martin and Dennis R. Burton. (2017). *Roitt's Immunology (Essentials)*. Wiley Blackwell, UK.
5. Raj Khanna. (2011). *Immunology.* Oxford University Press, USA.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	M	S	S
CO3	S	M	M	S	S	S	S	S	S	M
CO4	M	S	M	M	S	S	S	S	S	M
CO5	M	S	S	S	M	S	M	S	S	M

S - Strong; M - Medium; L - Low

Semester	23ZOOC402: CORE COURSE - XII ECOLOGY	H/W	C
IV		5	4

Course Objectives

The main objectives of this course are:

1	Learn about the ecosystem, biotic communities and utilizing the energy processing
2	Study the various community and population and population control
3	Understand the fundamentals of climatic conditions and its impact on environment
4	Realizing the nature of pollution and the ways for its control/reduction
5	Impact of environmental studies on solid waste management

UNIT - I: Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

UNIT - II: Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of meta population-demes and dispersal, interdemic extinctions, age structured populations -action taken to control population explosion.

UNIT - III: Species: Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. **Community ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. **Ecological succession:** Types; mechanisms; changes involved in succession; concept of climax.

UNIT - IV: Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). **Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

UNIT - V: Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches - Waste management. **Conservation biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Learn about the ecosystem, biotic communities and utilizing the energy processing
2	Study the various community and population and population control
3	Understand the fundamentals of climatic conditions and its impact on environment
4	Realizing the nature of pollution and the ways for its control/reduction
5	Impact of environmental studies on solid waste management

Text books:

1. Arumugam, N. (2019). *Ecology & Toxicology,* Saras Publications, Nagercoil, Tamil Nadu.
2. Prabhat Patnaik and Jayanath Bhattacharjee, (2012). *Environmental Biodiversity*, Wisdom Press, New Delhi.
3. Khitoliya, R.K. (2004). *Environmental pollution: Management and control for sustainable developments*. S. Chand & company (p) Ltd., New Delhi, India
4. Saha, T. K. (2007). *Ecology and environmental Biology*. Books and allied (P) Ltd. Kolkata, India.

Reference Books:

1. Krebs C. J. (2016). *Ecology:The experimental analysis of distribution and abundance*. Pearson India Education service (p) Ltd., New Delhi, India.
2. Arumugam A. and. Kumaresan V. (2016). *Environmental studies*. Saras Publication, Nagercoil, Tamil Nadu.
5. Mehta M (2010). *Understanding environmental science*. Discovery publishing house, New Delhi, India.
6. Pandy S.N. and S.P. Misra (2011). *Enviroment and ecology*. Ane Books Pvt. Ltd , New Delhi, India.
7. Agarwal K.C. (1999). *Environmental Biology*. Agro Botanica, New Delhi, India.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	M	S	S	M	S
CO2	S	S	M	M	L	S	S	S	M	M
CO3	S	M	M	L	M	S	L	L	S	L
CO4	M	M	S	S	M	L	L	S	S	S
CO5	M	S	S	M	S	M	L	M	L	S

S - Strong; M - Medium; L – Low

Semester	23ZOOP403 : LAB COURSE - PRACTICAL - IV IMMUNOLOGY AND ECOLOGY	H/W	C
IV		3	2

Course Objective :

1 2	Acquire knowledge to differentiate the various immune cells Understand antigen antibody interactions
3	Develop the analytical skill skills to know the nature of environment
4	Learn the method of analysis of water to know the pollution of it.

Practical: IMMUNOLOGY

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

Practical: ECOLOGY

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

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	differentiate the various immune cells
2	Understand antigen antibody interactions
3	Develop the analytical skill skills to know the nature of environment
4	Learn the method of analysis of water to know the pollution of it.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	L	S	M	S	M	M
CO2	S	S	L	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	M	S	M	S	M	S	S	S	M
CO5	M	S	S	M	M	S	M	L	S	M

S - Strong; M - Medium; L-Low

Semester	**23ZOOD404 : PROJECT With VIVA-VOCE**	**H/W**	**C**
IV		**10**	**7**

ELECTIVE (INDUSTRY/ENTREPRENEURSHIP):

Semester	Elective Course Code: 19ZOOE405 : MEDICAL LABORATORY TECHNIQUES	H/W	C
IV		4	3

Course Objectives

1	To understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.
2	To explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.
3	To evaluate the hematological parameters of biological samples.
4	To evaluate the histological parameters of biological samples.

UNIT - I: Laboratory safety - toxic chemicals and biohazards waste- biosafety level- good laboratory practice - hygiene and health issue - physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.

UNIT – II: Composition of blood and their function- collection of blood & lab procedure- haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time- clotting time- determination of haemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis- bleeding disorder of man - Haemolytic disease of new-born, Platelet count, reticulocytes count, Absolute Eosinophil count.

UNIT – III: Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosoma -Computer Tomography (CT scan) - Magnetic Resonance Imaging (MRI) –Positron Emission Tomography (PET) - Flowcytometry.

UNIT – IV: Cardiovascular system- Blood pressure - Pulse - regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – Echocardiogram and Treadmill test- Ultra sonography- Electroencephalography (EEG).

UNIT – V: Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome- sectioning, staining - staining methods - vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

Expected Course Outcome

At the end of the course, the student will be able to

1	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.
2	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.
3	Evaluate the hematological parameters of biological samples.
4	Evaluate the histological parameters of biological samples.

Text Books

1. Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.
2. Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi.
3. Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.
4. Sood, R, 2009. Medical Laboratory technology, Methods and interpretation.

Reference Books

1. Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi.
2. Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia.Published by Tata McGraw-Hill Education Pvt. Ltd.,
3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	M	L	L	M	M	L	M
CO2	S	S	M	S	S	S	L	M	S	S
CO3	M	S	S	S	S	S	S	S	S	L
CO4	S	S	M	M	L	M	L	M	M	S
CO5	M	M	S	S	M	S	L	L	S	S

S - Strong; M - Medium; L-Low

ELECTIVE COURSES:

Semester	Elective - I : (Discipline Centric): 23ZOOE104: MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY	H/W	C
I		5	3

Course Objectives

The main objectives of this course are:

1	To learn the structure, properties, metabolism and bioenergetics of biomolecules
2	To acquire knowledge on various types of enzymes, classification, their mechanism of action and regulation
3	To understand the importance and applications of methods in conforming the structure of biopolymers
4	To know the structural organization of proteins, carbohydrates, nucleic acids and lipids
5	To familiarize the use of methods for the identification, characterization and conformation of biopolymer structures

UNIT - I: Basics of biophysical chemistry and biochemistry: Structure of atoms, molecules and chemical bonds - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

UNIT - II: Biomolecular interactions and their properties: Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc. - Composition, structure, metabolism and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

UNIT - III: Bioenergetics and enzymology: Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isoenzymes

UNIT - IV Structural conformation of proteins and nucleic acids:Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).

UNIT - V: Stabilizing interactions in biomolecules:Stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions and disulfide linkage.

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Learn the structure, properties, metabolism and bioenergetics of biomolecules
2	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation
3	Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers
4	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids
6	Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures

Text Books

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2002. Biochemistry. 5th Ed., W.H. Freeman & Co., New York, pp-1050.
2. Kuchel P.W. and G. B. Ralston. 2008. Biochemistry. McGraw Hill (India) Private Limited, UP, pp-580.
3. McKee T. and J. R. McKee. 2012. Biochemistry: The Molecular Basis of Life. (7th Edition). Oxford University Press, US, pp-793.
4. Nelson D.L. and M.M. Cox. 2012. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.
5. Satyanarayana U. and U. Chakrapani, 2006. Biochemistry. (3rd Edition). Books and Allied (P) Ltd. Calcutta, pp-695.

Reference Books

1. Buchanan, B.B., W. Gruissem and R.L. Jones. 2015. Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK, pp-1280.
2. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell. 2003. Harper's Illustrated Biochemistry (26th Edition), The McGraw-Hill Companies, Inc., USA, pp-704.
3. Palmer, T. 2004. Enzymes. Affiliated East-West Press Pvt. Ltd., New Delhi, pp-416.
4. Voet D. and J.G. Voet. 2011. Biochemistry. (4th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp-1428.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	L	S	M	S	M	M
CO2	S	S	L	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	M	S	M	S	M	S	S	S	M
CO5	M	S	S	M	M	S	M	L	S	M

S - Strong; M - Medium; L-Low

Semester	Elective - I : (Discipline Centric): 23ZOOE105: MEDICAL ENTOMOLOGY	H/W	C
I		5	3

Course Objectives

The main objectives of this course are:

1	To acquire Knowledge of the Classification of Arthropod Vector insects in Medical Entomology.
2	To study the life Cycles of Vector Insects.
3	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

MOSQUITO: Morphology – Life history, vectors - diseases transmission– Control Measures.

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

UNIT - 4 : **Fleas and House fly**

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

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

.**UNIT - 5** : **Ticks and Mites**

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

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

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Identify insects based on morphological features
2	Start entrepreneurial activities
3	Take up jobs in vector control and public health departments
4	Take up integrated pest management activities

Text Books:

1. Tembhare, D.B. (2012). *Modern Entomology*, Himalaya Publishing House, New Delhi.
2. Tyagi , B.K. (2012). *Medical Entomology*, Scientific publishers, Chennai

Reference Book

1. Rathanswamy, G.K, (2010). A Hand book of Medical Entomology. S.Viswanatham Printers & Private & Ltd., Chennai
2. Vasantharaj Devid, and V.V. Ramamurthy, (2011). Elements of Economic Entomology.Namrutha Publications , Chennai -600116

Outcome Mapping

CO/ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	L	S	S	S	S	S
CO2	S	S	S	S	L	S	S	S	M	S
CO3	M	S	S	S	L	S	S	S	S	S
CO4	S	S	S	S	L	S	S	S	S	S

*S - Strong; M - Medium; L-Low

Semester	Elective - I : (Discipline Centric): 23ZOOE106: SERICULTURE	H/W	C
I		5	3

Course Objectives

The main objectives of this course are:

1	To understand the various practices in sericulture.
2	To know the needs for sericulture
3	To apply the techniques and practices needed for sericulture.
4	To know the difficulties in sericulture and be able to propose plans against it.

UNIT - I: Overview and introduction to sericulture, sources of silk fibre and various species of silk moth; properties and importance of silk fibre. Social relevance and advantages of sericulture in India.

UNIT - II: Host plants; Moriculture - distribution,morphology, propagation-seedling,cutting,grafting, layering and micropropagation methods, maintenance - irrigation, manuring and pruning, pests and diseases of mulberry.

UNIT - III: *Bombyx mori* - morphology,structure and function of silk gland, life cycle,indigenous and commercial races. Diapause, Egg storage and transportation.

UNIT – IV: *Bombyx mori* - Rearing houses and equipment. Rearing operation-disinfection, brushing, feeding and spacing. Moulting and spinning. Harvest. Rearing methods. Disease of bombyx mori - protozoan, bacterial,viral and fungal.

UNIT – V: Physical and commercial characteristics of cocoons. Cocoon harvesting and marketing. Cocoon sorting, stifling, de-flossing, riddling, cooking, brushing, reeling and re-reeling. Weaving. By-products of sericulture industry.

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Understand the various practices in sericulture.
2	Know the needs for sericulture and the status of India in global market.
3	Able to apply the techniques and practices needed for sericulture.
4	Know the difficulties in sericulture and be able to propose plans against it.

Text Books

1. G. Ganga and J. Sulochana Chetty. 2019. An introduction to sericulture, 2nd edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. M. Johnson and M. Kesary. 2019. Sericulture, Saras publication, Tamilnadu.
3. Singh, Amardev & Ravinder Kumar. 2013. Sericulture handbook Vol 1, Biotech.
4. M. Madan Mohan Rao. An Introduction to Sericulture, 2nd edition, BS Publications.

Reference Books /Recommended websites

1. https://agritech.tnau.ac.in/sericulture/
2. https://csb.gov.in/

Mapping with Programme Outcome3*										
CO3	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	L	L	L	L	L	M	S	L	L
CO2	L	M	L	M	L	M	M	S	M	L
CO3	M	S	L	L	L	M	L	L	M	S
CO4	M	S	M	S	M	M	L	L	S	S
CO5	M	M	L	M	M	L	L	L	L	M

*S - Strong; M - Medium; L- Low

Semester	Elective - II: (Generic Centric): 23ZOOE107: BIOSTATISTICS	H/W	C
I		5	3

Course Objectives

The main objectives of this course are:

1	To understand the importance of analysis of qualitative and quantitative information from biological studies.
2	To acquire skills to perform various statistical analyses using modern statistical techniques and software.
3	To Know the merits and limitation of practical problems in biological/ health management study
4	To propose and implement appropriate statistical design/ methods of analysis.

UNIT - I: Definition, scope and application of statistics; Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.

UNIT - II: Measures of central tendency: Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range, variation, standard deviation, standard error and coefficient of variation.

UNIT - III: Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.

UNIT – IV: Hypothesis testing: Students '*t*' test - paired sample and mean difference'*t*' tests. Correlation: Types - Karl Pearson's Co-efficient, Rank correlation, Significance test for correlation coefficients.

UNIT - V: Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction. Analysis of variance: one way and two way classification.

Expected Course Outcome

On the successful completion of the course, student will be able to:

1	Clear understanding of design and application of biostatistics relevant to experimental and population studies.
2	Acquired skills to perform various statistical analyses using modern statistical techniques and software.
3	Knowledge on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.

Text Books

1. Arora, P. N. and P. K. Malhan. 1996. Biostatistics, Himalaya Publishing House, Mumbai, pp-447.
2. Gurumani, N. 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
3. Das, D. and A. Das. 2004. Academic Statistics in Biology and Psychology, Academic Publisher, Kolkata, pp-363.
4. Palanichamy, S. and Manoharan, M. 1990. Statistical Methods for Biologists, Palani Paramount Publications, Tamil Nadu, pp-264.

Reference Books

1. Bailey, N. T. J. 1959. Statistical in Biology, English Universities Press, London, pp-48.
2. Sokal, R. R. and F. J. Rohlf, 1973. Introduction to Biostatistics, W.H. Freeman, London, pp-467.
3. Sokal, R.R. and F.J. Rohlf. 1981. Biometry: The principles and practice of statistics in biological research, San Francisco: W.H. Freeman, London, pp-859.
4. Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India, pp-660.
5. Bailey, N. T. J. 1994. Statistical Methods in Biology (Third Edition), Cambridge University Press, Cambridge, pp-255.
6. Wayne W. Daniel. Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons Inc, USA, pp-443.
7. Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods (Sixth Edition), Oxford & IBH Publishing Co., New Delhi, pp-593.
8. Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	L	M	S	S	M	S	M	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	S	S	S	S	S	L
CO4	M	M	S	L	M	M	M	S	L	M
CO5	M	M	S	L	M	S	M	L	S	M

S - Strong; M - Medium; L- Low

Semester	Elective - II : (Generic Centric): 23ZOOE108: TOXICOLOGY	H/W	C
I		5	3

Course Objectives

The main objectives of this course are:

1	**To learn the concepts and processes involved in toxicology**
2	To understand the various methods to know absorption and distribution of toxicants
3	To study the biotransformation and excretion of toxicants
4	To learn the impacts of toxicants and human beings.
5	To learn the application of antidotes

UNIT - I: Introduction to Toxicology

Definition – Brief history of toxicology– Toxicity methods – Acute toxicity tests – Sub-acute toxicity test – Chronic toxicity test – Bio-assay – Determination of LC_{50} and LD_{50} – Dose - Response relationship.

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

Route of exposure of Toxicants: Dermal route – Inhalation route – Ingestion route. Absorption of Toxicants: Introduction – Mechanism of absorption – Passive transport and carrier mediated transport – Factors affecting absorption. Distribution of Toxicants: Membrane barriers.

UNIT - III: Biotransformation and Excretion of Toxicants

Biotransformation: Pattern of Biotransformation - Phase I reaction – Oxidation – Mixed Function Oxidase System – Reduction reaction – Hydrolysis – Phase II reaction – Biochemical conjugation – Glucuronidation – conjugation with Glutathione – Sulphate conjugation – Acetylation and Methylation – Amino acid conjugation - Excretion of Toxicants: Urinary excretion – Biliary excretion.

UNIT - IV: Toxic effects on human

Categories of toxic effects – Local and systemic effects – Reversible and irreversible effects – Immediate and delayed effects - Effects on target organs: Neurotoxic effects – Hepatotoxic effects – Genotoxic effects – mutagenic – Teratogenic – carcinogenic effects.

UNIT - V: Antidotes

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

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Carry out toxicological analysis of various environmental samples
2	Make observations and biochemical analysis of biological samples
3	Carry out toxicological testing using live specimen to determine toxicity of toxicants
4	Take up jobs in toxicological research institutions and clinical labs

TEXT BOOKS

1. Lee, B.M. and S.Kacew. (2018). *Lu's Basic Toxicology,* Informa Healthcare.
2. Sharma, P. D., (1996). *Environmental biology and toxicology*. Rastogi Publication, Meerut, India
3. Frank C. Lu (1985). *Lu's Basic Toxicology*. Hemispher Publication Corporation Washington, N.Y. London.
4. Gupta, P.K., and Salunka, D.K., (1985). *Modern Toxicology*. Vol. I and II, Metropolitan, New Delhi.
5. Pandey, K., J. P. Shukla and S. P. Trivedi. (2013). *Fundamentals of Toxicology*, New Central Book Agency, New Delhi.
6. Chris Kent (1998). *Basics of Toxicology*. John Wiley & Sons. New York

REFERENCE BOOKS

1. Vija Byung-Mu Lee, Sam Kacew and Hyung Sik Kim. (2017). *Lu's Basic Toxicology: Fundamentals, Target Organs, and Risk Assessment*. CRC Press, USA.
2. Stephen M. Roberts, Robert C. James and Phillip L. Williams. (2015). *Principles of Toxicology: Environmental and Industrial Applications*. Wiley Blackwell.
3. Frank A. Barile. (2017). *Principles of Toxicology Testing*. CRC Press, USA.
4. Karen E. Stine and Thomas M. Brown. (2015). Principles of Toxicology. CRC Press, USA.
5. Barile, F.A. (2013). *Principles of Toxicology Testing*, CRC Press.
6. Kamaleshwar Pandey, J. P. Shuikla and S. P. Trivedi. (2011). *Fundamentals of Toxicology*. New Central Book Agency, New Delhi.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	L	M	S	S	M	S	M	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	S	S	S	S	S	L
CO4	M	M	S	L	M	M	M	S	L	M
CO5	M	M	S	L	M	S	M	L	S	M

S - Strong; M - Medium; L- Low

Semester	Elective - II : (Generic Centric): 23ZOOE109: APICULTURE	H/W	C
I		5	3

Course Objective

1	Clear understanding of morphology, life cycle, characteristics of honey bees and bee keeping.
2	Acquired skills to perform bee keeping from managing colonies of bees in order to harvest honey and other Bee related by-products in different setups and as an Entrepreneurial venture.
3	Knowledge on the harvesting, preserving and processing of bee products and identification of the appropriate markets to sell the produce.

UNIT - I: Introduction to Apiculture. History, classification, types, life Cycle of different species of Honey Bees and their behavioural patterns. Social organization of bee colony

UNIT - II: Bee-keeping system, tools and equipment's needed for bee keeping. Types of bee hives, structure and functional features. Criteria for site selection for apiculture and factors affecting them.

UNIT – III: Identification and characteristics and Preventive measures to be taken against of different bee enemies. Diseases affecting honey bees and their control measures. Colony collapse disorder and its management.

UNIT – IV: Bee products, uses and importance- Honey, Royal jelly, Propolis, Pollen and Bee venom. Harvesting, Processing, Packaging and Marketing of bee products.

UNIT - V: Apiculture industry around the world and Role of Central Bee Research & Training institute in India. Apiculture as an Entrepreneurial venture.

Expected Course Outcome (CO)

On the successful completion of the course, student will be able to**:**

1	Clear understanding of morphology, life cycle, characteristics of honey bees and bee keeping.
2	Acquired skills to perform bee keeping from managing colonies of bees in order to harvest honey and other Bee related by-products in different setups and as an Entrepreneurial venture.
3	Knowledge on the harvesting, preserving and processing of bee products
4	Identify the appropriate markets to sell the produce.

Text Books

1. Singh, D., Singh, D. Pratap. 2006. A Handbook of Beekeeping. AGROBIOS (INDIA)
2. Sharma P.L. and Singh, S.H. Book of Bee keeping.
3. Cherian and Ramanathan, S. Bee keeping in south India.
4. Prospective in Indian Apiculture - R.C. Mishra.

Reference Books

1. Caron, D.W. 2013 (revised from 1999). Honey Bee Biology and Beekeeping. Wicwas Press. Cheshire, CT, 368 pp.
2. Kaspar, R., C. Cook, and M. D. Breed. 2018. Animal Behaviour 142: 69-76.
3. Hendriksma, H. P., A. L. Toth, and S. Shafir. 2019. Individual and Colony Level Foraging decisions of Bumble Bees and Honey Bees in Relation to Balancing of Nutrient Needs. Frontiers in Ecology and Evolution 7: 177.
4. Steinhauer, N. et al. 2018. Drivers of Colony Loss. Current Opinion in Insect Science 26: 142-148.
5. Technology and value addition of Honey - Dr. D. M. Wakhle and K. D. Kamble.
6. ABC & XYZ of Bee culture - A. I. Root.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	L	L	S	L	S	S	L	M
CO2	S	S	S	S	S	S	L	L	S	S
CO3	S	L	M	M	S	M	M	L	L	L
CO4	M	S	L	S	L	M	L	M	M	M
CO5	S	L	L	S	L	M	L	L	M	L

*3 - Strong; M - Medium; 1-1ow

Semester	Elective - III: (Discipline Centric): 23ZOOE204 : ECONOMIC ENTOMOLOGY	H/W	C
II		4	3

Course Objectives

The main objectives of this course are:

1	To understand taxonomy, classification and life cycle of insects.
2	To know the method of rearing and management of diseases of beneficial insects.
3	To know the type of harmful insects, and their damage potential
4	To recognize insects which act as vectors causing diseases in animals and human.

UNIT - I: Basic morphological concepts – Insect taxonomy upto orders – salient features withsuitable examples of the insect orders – Odonata, Orthoptera, Coleoptera, Lepidoptera and Diptera. Elementary knowledge on insect system and function.

UNIT - II: Beneficial insects: Silkworm – types,life history, disease management and rearing methods - types of honey bees, life history, social organization, structural adaptation and beehive. Lac insects – life history, lac cultivation.

UNIT – III: Destructive insects: Insect pests - definition – categories of pests – types of damage to plants by insects – causes of pest outbreak – Economic threshold level – Biology of Paddy, cotton, sugarcane pests.

UNIT – IV: Pest management/Control strategies:Methods and principles of pest control - Natural control, Artificial control, Merits and demerits or limitations of these methods in pest control - Development and uses of pest resistant plant varieties - Integrated pest management - Concepts and practice.

UNIT - V: Vector biology and control: Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures.

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Understand taxonomy and classification of insects
2	Know the life cycle, rearing and management of diseases of beneficial insects.
3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control
4	Recognize insects which act as vectors causing diseases in animals and human.
5	Overall understanding on the importance of insects in human life.

Test Books

1. Ayyar, L.V. R. 1936. Hand book of Economic Entomology for South India. Narendra Publishing House. New Delhi, pp- 528.
2. Vasantharaj David, B. and V.V. Ramamurthy. 2016. Elements of Economic Entomology, Eighth Edition, Brillion Publishing, New York, pp-400.
3. Ross. H.H. 1965. A Text Book of Entomology, John Wiley & Sons Inc., New York, pp-746.

Reference Books

1. Chapman, R.F., S.J. Simpsonand A.E.Douglas. 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, pp-959.
2. Imms, A.D., O.W.Richards and R.G. Davies (Eds.) IMMS' General Textbook of Entomology, Volume I: Structure, Physiology and Development, pp-418; Volume 2: Classification and Biology, pp-934, Springer Netherlands.
3. Daly, H.V., J.T. Doyen and P.R. Ehrlich. 1978. Introduction to Insect Biology and Diversity. Mc Graw-Hill Kogakusha Ltd., Tokyo, pp-564.
4. Hill, D.S. 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York, pp-746.
5. Krishnaswami, S. 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.
6. Mani, M.S. 1982. General Entomology. Oxoford & IBH Publishing Co., pp-912.
7. Wigglesworth, V.B. 1972. The Principles of Insect Physiology, ELBS & Chapman and Hall, London, pp-827.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	M	M	S	L	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	M	M
CO5	S	S	S	M	M	S	M	L	S	M

S - Strong; M - Medium; L-Low

Semester	Elective - III: (Discipline Centric): 23ZOOE205 : Biodiversity and conservation	H/W	C
II		4	3

Course Objectives

The main objectives of this course are:

1	To make students to realize the structure and function of ecosystem.
2	To make students to realize the wealth of our natural resources
3	To make students to realize the conservation measures to be taken
4	To make students to realize to create awareness of the laws governing environment.

Unit – I: Ecosystem

Composition of atmosphere – structure and stratification of atmosphere - Hydrological cycle-kinds of ecosystem-structure and functions of ecosystem-energy flow in ecosystem-trophic levels

Unit – II: Natural Resources and Conservation

Types of resources-conventional and non- conventional sources of energy-conservation of soil, land and forest - Deforestation and Afforestation – Conservation strategies (WCS &NCS) - Wild life management in India.

Unit – III: Air and Water Pollution

Air pollution-types of air pollutants-classification and effect of pollutants on vegetation, farm animals and human health-prevention and control of air pollution.

Water pollution-sources of water pollution-water quality standards – Eutrophication-prevention and control of water pollution.

Unit – IV: Radiation, Noise and Industrial Pollution

Radiation pollution-sources and effects of ionizing radiation.

Noise pollution – sources of noise pollution – effects of noise pollution – control measures. Pollution control and abatement on cement industry – leather industry – textile industry.

Unit – V: Environmental Impact Assessment and Law

The objective of Environmental Impact Assessment (EIA) – Environmental Appraised Committee (EAC) – The Environmental Management Plan (EMP) – Control of Environmental pollution through law – Environmental Protection Act (1986).

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Realize the structure and function of ecosystem.
2	Know the wealth of our natural resources
3	Realize the conservation measures to be taken
4	Create awareness of the laws governing environment.

Text Books

1. Sharma.P.D., 1995. Environmental Biology and Toxicology. Rastogi and Company, Meerut, India.
2. Trivedi P.R.,& Gurdeepraj., 1992. Environmental Biology. Akashdeep Publishing House, New Delhi.
3. Pal, B.P.,1982 Environmental Conservation and Development, Nataraj Publishers, Dehra Dun, India.
4. Agarwal, K.C., 1989. Environmental Biology. Agro Botanical Publishers, India.

Reference Books

1. Trivedi, P.R.& Gurdeepraj., 1992. Water Pollution. Akashdeep Publishing house, New Delhi.
2. Break Mely, W.1980. Chemicals in the Environment. Marshal Dokker INC Newyork.
3. Irving Sax, N.1974. Industrial Pollution. Van Nostrand Raingold Co., Newyork.
4. Pandey G.N.& G.C.Carney, 1989. Environmental Engineering. Tata McGraw-Hill Publishing Co., Ltd.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	M	M	S	L	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	M	M
CO5	S	S	S	M	M	S	M	L	S	M

S - Strong; M - Medium; L-Low

Semester	Elective - III: (Discipline Centric): 23ZOOE206 : VERMICULTURE	H/W	C
II		4	3

Course Objective

1	To understand the various practices in vermiculture.
2	To know the needs for Vermiculture and the status of India in global market.
3	Able to apply the techniques and practices needed for vermiculture.
4	To know the difficulties in Vermiculture and be able to propose plans against it.

UNIT - I: Earthworms - Taxonomic position, external features - shape, size, colour, segmentation, setae & clitellum. Body wall, coelom- locomotion,digestive, circulatory, respiratory, excretory & nervous system. Reproductive system-Male & Female, copulation, cocoon formation & fertilization, development of earth worm. Vermitechnology- Definition, history, growth and development in other countries & India, significance.

UNIT - II: Vermiculture - definition, common species for culture; Environmental parameters; culture methods – wormery - breeding techniques; indoor and outdoor cultures - monoculture and polyculture - merits and demerits

UNIT - III: Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the compost, storage..

UNIT – IV: Applications of vermiculture - Vermiculture Bio-technology, vermicomposting, use of vermicastings in organic farming/horticulture and forest regeneration. Earthworms for management of municipal/selected biomedical solid wastes; as feed/bait for capture/culture fisheries;.

UNIT – V: Potentials and constraints for vermiculture in India. Marketing the products of vermiculture - quality control, market research, marketing techniques – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing. Economic importance of Earthworms: In sustainable agriculture, organic farming, earthworm activities, soil fertility & texture, soil aeration, water imperculation, decomposition & moisture, bait & food.

Expected Course Outcomes

At the end of the course, the student will be able to

1	Understand the various practices in vermiculture.
2	Know the needs for Vermiculture and the status of India in global market.
3	Aapply the techniques and practices needed for vermiculture.
4	Know the difficulties in Vermiculture and be able to propose plans against it.

Text Books

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
2. Bhatnagar & Patla, 2007. Earthworm vermiculture and vermin-composting, Kalyani Publishers,New Delhi
3. Mary Violet Christy, 2008. Vermitechnology,MJP Publishers, Chennai.
4. Aravind Kumar, 2005.Verms & Vermitechnology, A.P.H. Publishing Corporation, New Delhi.
5. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.

Reference Books

1. https://agritech.tnau.ac.in/sericulture/
2. https://www.agrifarming.in/vermiculture-process-techniques-worm-farming
3. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	M	L	L	L	L	S	L	L	L
CO2	L	S	S	S	S	S	L	S	S	S
CO3	M	S	S	S	S	S	L	S	S	L
CO4	L	S	S	S	M	S	M	S	S	M
CO5	S	S	M	S	L	L	L	M	L	M

*S - Strong; M - Medium; L- Low

Semester	Elective - IV: (Generic Centric): 23ZOOE207 : RESEARCH METHODOLOGY	H/W	C
II		4	3

Course Objectives

The main objectives of this course are:

1	To understand the Good Laboratory Practices
2	To learn the working principles of different instruments
3	To gain the knowledge on techniques of histology and histochemistry
4	To acquire knowledge on the basic principle and application of various modules of light and electron microscopy

UNIT - I: Good laboratory practice (GLP) - pH, Electrodes and pH meter - Colorimeter and Spectrophotometry

UNIT - II: Histology, Histochemistry, Bioinformatics and Electron microscopy.

UNIT – III: Light Microscopy, Bright field, Phase contrast, DIC & Fluorescence microscopy, wide field and Confocal microscopy.

UNIT – IV: Centrifuges, Chromatography, Electrophoresis, HPLC, GC-MS, PCR, ELISA and blotting

UNIT - V: Principles and Applications of tracer techniques in biology, Animal cell culture techniques.

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Understand the implications of GLP
2	Learn the working principles of different instruments
3	Gain the knowledge on techniques of histology and histochemistry
4	Acquire knowledge on the basic principle and application of various modules of light and electron microscopy

Text Books

1. Pearse, A.G. 1968. Histochemistry: Theoretical and Applied, Vol. I, Third Edition, J & A Churchill Ltd, pp-758.
2. Lillie, R.D. 1954. Histopathologic Technic and Practical Histochemistry, Second Edition, Blakiston, New York, pp-715.
3. Hoppert, M. 2003. Microscopic Techniques in Biotechnology, Wiley-VCH GmbH, Weinheim, Germany, pp-330.

Reference books

1. Chandler, D.E. and Roberson R.W. 2009. Bioimaging: Current Concepts in Light and Electron Microscopy, Jones and Bartlet Publishers, Sudbury, MA, USA, pp440.
2. Engelbert, B. 1960. Radioactive Isotopes in Biochemistry, Elsevier Applied Science, pp-376.
3. Wolf, G. 1964. Isotopes in Biology, Academic Press, pp-173.
4. Srivastava, B. B. 2005. Fundamentals of Nuclear Physics, Rastogi Publications, pp-500.
5. Pantin, C. F. A. 1948. Microscopical Techniques, Cambridge University Press, London.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	S	M	S	M	M
CO2	S	S	M	S	S	S	M	M	M	S
CO3	S	M	S	S	S	S	S	S	S	L
CO4	S	S	S	S	S	M	S	S	S	M
CO5	S	S	S	M	M	S	M	L	S	M

S - Strong; M - Medium; L-Low

Semester	Elective - IV: (Generic Centric): 23ZOOE208 : BASIC BIOTECHNOLOGY	H/W	C
II		4	3

Course Objectives

The main objectives of this course are:

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

UNIT - I: Introduction

Definition – Scope – Achievements of Biotechnology – Enzymes in genetic engineering - Restriction Enzymes, DNA ligase, DNA polymerase of Cloning vectors – Plasmids- Bacteriophage, Cosmids, Yeast plasmids.

UNIT - II: Techniques in Biotechnology

Southern blotting, Northern blotting, Western blotting, In-situ hybridization, DNA sequencing, PCR, DNA finger printing.

UNIT - III: Medical Biotechnology

rDNA Technology - Insulin, Somatotrophin, Somatostatin - hormone production, vaccines, interferons, gene therapy, monoclonal antibodies, Human Genome Project (HGP).

UNIT - IV: Agricultural Biotechnology

Micropropagation, protoplast culture, Biofertilizers - Symbiotic and Non symbiotic nitrogen fixation, Biopesticides - Transgenic plants and animals.

UNIT - V: Microbial and Environmental Biotechnology

Bioreactor, primary metabolites – Vitamins, alcohols, Secondary metabolites – Antibiotics, Toxins, Microbial enzyme production – amylase. Bioremediation, Microbial leaching.

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Gain knowledge on the principles of biotechnology
2	Know various experiments related to biotechnology
3	Carry out biotechnological applications in the fields of medicine, agriculture and environmental fields
4	Equip themselves to take up jobs in various biotechnological companies and labs

TEXT BOOKS

1. Dubey. R. C., (2018). *A Text Book of Biotechnology*. S. Chand & Co. Ltd., New Delhi.
2. Lohar, P.S. (2014). *Text Book Of Biotechnology,* MJP Publishers,Chennai, Tamil Nadu.
3. Glick, B.R. and C.L Patten. (2018). *Molecular Biotechnology : Principles and Applications of Recombinant DNA,* ASM Pres, USA.
4. Clark, D.P. and N.J. Pazdernik. (2017). *Biotechnology,* Academic Cell.
5. Lohar, P.S. (2017). *Biotechnology,* MJP Publishers,Chennai, Tamil Nadu.
6. Gupta. P. K., (2009). *Elements of Biotechnology*. Rastogi & Company, Meerut.
7. Purohit, S. S. (2007). *Biotechnology, Fundamentals and Applications.* Agrobios, New Delhi.

REFERENCE BOOKS

1) Bernard R. Glick and Chery L Patten. (2017). *Molecular Biotechnology.* Taylor & Francis.
2) William J. Thieman and Michael A. Palladino. (2014). *Introduction to Biotechnology.* Pearson.
3) Singh B. D. (2015). *Biotechnology:* Expanding Horizons. Kalyani.
4) Dubey R. C. (2014). *Advanced Biotechnology*. S Chand & Co., New Delhi.
5) Pratibha Nallari and V. Venugopal Rao. (2010). *Medical Biotechnology.* Oxford University Press, USA.
6) Kumarsan, V. and N. Arumugam. (2016). *Fundamentals of Biotechnology,* Saras Publications, Nagercoil, Tamil Nadu.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	S	M	S	M	M
CO2	S	S	M	S	S	S	M	M	M	S
CO3	S	M	S	S	S	S	S	S	S	L
CO4	S	S	S	S	S	M	S	S	S	M
CO5	S	S	S	M	M	S	M	L	S	M

S - Strong; M - Medium; L-Low

Semester	Elective - IV: (Generic Centric): 23ZOOE209 : BIOCOMPOSTING	H/W	C
II		4	3

Course Objective

1	To gain knowledge on the process of bio-composting
2	To demonstrate bio-composting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane biogases, etc.
3	To know the economic cost of establishing small bio-compost units in the cottage industry.

UNIT - I: Bio-composting - Definition, types and ecological importance

UNIT – II: Types of bio-composting technology - Field pits/ground heaps/ tank/large-scale/batch and continuous methods

UNIT - III: Preparation of bio-compost pit and bed using different amendments

UNIT – IV: Applications of bio-compost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc

UNIT – V: Establishments of small bio-compost unit - project report proposal for Self Help Group (Income and employment generation).

Expected Course Outcomes

At the end of the course, the student would have

1	Gained knowledge on the process of bio-composting
2	The ability to demonstrate bio-composting techniques for various end applications like solid waste management.
3	The ability to demonstrate bio-composting techniques for industrial waste recycling using sugarcane bagasse, etc.
4	Knowledge, gain on the economic cost of establishing small bio-compost units in the cottage industry.

Text Books

1. Bikas R. Pati& Santi M. Mandal (2016). Recent trends in composting technology.
2. Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termorshuizen, A.J. (Editors). 2016. Handbook for Composting and Compost Use in Organic Horticulture.
3. BioGreenhouse COST Action FA 1105,

Recommended websites

1. www.biogreenhouse.org

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	M	L	L	M	L	M
CO2	S	M	M	M	M	M	L	L	M	M
CO3	S	S	S	S	S	S	L	M	M	S
CO4	S	L	L	M	M	S	M	S	S	M
CO5	M	L	L	L	S	M	M	M	M	S

*S - Strong; M - Medium; L- Low

Semester	Elective - V: (Discipline Centric): 23ZOOE305 : STEM CELL BIOLOGY	H/W	C
III		3	3

Course Objectives

The main objectives of this course are:

1	To gain the basic knowledge of stem cells and their origin
2	To differentiate the embryonic and adult stem cells
3	To understand and apply the current stem cell therapies

UNIT - I: Introduction to stem cell biology: Stem cell definition, origin and hierarchy, stem cell properties, Identification and Characterization, potency and differentiation, niche of stem cell, overview of different stem cell types (embryonic stem cells, adult stem cells and induced pluripotent stem cells).

UNIT - II: Embryonic stem (ES) cell: Characterization and properties of ES cells , pluripotency and self-renewal of ES cells; molecular mechanisms regulating pluripotency and maintenance of the stem state, progressive differentiation of ES cells into ectoderm lineage organs (skin, brain and nerve), mesoderm lineage organs (heart, kidney, muscle, bone and blood), and endoderm lineage organs (lung, liver, stomach, pancreas and intestine).

UNIT – III: Adult stem cells: Mesenchymal stem cells (MSCs) - sources, properties (plasticity, homing and engraftment), potency and characterization; Haematopoietic stem cells (HSCs) - sources, properties, potency and characterization; steps involved in production of induced pluripotent stem cells (iPSCs); role of Yamanaka factor in iPSCs..

UNIT – IV: Stem cell and aging: aging theory; cell cycle; telomere and telomerase; senescence of stem cell; role of stem cell in aging; tissue repair and regeneration of adult stem cell.

UNIT - V: Current stem cell therapies: Advantages and disadvantages of ES cells and adult stem cells (MSCs and HSCs) therapy; Ethical concern on stem cell therapy; current stem cell therapy for various diseases; clinical outcome of stem cell therapy; state of clinical trials in adult stem cells for various diseases.

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Understand the basic knowledge of stem cells and their origin
2	Differentiating the embryonic and adult stem cells
3	Acquire knowledge on stem cells and aging
4	Understand and apply the current stem cell therapies for their research

Text Books

1. Kiessling, A.A. 2006. Human Embryonic Stem Cells (Second Ed.), Jones & Barlett Publishers.
2. Lanza, R. and A. Atala. 2005. Essentials of Stem Cell Biology. Academic Press, pp-712.
3. Turksen, K. 2004. Adult Stem Cells. Humana Press, Inc, pp-429.
4. Lanza, R. *et al*. 2004. Handbook of Stem Cells: Embryonic/Adult and Fetal Stem Cells (Vol. 1 & 2). Academic Press, pp-1626.
5. Institute of Medicine, 2002. Stem cells and the future of regenerative medicine. National Academy Press, pp-112.
6. Marshak, D., R.L. Gardener and D. Gottlieb. 2001. Stem Cell Biology, Cold Spring Harbour Monograph Series, 40, pp-550.
7. Booth, C. 2003. Stem Cell Biology and Gene Therapy, Cell Biology International, Academic Press.

Reference Books

1. Quesenberry, P.J., G.S. Stein, B. Forget and S. Weissman. 2001. Stem Cell Biology and Gene Therapy, Wiley Publishers, pp-584.

2. Sell, S. and Totowa, N.J. 2004. Stem Cells Handbook, Humana Press, pp-534.

3. Sullivan, S., C. A. Cowan and K. Eggan. 2007. Human Embryonic Stem Cells: The Practical Handbook, Wiley Publishers, pp-424.

4. Battler, A., and Leo, J. 2007. Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Springer Publication, pp-422.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	S	M	S	M	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	M	L	S	M
CO4	S	S	S	S	S	M	M	S	L	M
CO5	S	S	S	M	M	S	S	S	S	S

S - Strong; M - Medium; L-Low

Semester	Elective - V: (Discipline Centric): 23ZOOE306 : AQUACULTURE	H/W	C
III		3	3

Course Objectives

1	To develop knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques
2	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval rearing
3	To identify the different fish diseases, diagnosis and their management strategies.
4	Understands Ornamental fishes and central aquaculture organizations

UNIT - I: Importance of aquaculture- Present status, prospects and scope in India. Freshwater aquaculture- Brackishwater aquaculture- Mariculture - Metahaline culture in India. Types of fish culture -Types of fish ponds for culture practice. Topography, site selection - water quality - soil condition and quality – structure and construction design and layout - inlet and outlet. Water quality management for aquaculture. Control of parasites, predators and weeds in culture ponds. Fish farm implements - Secchi disc - aerator - pH meter - tools for hypophysation - feeding trays – Fishing gears used in aqua farming.

UNIT - II: Procurement of seed from natural resources- collection methods and segregation. Hatchery technology for major carps and freshwater prawn. Artificial seed production –Breeding under control conditions, induced breeding technique, larval rearing, packing and transportation - Commercial substitute for pituitary extracts. Classification of fish feed- Artificial feeds - Types, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.

UNIT – III: Shrimp hatchery technology - Hatchery design, brood stock management, spawning, larval rearing, Shrimp developmental stages, algal culture, packing and transportation. Shrimp culture technology - extensive culture methods - semi-intensive - intensive culture methods - Biofloc technology - Culture operations (water quality, feed and health management) - harvesting, preservation and marketing. Brackish water fish culture. Edible and Pearl oyster culture - pearl production. Crab culture. Economic importance of Lobster, Sea urchin and Sea cucumber - their by-products. Types of Seaweeds - species and methods of culture – by-products

UNIT – IV Fish and Shrimp diseases and health management – infectious diseases - Bacterial, Fungal, Viral, Protozoan; Non-infectious - environmental and nutritional diseases. Diseases diagnosis, prevention and control measures.

UNIT - V: Types of ornamental fishes (freshwater and marine), their breeding behavior and biology. Oviparous, Ovo-viviparous and Viviparous fishes. Setting and maintenance of freshwater Aquarium tanks. Central aquaculture research organizations- CMFRI, CIBA, CIFT, CIFA, CIFE, MPEDA, RGCA and their activities.

Expected Course Outcome

At the end of the course, the student would have

1 2	Knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval rearing
3	Identify the different fish diseases, diagnosis and their management strategies.
4	Understands Ornamental fishes and central aquaculture organizations

Text Books

1. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd.
2. Santhanam, R. (1990). Fisheries Science. Daya Publishing House.
3. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
4. Yadav, B. N. (1997). Fish and fisheries.Daya Publishing house, New Delhi.

Reference Books

1. Das M. C. and Patnaik, P. N. (1994) Brackish water culture. Palani paramount Publications, Palani, T. N.
2. Day, F (1958). Fishes of India , VoL I and Vol. II. William Sawson and Sons Ltd., London.
3. Jhingran, V. G. (1991). Fish and Fisheries of India. Hindustan Publishing Co., India
4. Maheswari. K. (1983) Common fish disease and their control. Institute of Fisheries Education, Powarkads (M.P).

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	M	S	S	S	S	M	M	S
CO5	S	S	M	S	M	S	M	L	S	S

S-Strong; M-Medium; L-Low

Semester	Elective - V: (Discipline Centric): 23ZOOE307 : ENDOCRINOLOGY	H/W	C
III		3	3

Course Objectives

The main objectives of this course are:

1	To learn basics of various endocrine glands
2	To understand structure and functions of pituitary, thyroid and parathyroid gland
3	To understand the structure and functions of pancreas and adrenal glands

UNIT - I: Pituitary Gland

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

UNIT - II: Thyroid gland

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

UNIT - III: Parathyroid gland

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

UNIT - IV: Pancreas

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

UNIT - V Adrenal glands

Adrenals – structural organization - synthesis of adrenocortical hormones – Mineralocorticoids – Glucocorticoids - functions – regulation of cortisol secretion - abnormalities of adrenocortical secretions – hormones of adrenal medulla and their biological actions.

Expected Course Outcome

On the successful completion of the course, student will be able to**:**

1	Understand the basics of various endocrine glands.
2	Pursue higher studies on endocrinology.
3	Take up jobs in clinical labs
4	Analyze biological samples of endocrinological importance

TEXT BOOKS

1. Shlomo Melmed , Kenneth S. Polonsky , P. Reed Larsen and Henry M. Kronenberg . (2017). William's text book of Endocrinology , Elsevier India.
2. Handley, M.E. and J.E. Levine. (2017). Endocrinology , Pearson Education India.
3. Turner C. D. (1996). General endocrinology. 4th Ed, W.B. Saunders Co., London.
4. Bentley P. J. (1998). Comparative Vertebrate Endocrinology. Cambridge University Press, UK.
5. Barrington E. J. W., (1968). An Introduction to General and comparative endocrinology. Academic press, London.
6. Williams. R. H. (1974). Text book of endocrinology 5th Ed. W B Souanders & co., Philadelphia, USA.

REFERENCE BOOKS

1) Pandey B.N. (2019). *Endocrinology*. Atlantic Publishers, Chennai, Tamil Nadu.
2) Jameson, J.L. (2016). *Harrison's Endocrinology.* McGraw Hill Education, New Delhi.
3) Lawrence I. Gilbert. (2011). *Insect Endocrinology*. Academic Press, USA.
4) Bruce A. White and Susan P. Porterfield (2013). *Endocrine and Reproductive Physiology*. Elsevier, India.
5) David O. Norris and J.A.Carr. (2013). *Vertebrate Endocrinology*, Academic Press, USA.
6) Yadav B. N. (2011). *Mammalian Endocrinology*. Vishal Publishing Co., Punjab.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	S	M	S	M	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	M	L	S	M
CO4	S	S	S	S	S	M	M	S	L	M
CO5	S	S	S	M	M	S	S	S	S	S

S - Strong; M - Medium; L-Low

SKILL ENHANCEMENT COURSE

Semester	SKILL ENHANCEMENT COURSE (SEC – I) 19ZOOS210 : POULTRY FARMING	H/W	C
II		4	2

Course Objectives

1	To understand the various practices in Poultry farming.
2	To know the needs for Poultry farming and the status of India in global market.
3	To apply the techniques and practices needed for Poultry farming.
4	To know the challenges in Poultry farming

UNIT - I: General introduction to poultry farming - Definition of Poultry - Past and present scenario of poultry industry in India - Principles of poultry housing - Poultry houses - Systems of poultry farming

UNIT - II: Management of chicks - growers and layers - Management of Broilers. - Preparation of project report for banking and insurance

UNIT - III: Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.

UNIT – IV: Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.

UNIT - V: Selection, care and handling of hatching eggs - Egg testing. Methods of hatching.- Brooding and rearing -. Sexing of day-old chicks. - Farm and Water Hygiene - Recycling of poultry

Expected Course Outcome

At the end of the course, the student will be able to

1	Understand the various practices in Poultry farming.
2	Know the status of Poultry farming.
3	Apply the techniques and practices needed for Poultry farming.
4	Know the difficulties in Poultry farming and be able to propose plans against it.

Text Books

1. Sreenivasaiah., P. V., 2015. Textbook of Poultry Science. 1st Edition. Write & Print Publications, New Delhi 2.
2. Jull A. Morley, 2007. Successful Poultry Management. 2nd Edition. Biotech Books, New Delhi"
3. Hurd M. Louis, 2003. Modern Poultry Farming. 1st Edition. International Book Distributing Company, Lucknow."
4. Life and General Insurance Management"

Reference Books

1. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
2. http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
3 .https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf
4. http://ecoursesonline.iasri.res.in/course/view.php?id=335
5. https://swayam.gov.in/nd2_nou19_ag09/preview

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	L	L	L	L	L	S	S	L	L
CO2	S	L	M	M	S	M	M	M	S	S
CO3	S	M	M	M	S	S	S	S	M	M
CO4	S	S	S	L	S	S	S	S	S	S
CO5	S	S	M	S	S	S	M	L	S	M

S - Strong; M - Medium; L – Low

Semester	SKILL ENHANCEMENT COURSE (SEC – II) 19ZOOS308 : DAIRY FARMING	H/W	C
III		3	2

Course Objectives

1	To understand the various practices in Dairy farming.
2	To know the status of Dairy farming.
3	To be able to apply the techniques and practices needed for Dairy farming.
4	To know the difficulties in Dairy farming.

UNIT - I: Introduction to Dairy Farming- Advantages of dairying- Classification of breeds of cattle-Indigenous and exotic breeds- Selection of dairy cattle. Breeding-artificial insemination-Dairy cattle management-General Anatomy.

UNIT - II: Construction of Model Dairy House - Types of Housing - Different Managemental Parameters - Winter Management - Summer Management

UNIT - III: Feedstuffs available for livestock- Roughages -Concentrates - Energy rich concentrates - Protein rich concentrates - Mineral Supplements - Vitamin Supplements - Feed additives - Feeding management - Calves Feeding - Feeding of adults - Feeding of pregnant dairy animals - Feeding pregnant heifer.

UNIT – IV: Composition of milk-milk spoilage-pasteurization - Milk and milk products in human nutrition – Dairying as a source of additional income and employment.

UNIT – V: Contagious disease - Common Bacterial - Protozoan - Helminth and Viral Diseases - Parasitic Infestation - Vaccination - Biosecurity.

Expected Course Outcome

At the end of the course, the student will be able to

1	Understand the various practices in Dairy farming.
2	Know the needs for Dairy farming and the status of India in global market.
3	Apply the techniques and practices needed for Dairy farming.
4	Know the difficulties in Dairy farming and be able to propose plans against it.

Text Books

1. The Veterinary Books for Dairy Farmers by Roger W. Blowey.
2. Hand Book of Dairy Farming by Board Eiri.
3. Handbook of animal husbandry TATA, S.N ed., ICAR 1990
4. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya,
   Chennai.
5. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea &Fabiger Publisher.

Reference Books

1. https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Dairy%20unit.html
2. https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Tata,+S.N.,+ed%22
3. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
4. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	L	L	S	S	M	S	L	M
CO2	M	S	S	S	M	S	M	L	S	S
CO3	M	S	S	S	S	S	S	S	S	M
CO4	M	S	S	S	M	M	L	L	M	M
CO5	S	S	S	M	S	M	S	L	S	S

S - Strong; M - Medium; L – Low

Semester	SKILL ENHANCEMENT COURSE (SEC – III) 19ZOOS406 : ANIMAL BEHAVIOUR	H/W	C
IV		4	2

Course Objectives

1	To know genetic basis and evolutionary history of behaviour.
2	To identify innate, learned and cognitive behaviour and various mating systems.
3	To classify movement and migration behaviours
4	To know environmental influence on behaviour.

UNIT - I: Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.

UNIT - II: Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.

UNIT - III: Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.

UNIT – IV: Instinct learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images,Intelligence, tool use and culture, Animal awareness and Emotion

UNIT – V: Organization of circadian system in multicellularanimals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo- transduction; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases – Chrono-pharmacology, chrono-medicine, chrono-therapy.

Expected Course Outcome

At the end of the course, the student will be able to

1	Recall and record genetic basis and evolutionary history of behaviour.
2	Analyse and identify innate, learned and cognitive behaviour and various mating systems.
3	Classify movement and migration behaviours
4	Explain environmental influence upon behaviour.

Text Books

1. David McFarland, 1985..Animal Behaviour, Longman Scientific & Technical, UK.576pp.
2. Harjindra Singh, 1990. A Text Book of Animal Behaviour, Anomol Publication, 293pp.
3. Hoshang S. Gundevia and Hare Goving Singh, 1996. Animal Behaviour, S.Chand&Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

Reference Books

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	L	L	M	M	L	L
CO2	S	M	L	L	S	L	M	M	L	M
CO3	M	L	M	L	S	S	M	S	M	S
CO4	S	S	S	S	M	S	L	L	L	M
CO5	S	L	L	L	M	L	L	S	M	S

S - Strong; M - Medium; L- Low

Semester	PROFESSIONAL COMPETENCY COURSE (SEC – III) 19ZOOS407 : IPR- INTELLECTUAL PROPERTY RIGHTS	H/W	C
IV		4	2

Course Objectives

The main objectives of this course are:

1	To know the importance of qualitative and quantitative information from biological data.
2	Able to claim the rights for the protection of their invention done in their project work.
3	To identify criteria to fit one's own intellectual work in particular form of IPRs
4	To get registration in our country and foreign countries of their invention, designs and thesis or theory written by students during their project.

UNIT - I: Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad - Genesis and Development - the way from WTO to WIPO - TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations - Important examples of IPR.

UNIT - II: Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

UNIT - III: International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT - IV: Digital Innovations and Developments as Knowledge Assets - IP Laws, Cyber Law and Digital Content Protection - Unfair Competition - Meaning and Relationship between Unfair Competition and IP Laws - Case Studies.

UNIT - V: Infringement of IPRs, Enforcement Measures, Emerging issues - Case Studies.

Expected Course Outcome (CO)

On the successful completion of the course, student will be able to**:**

1	Claim the rights for the protection of their invention done in their project work.
2	Identify criteria to fit one's own intellectual work in particular form of IPRs
3	To get registration in our country and foreign countries of their invention, designs and thesis or theory written by students during their project.
4	Acquire knowledge on IPR law, Cyber law and digital content protection

Text Books

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

Reference Books

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S.V Satakar Intellectual property Rights and Copy Rights, Ess Publication, New Delhi, 2002

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	M	S	S	M	M	M
CO2	S	S	M	S	M	S	S	S	M	L
CO3	S	M	M	S	M	L	L	S	L	S
CO4	M	M	S	L	M	S	S	S	S	S
CO5	M	S	S	L	S	M	M	L	L	S

*S - Strong; M - Medium; L – Low