



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



Regulations, Curriculum and Syllabus

2019


ANNAMALAI UNIVERSITY
FACULTY OF SCIENCE
DEPARTMENT OF ZOOLOGY
M.Sc. ZOOLOGY TWO YEAR PROGRAMME
PROGRAMME CODE: SZOO 21

These Regulations are common to all the students admitted to the Two-Year Master Programme in the Faculties of Science from the academic year 2019-20.

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 **Core Course** is mandatory and an essential requirement to qualify for the Degree.
- 1.12 **Elective Course** is a course that a student can choose from a range of alternatives.
- 1.13 **Value-added Courses** are optional courses that complement the students' knowledge and skills and enhance their employability.
- 1.14 **Credit** refers to the quantum of course work in terms of number of class hours in a semester required for a programme. The credit value reflects the content and duration of a particular course in the curriculum.

- 1.15 **Credit Hour** refers to the number of class hours per week required for a course in a semester. It is used to calculate the credit value of a particular course.
- 1.16 **Programme Outcomes (POs)** are statements that describe crucial and essential knowledge, skills and attitudes that students are expected to achieve and can reliably manifest at the end of a programme.
- 1.17 **Programme Specific Outcomes (PSOs)** are statements that list what the graduate of a specific programme should be able to do at the end of the programme.
- 1.18 **Learning Objectives** are statements that define the expected goal of a course in **Course Objectives** in terms of demonstrable skills or knowledge that will be acquired by a student.
- 1.19 **Course Outcomes (COs)** are statements that describe what students should be able to achieve/demonstrate at the end of a course. They allow follow-up and measurement of learning objectives.
- 1.20 **Grade Point Average (GPA)** is the average of the grades acquired in various courses that a student has taken in a semester. The formula for computing GPA is given in section 11.3
- 1.21 **Cumulative Grade Point Average (CGPA)** is a measure of overall cumulative performance of a student over all the semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters and is given in section 11.4.
- 1.22 **Letter Grade** is an index of the performance of a student in a particular course. Grades are denoted by the letters S, A, B, C, D, E, RA, and W.

2. **Programme Offered and Eligibility Criteria**

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 in to two semesters, the first being from July to November and the second from December to April.
- 4.3 Each semester will have 90 working days (18 weeks).

5 **Programme Structure**

- 5.1 The Two Year Master's Programme consists of Core Courses, Elective Courses (Departmental & Interdepartmental) and Project.

5.2 **Core courses**

- 5.2.1 These are a set of compulsory courses essential for each programme.
- 5.2.2 The core courses include both Theory (Core Theory) and Practical (Core Practical) courses.

5.3 **Elective courses**

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

5.3.2 Interdepartmental Electives (IDEs) are Electives that students can choose from amongst the courses offered by other departments of the same faculty as well as by the departments of other faculties.

5.4 Experiential Learning

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

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

5.4.3 Experiential learning is categorized as non-Core.

5.5 Project

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

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

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

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

5.6 Value added Courses (VACs)

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

5.6.2 These courses impart employable and life skills.

5.6.3 Each VAC carries 2 credits with 30 hours of instruction. Classes for a VAC are conducted beyond the regular class hours and preferably in the III Semesters.

5.7 Online Courses

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

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

5.8 Credit Distribution: The credit distribution is organized as follows:

	Credits
Core Course	70
Electives	15
Project	6
Constitution of India	2
Total Credits (Semester I to IV)	93

5.9 Credit Assignment

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

1 Credit is defined as

1 Lecture period of one hour per week over a semester

1 Tutorial period of one hour per week over a semester

1 Practical/Project period of two or three hours 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 and project, the CIA Tests will carry 40% and the ESE 60% 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

	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:

	Marks
Test-I	15
Test-II	15
Record	10
Total	40

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 - 10	Review – II - 15	Project/Dissertation Evaluation	Viva - Voce
		50	25

9.5 Assessment of Value-added Courses

9.5.1 Assessment of VACs shall be internal. Two CIA Tests shall be conducted by the Department(s) offering VAC.

9.5.2 The grades obtained in VACs will not be included for calculating the GPA/CGPA.

9.6 Passing Minimum

9.6.1 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.

9.6.2 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, C_i is the Credit earned for the Course i in any semester;
 G_i is the Grade Point obtained by the student for the Course i and
 n is the number of Courses passed in that semester.

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

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

where, C_i is the Credit earned for the Course i in any semester;
 G_i is the Grade Point obtained by the student for the Course i and
 n is the number of Courses passed in that semester.
 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 in to 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.

Annamalai University

DEPARTMENT OF ZOOLOGY

M.Sc. ZOOLOGY TWO YEAR PROGRAMME

Programme Code: SZOO 21

CURRICULA AND SCHEME OF EXAMINATIONS (2019)

Course Code	Course Title	Hours/ Week			Credit	Marks		
		L	T	P		C	CIA	ESE
Semester - I								
19ZOOC101	Core 1: Structure and functions of Invertebrates and Vertebrates	4	0	0	4	25	75	100
19ZOOC102	Core 2: Developmental Biology	4	0	0	4	25	75	100
19ZOOC103	Core 3: Cell and Molecular biology	4	0	0	4	25	75	100
19ZOOP104	Core 4: Practical – I Pre lab Discussion (1 hour) Practical - I (11 hours) (Covering 19ZOOC 101, 102 & 103)	0	0	12	6	40	60	100
19XXXXXXX	Elective -I: Interdepartmental Elective	3	0	0	3	25	75	100
Total Credits – Semester - I			0	0	21			500
Semester- II								
19ZOOC201	Core 5: Animal Physiology	4	0	0	4	25	75	100
19ZOOC202	Core 6: Genetics	4	0	0	4	25	75	100
19ZOOC203	Core 7: Immunology	4	0	0	4	25	75	100
19ZOOP204	Core 8: Practical - II Pre lab Discussion (1 hour) Practical - II (11 hours) (Covering 19ZOOC 201, 202 & 203)	0	0	12	6	40	60	100
19ZOOEXXX	Elective - II – Department Elective	3	0	0	3	25	75	100
19XXXXXXX	Elective - III – Interdepartmental Elective	3	0	0	3	25	75	100
Total Credits – Semester - II			0	0	24			600
Semester- III								
19ZOOC301	Core 9: Evolution	4	0	0	4	25	75	100
19ZOOC302	Core 10: Environment and Biodiversity Conservation	4	0	0	4	25	75	100
19ZOOC303	Core 11: Animal Behaviour	4	0	0	4	25	75	100
19ZOOC304	Core 12: Biotechnology	4	0	0	4	25	75	100
19ZOOP305	Core 13: Practical - III Pre lab Discussion (1 hour) Practical - III (11 hours) (Covering 19ZOOC 301, 302, 303 & 304)	0	0	12	6	40	60	100
19ZOOEXXX	Elective - IV – Department Elective	3	0	0	3	25	75	100

19XXXXXXX	Elective - V – Interdepartmental Elective	3	0	0	3	25	75	100
19PSCI 300	Constitution of India	2	0	0	2*	25	75	100
	Total Credits – Semester - III		0	0	30			800
	Semester- IV		0	0				
19ZOO401	Core 14: Bio-chemistry	4	0	0	4	25	75	100
19ZOO402	Core 15: Endocrinology	4	0	0	4	25	75	100
19ZOO403	Core 16: Practical - IV Pre lab Discussion (1 hour) Practical - IV (7 hours) (Covering 19ZOO 401 & 402)	0	0	8	4	40	60	100
19ZOO404	Project (Dissertation and Viva-Voce)	0	0	12	6	25	75	100
	Total Credits – Semester - IV				18			400
	TOTAL CREDITS - Semester - IV				93			2300
	Value Added Courses							
	Online Courses (SWAYAM, MOOC, NPTEL)							

Note: ' * ' - Non -Credit Compulsory Course (Credit not counted)

***19PSCI 300 = Non-Credit Compulsory Course**

L- Lectures; T – Tutorial; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination.

Note:

1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available. The details of interdepartmental electives are given in the "**Handbook of Interdepartmental Electives-PG Programmes**" and listed in the University website.
2. Students may opt for any Value-added Courses listed in the University website. The details of Value Added Courses are given in the "**Handbook of Value Added Courses**" and listed in the University website.
3. Guidance/Discussion on course specific **experimental learning** to Students will be provided wherever feasible to apply the knowledge, skills and attitude taught in the course, either within the classroom, within the community, or within the workplace, to learn by experience which would improve their employability skills.

DEPARTMENT ELECTIVE COURSES (DE)

S. No	Course Code	Course Title	Hours/ Week			Credit	Marks		
			L	T	P	C	CIA	ESE	Total
1	19ZOOE215	Entomology	3	0	0	3	25	75	100
2	19ZOOE216	Public Health and Hygiene	3	0	0	3	25	75	100
3	19ZOOE315	Fisheries & Aquaculture	3	0	0	3	25	75	100
4	19ZOOE316	Toxicology	3	0	0	3	25	75	100

ANNAMALAI UNIVERSITY

Department of Zoology

[Question Paper Pattern - INTERNAL TESTS I & II (CIA)]

(Based on Revised Bloom's Taxonomy)

Programme: M.Sc. : Two Year PG

Semester: All

Time: 2 Hrs

Max. Marks: 50

Part-A (Level-K1)

Marks: (6x2=12)

(Answer ALL of the questions)

1. Define /Choose/ Relate.....
2. What / Why / How?
3. Multiple Choices a. b. c. d.
4. Multiple Choices a. b. c. d.
5. Match the following i - a ii - b iii - c iv - d v -
6. Match the following i - a ii - b iii - c iv - d v -

Part-B (Level-K2)

Marks: (3x5=15)

(Answer any THREE of the questions)

7. Explain.....
8. Describe.....
9. Select.....
10. Compare

Part-C (Level-K3/ Level-K4)

Marks: (2x7=14)

(Answer any TWO of the questions)

11. Apply....
12. Calculate....
13. Categorize...

Part-D (Level-K5/ Level-K6)

Marks: (1x9=9)

(Answer any ONE of the questions)

14. Discuss....
15. Summarize....

ANNAMALAI UNIVERSITY

Department of Zoology

Pattern of question paper for END semester examinations

(Based on Revised Bloom's Taxonomy)

Programme: M.Sc. Two Year PG Programme Year : I Semester: I / II

Course Code: Course Name:

Time: 3 Hrs

Max. Marks: 100

Part-A (Level-K1/ Level-K2)
(Answer ALL of the questions)

Marks: (10x2= 20)

1. Define.....
2. Multiple Choices a. b. c. d.
3. Multiple Choices a. b. c. d.
4. Match the following i - a ii- b iii- c iv -d v -
5. Match the following i - a ii- b iii- c iv -d v -
6. Explain.....
7. Select.....
8. Describe.....
9. Classify....
10. Elucidate....

Part-B (Level-K3/ Level-K4) Marks: (8x5=40)
(Answer any EIGHT of the questions)

11. Prepare.....
12. Solve.....
13. Apply.....
14. Show.....
15. Categorize...
16. Analyze...
17. Distinguish....
18. Infer....
19. Compare.....
20. Compute

Part-C (Level-K5) Marks: (3x10=30)
(Answer any THREE of the questions)

21. Discuss...
22. Summarize....
23. Evaluate.....
24. Disprove....

Part-D (Level-K6)*
(Answer any ONE of the questions)

Marks: (1x10=10)

25. Design....
26. Develop...

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Programme: M.Sc. Two Year PG Programme Year : II

Semester: III / IV

Course Code:

Course Name:

Time: 3 Hrs

Max. Marks: 100

Part-A (Level-K1/ Level-K2) Marks: (10x2=20)
(Answer ALL of the questions)

1. Define.....
2. Multiple Choices a. b. c. d.
3. Multiple Choices a. b. c. d.
4. Match the following i - a ii- b iii- c iv -d v -
5. Match the following i - a ii- b iii- c iv -d v -
6. Explain.....
7. Select.....
8. Describe.....
9. Classify....
10. Elucidate....

Part-B (Level-K3/ Level-K4) Marks: (6x5=30)
(Answer any SIX of the questions)

11. Apply.....
12. Show.....
13. Prepare
14. Make use of....
15. Categorize...
16. Analyze...
17. Distinguish....
18. Simplify.....

Part-C (Level-K5) Marks: (3x10=30)
(Answer any THREE of the questions)

19. Discuss...
20. Recommend with
21. Evaluate.....
22. Justify....
23. Optimize...

Part-D (Level-K6)* Marks: (2x10=20)
(Answer any TWO of the questions)

24. Design....
25. Formulate ...
26. Modify

M.Sc. Zoology (TWO YEAR) PROGRAMME							
[End Semester Examinations]							
Bloom's Taxonomy - Questions Conforming to Levels K1 to K6							
I Year (Two year PG)				II Year (Two Year PG)			
Level	Part	Questions & Marks	Total Marks	Level	Part	Questions & Marks	Total Marks
K1	A	5 x 2	10	K1	A	5 x 2	10
K2		5 x 2	10	K2		5 x 2	10
K3	B	4 x 5	20	K3	B	2 x 5	10
K4		4 x 5	20	K4		4 x 5	20
K5	C	3 x 10	30	K5	C	3 x 10	30
K6	D	1 x 10	10	K6	D	2 x 10	20
			100				100

PROGRAMME OUTCOMES (POs)

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

PO1:	Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.
PO2:	Resource Utilization. Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge-base and stay abreast of recent developments
PO3:	Analytical and Technical Skills: Ability to handle/ use appropriate tools/ techniques/ equipment with an understanding of the standard operating procedures, safety aspects/limitations.
PO4:	Critical thinking and Problem solving: Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/solutions.
PO5:	Project Management: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solutions. Exhibit organizational skills and the ability to manage time and resources.
PO6:	Individual and team work: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.
PO7:	Effective Communication: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.
PO8:	Environment and Society: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.
PO9:	Ethics: Commitment to professional ethics and responsibilities.
PO10:	Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline

PROGRAMME SPECIFIC OUTCOMES (PSOs)

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

PSO1:	Ensure that the candidate after successfully completing the master's degree in Zoology is well versed in subjects related to the programme and are able to impart knowledge to the concerned sections of the society.
PSO2:	Acquire skills in utilizing the fundamental knowledge gained in various fields of biological sciences in teaching learning activities.
PSO3:	Analyze biological problems professionally with a scientific temperament and research attitude and also to think logically in a scientific way to solve biological issues that they may come across.
PSO4:	Critically evaluate and interpret biological data and to acquire skills in modern tools and techniques in biological field to take up jobs in teaching/ research/ clinical/ Biotechnology/ animal husbandry and environment related establishments.
PSO5:	Analyze environmental issues and contribute to words environmental protection, bio-sustainability and biodiversity and also to apply the scientific knowledge in guiding the society in maintaining public health and hygiene and thereby avoiding spreading of diseases.

FIRST YEAR

Semester	19 ZOO C 101: STRUCTURE AND FUNCTIONS OF INVERTEBRATES AND VERTEBRATES	L	T	P	C
I		4	0	0	4

Learning Objective (LO):

LO1	To understand the Structure and Functions of invertebrates and vertebrates
LO2	To understand the organs of respiration and excretion and their functioning in invertebrates.
LO3	To analyses the nervous systems of various groups in invertebrates
LO4	To evaluate the larval forms of invertebrates to acquire knowledge on various organ system of vertebrates

Course Outcomes (CO)

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

CO1	Understand the morphological features and physiological functions like Respiration, reproduction and nervous system of invertebrates and Vertebrates
CO2	Understand the various salient features of higher invertebrates and Vertebrates
CO3	Differentiate the patterns of functioning of various organ systems in invertebrates and vertebrates
CO4	Know the structural organization and functioning of various organs in invertebrates and vertebrates.

UNIT - I: Respiration and Excretion of Invertebrates

Organs of respiration: gills, lungs and trachea – Respiratory pigments – Mechanism of respiration – Excretion – Organs of excretion: coelom, coelomoducts, nephridia and Malphigian tubules – Mechanisms of excretion – Excretion and osmoregulation.

UNIT - II : Nervous System of Invertebrates

Primitive nervous system: Coelenterata and Echinodermata – Advanced nervous system: Annelida, Arthropoda (crustacean and insecta) and Mollusca (Cephalopoda) – Trends in neural evolution.

UNIT - III : Invertebrata larvae

Larval forms of free living invertebrates – Larval forms of parasites – Strategies and evolutionary significance of larval forms – Minor Phyla – Concept and significance – Organization and general characters.

UNIT - IV : Skin and Skeletal System of Vertebrates

General structure and functions of skin and its derivatives – glands, scales, horns, claws, nail, hooves, feather and hairs. Skeletal elements of the body – account of jaw suspensorium, vertebral column – limbs and girdles.

UNIT - V : Respiratory system and Nervous system of Vertebrates

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

PRACTICAL

1. Dissections:

Dissection of Cockroach – Digestive and Nervous system, Dissection of Prawn - Nervous system and mounting of appendages.

Dissection of Fish – Nervous system, Respiratory system and Digestive system.

2. Observation and Classification of the following Specimens by giving reasons: Paramecium, Sycon, Obelia, *Taenia solium*, Neries, Prawn, Freshwater mussel, Amphioxus, Hyla, Calotes, Rat.
3. Study of Adaptations to the mode of life: Trypanosoma, Corals, Ascaris, Wuchereria
4. Biological Significance of the following forms: Peripatus, Sea anemone, Anabas, Arius, Exocoetus, Eel, Amblystoma, Woodpecker, Ant eater, Lingula, Sagitta and Phoronis.
5. Relate structure and function of the following forms: Taenia, Scolex, Nereis-Parapodium, Ctenoid and Quill feather of pigeon.

TEXT BOOKS

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

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*. Saras Publication, Nagercoil, Tamil Nadu.
- 3) Barrington E. J. W. (2012). *Invertebrate structure and function*. Affiliated East West Press Pvt. Ltd., New Delhi.
- 4) Richard C. Brusca, Wendy Moore and Stephen M. Shuster. (2016). *Invertebrates*. Oxford University Press, USA.
- 5) Kent, G.C. (2015). *Comparative Anatomy of the Vertebrates*. McGraw Hill, New York, USA.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	2	3	1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	1	3	3	3	3	2	3	3	2	3	3
CO3	2	3	3	3	1	3	3	3	3	3	3	2	3	3	3
CO4	3	3	3	3	1	3	2	3	3	3	3	3	3	2	3

Semester	19 ZOO C 102: DEVELOPMENTAL BIOLOGY	L	T	P	C
I		4	0	0	4

Learning Objective (LO):

LO1	To understand the various concepts of development
LO2	To study gametogenesis and process of fertilization
LO3	To learn the processes of embryogenesis, organ formation and differentiation
LO4	To analyse the embryonic induction and teratogenesis
LO5	To critically explore assisted reproductive technologies for human welfare

Course Outcomes (CO)

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

CO1	Acquire knowledge on reproduction and development
CO2	Understand process of fertilization
CO3	Understand the whole process of embryogenesis
CO4	Acquisition of skills in common methods and practices followed in developmental biology related laboratory activities and Take up jobs in fertility clinics and research labs

UNIT - I: Introduction to Embryology

Scope of embryology. Gametogenesis – spermatogenesis, oogenesis and egg membranes. Fertilization - mechanism of fertilization, capacitation, acrosomal reaction, cortical reaction and significance of fertilization. Cleavage – cleavage in frog and chick. Gastrulation – gastrulation in frog and chick. Fate map of amphibians, aves and mammals.

UNIT - II: Embryonic adaptations and Parthenogenesis.

Foetal membranes and their functions – Implantation – types and mechanism of implantation. placentation - placenta, structure, types and physiology of placenta. Parthenogenesis – types, mode of action of agents in artificial parthenogenesis – significance of parthenogenesis.

UNIT - III: Organogenesis and Differentiation

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

UNIT - IV: Embryonic induction and Teratogenesis

Embryonic induction - types, embryonic induction in amphibians, reptiles, birds and mammals. Neural induction, gene activation, mechanism of neural induction and chemical basis of neural induction. Teratogenesis - genetic teratogenesis - in human beings and animals, teratogenic agents and mechanism of teratogenesis.

UNIT - V: Reproductive Technology for Human Welfare

Causes of impotency and sterility in the male – causes of sterility in the female – Treatment of sterility – Artificial insemination in human beings - Infertility in men and women.

PRACTICAL

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

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

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 Shukul. (2012). *Developmental Biology*. Rastogi Publication, Meerut, Uttar Pradesh..

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
C01	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
C02	3	3	3	3	1	2	3	3	3	3	3	3	2	3	3
C03	2	3	3	3	1	3	3	3	3	3	3	3	3	3	3
C04	3	3	2	3	1	3	3	2	3	3	2	3	3	3	2

Semester	19 ZOO C 103: CELL AND MOLECULAR BIOLOGY	L	T	P	C
I		4	0	0	4

Learning Objective (LO):

LO1	To understand the molecular basis of cell structure and functions
LO2	To learn the structure and functions of various organization and cell membrane.
LO3	To learn bioenergetics and biogenesis
LO4	To learn structure and replication of DNA
LO5	To learn various molecular techniques

Course Outcomes (CO)

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

CO1	Acquire knowledge on cellular structure and functions.
CO2	Understand the process of energetic and genesis in cells
CO3	Interpret the structural and functional significances of DNA and RNA
CO4	Take up jobs in molecular biology labs and clinical labs

UNIT - I: Cell structure and Cell membrane

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

Cell membrane: Ultrastructure of plasma membrane – chemical composition of cell membrane, lipid bilayer – unit membrane concept – Fluid mosaic model; Functions of Plasma membrane; membrane transport - cell adhesion – cell recognition – antigen specificity – hormone receptors.

UNIT - II: Organelles of Endomembrane

Golgi apparatus & secretion: Ultra structure – chemical composition - origin of golgi complex - process and mechanism of secretion – Type of secretion – Function of Golgi apparatus.

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

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

UNIT - III: Organelles of Bioenergetics & Biogenesis

Organelles of Bioenergetics: Mitochondria - Ultra structure - respiratory chain complex; chemical composition and enzyme distribution – role in metabolism for cellular energetic - Anaerobic glycolysis, Pasteur effect - Krebs cycle – Formation of ATP. Chemical and conformation coupling hypothesis; shuttle system – Glycerophosphate and malate shuttle.

Organelle of Biogenesis: Chloroplast – Ultra structure - photochemical reaction in biogenesis - Light reaction and Dark reaction – Role of CO₂ and H₂O in photosynthesis – ‘Z’ scheme.

UNIT - IV: DNA Structure and Replication

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

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

UNIT - V: RNAs Structure and Transcription

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

Transcription and processing of RNA: Genetic code – Prokaryotic and eukaryotic transcription – RNA polymerases, general and specific transcription factors – regulatory elements – mechanism of transcription. Post transcriptional modifications. Translation – Prokaryotic and eukaryotic translation - translational machinery – mechanism of initiation, elongation and termination – regulation of translation. Post translational modifications.

Current Streams of Thought (Not for final exam) : Recent discoveries and Nobel prize in cellular and molecular research. Advanced research on assembly of ribosomes and ribosomal structure. Recent approach on purification and separation of nucleic acids; Analysis of protein interactions.

PRACTICAL

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

TEXT BOOKS

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.

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.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	1	3	3	3	2	3	3	3	2	3	3
CO3	3	2	3	3	1	3	3	3	3	3	3	3	3	3	2
CO4	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3

Semester	19 ZOO C 201: ANIMAL PHYSIOLOGY	L	T	P	C
II		4	0	0	4

Learning Objective (LO):

LO1	To learn the significance of food and physiology diagram
LO2	To understand the significance of excretory and osmoregulation system.
LO3	To study the functioning of cardiovascular system
LO4	To study respiratory and nervous systems including various receptors

Course Outcomes (CO)

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

CO1	Understand the normal physiological functions and necessity to maintain a healthy Life
CO2	Get an opportunity to understand various factors that could lead to altered physiological functions and thereby health problems
CO3	Perform various physiological experiments and observations
CO4	Take up jobs in clinical labs and research institutes

UNIT - I: Food and Digestion

Composition of food - classification of nutritive substances - comparative physiology of digestion - digestion in mammals - digestive enzymes – absorption - hormonal control of digestion – BMR – BMI.

UNIT - II: Excretion and Osmoregulation

Excretion - Nitrogenous wastes and their formation – Patterns of Excretion in different animal groups – Mammalian excretory system – structure and functions of vertebrate kidney-Mechanism of urine formation – Acid-base balance – electrolyte balance - Hormonal control of kidney function in mammal.

General concepts of osmoregulation – osmoregulation in invertebrates and vertebrates.

UNIT - III: Circulation

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

UNIT - IV: Respiration

Respiration in vertebrate – Respiratory organs and their ventilation – Integumentary respiration – bronchial respiration – lung respiration – mechanism of respiration in vertebrates – Regulation of breathing - Neural and chemical regulation – Transport of Oxygen - Respiratory pigments – Bohr's effect – Transport of CO₂ – Haldane's effect.

UNIT - V: Nervous system, Muscle and Sense organs

Nervous System: Structure of neuron - Transmission of nerve impulse – axonal transmission - theories of excitation - synaptic transmission – nervous system (central & Peripheral) - neuroendocrine system - hormones and their functions.

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

Sense Organs: Mechanoreceptors – chemoreceptors - photoreceptors – phonoreceptors – equilibrium receptor - Bioluminescence.

Current Streams of Thought (Not for final exam) : Cell biology: Recent discoveries in cell physiology – Nobel prize in physiological (or) medical research – Advances research on need of oxygen for functions of cell; Sense and respond to cell to the Oxygen level; Cell adjustment with level of oxygen at high attitudes

PRACTICAL

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

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.

REFERENCE BOOKS

- 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

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	1	3	3	2	3	3	3	3	3	3	2
CO2	3	2	3	3	1	3	3	3	3	3	2	3	3	3	3
CO3	3	3	3	3	1	2	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	1	3	3	3	2	3	3	3	3	3	3

Semester	19 ZOO C 202: GENETICS	L	T	P	C
II		4	0	0	4

Learning Objective (LO):

LO1	To learn the fundamental concepts of genetics
LO2	To study human health related genetic problems, qualitative and quantitative traits and population genetics
LO3	To learn the structure of genes and their regulation
LO4	To acquire skills in chromosomal alterations, gene mutations and cancer.
LO5	To learn application of genetics concepts in microbial genetics and genetic engineering.

Course Outcomes (CO)

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

CO1	Interpret phenotypic expressions based on genotype
CO2	Understand and interpret genetically linked diseases
CO3	Perform blood group analysis and test metabolic disorders
CO4	Working in clinical laboratories and take up researches

UNIT - I: Principles and Concepts of Gene and Gene mapping

Mendelian principles: Law of Dominance, Law of Segregation and Law of Independent assortment; extensions of laws of inheritance principles: Gene Interactions, dominant epistasis, Pleiotrophy: Penetrance and expressivity. Linkage and crossing over – concept, theories and example - linkage maps (X chromosome) gene mapping in drosophila, Coincidence and Interference – multiple allele – ABO and Rh blood group in man.

UNIT - II: Quantitative, Population and Human Genetics

Polygenic inheritance: concept, mode of inheritance of skin colour in man – heritability and its measurements - normal karyotypes – Syndromes related to numerical variations of chromosomes – pedigree analysis – genetic counseling, Hardy-Weinberg law of genetic equilibrium.

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

Fine structure of gene - regulation of gene action - 'Lac and His' operon system- genes and metabolism – inborn errors of carbohydrate, proteins and lipid metabolism in man. One gene one enzyme concept – One gene one polypeptide concept.

UNIT - IV: Chromosomal Alterations, Gene Mutation and Oncogenes

Chromosomal aberrations – types and causes – point mutation – mutagens- chemical mutagens – molecular mechanism of gene mutation, mutant types – lethal, conditional biochemical loss of function – oncogene and cancer.

UNIT - V: Microbial Genetics and Genetic Engineering

Microbial genetics: Methods of genetic transduction – sex-duction – genetic engineering - restriction enzymes – recombinant DNA techniques – applications of recombinant DNA technology.

PRACTICAL

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

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.

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- 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.

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	3	3	1	3	2	3	3	3	3	3	3	2	3
CO2	3	3	3	2	1	3	3	3	3	2	3	3	3	3	3
CO3	3	3	3	3	1	3	3	2	3	3	3	3	3	3	3
CO4	3	3	2	3	1	3	3	3	3	3	3	2	3	3	2

Semester	19 ZOO C 203: IMMUNOLOGY	L	T	P	C
II		4	0	0	4

Learning Objective (LO):

LO1	To learn the basic concepts, principles and mechanisms involved in Immunology
LO2	To develop awareness regarding the molecules, cells and organ involved in immune system and their significances in up keeping the organism
LO3	To learn the various types of antigen and antibody
LO4	To acquire skills in the methodologies of antigen antibody interaction
LO5	To gain knowledge regarding the application of immunological techniques

Course Outcomes (CO)

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

CO1	Analyze the various immunological issues
CO2	Apply immunological procedures for various immunological testing procedures
CO3	Interpret the results of immunological experiments and Take up jobs in clinical labs and related institution
CO4	Carry out immunological investigation and Equip themselves for higher studies

UNIT - I: Overview and Scope of Immunology

Innate and acquired immunity. Humoral and cell mediated immunity. Clonal selection of lymphocytes. MHC/HLA system. Immunological significance of inflammation. Transplantation immunology: Cell mediated graft rejection - hyper acute, acute and chronic rejections.

UNIT - II: Molecules, Cells and Organs of Immune System

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

UNIT - III : Immunogen and Antigen

Definition of antigen and immunogen and classification. Properties of immunogen: Immunogenicity, antigenicity, allergenicity and tolerogenicity. Factors affecting immunogenicity: Contribution of immunogen - foreignness, molecular size, chemical composition & heterogeneity, degradability; contribution of biological system - genotype of recipient, dosage and route of administration; adjuvants, epitopes, heptens and mitogens.

UNIT - IV: Antibodies

Basic structure of immunoglobulins. Classes of immunoglobulins (IgG, IgM, IgA, IgE, IgD), their structural modifications and biological activities. Monoclonal and polyclonal antibodies. Antigenic determinants on immunoglobulins: isotype, allotype and idiotype. Hyper sensitivity: Brief description of type I, II, III and IV. Autoimmune diseases : Organ specific – insulin-dependent diabetes mellitus and Graves' disease; systemic – rheumatoid arthritis and multiple sclerosis.

UNIT - V Antigen – Antibody Interactions

Strength of antigen – antibody interactions: Antibody affinity, antibody avidity; cross reactivity; precipitin reaction; agglutination reaction - haemagglutination, bacterial agglutination, passive agglutination and agglutination inhibition. Radial immuno diffusion, double immuno diffusion. Radio immuno assay (RIA). Enzyme linked Immunosorbant Assay (ELISA). Western blotting.

Current Streams of Thought (Not for final exam): Significant immunological development in recent years. Immunotherapy. Autoimmune diseases and immune deficiencies. Organ transplantation and stem cell research.

PRACTICAL

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

TEXT BOOKS

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.

- Rao. C.V. (2011). *Immunology, A Text Book*. 2nd Ed. Narosa Publishing House, New Delhi.

REFERENCE BOOKS

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

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	1	2	3	3	2	3	3	2	3	2	3
CO3	3	3	3	3	1	3	3	3	3	3	3	3	3	3	2
CO4	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3

SECOND YEAR

Semester	19ZOOC301: EVOLUTION	L	T	P	C
III		4	0	0	4

Learning Objective (LO):

LO1	To gain awareness about the origin of life
LO2	To understand the roles of variations, polymorphisms, and polyploidy in evolution
LO3	To familiarize the role of isolation and speciation in evolution
LO4	To understand the various types of adaptations and mimicry
LO5	To learn the evolution of mankind

Course Outcomes (CO)

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

CO1	Analyse the evolutionary history of biological organisms
CO2	Critically assess the evolutionary relationship among various phyla
CO3	Identify the role of natural selection in the survival of the species
CO4	Understand the various mechanisms involved in evolution.

UNIT - I: Origin

- i. Environment:- nature and origin of life - proteins nucleic acids - Container membrane – Molecular interactions - Pool origin – Volcanic origin - Metaoric origin – Chemical Evolution.

Theories

- I. Theories of organic evolution: Lamarck’s Evolutionary propositions - Critical analysis of Lamarck’s prepositions - Neo–Lamarckism..
- ii. Theory of natural selection : Darwin – Wallace theory of natural selection - Critical analysis of Darwinism – Neo-Darwinism - Modern synthetic theory.

Natural Selection and process :

- i. Process of evolutionary change: Two – Step process Random mating – the Hardy – Weinberg Law and its Application – Migration - Random. Genetic Drift - founder effect and bottlenecks - Genetic Assimilation – Genetic Homeostasis.
- ii. The concept of natural selection - Darwinism Fitness – Selection against recessive homozygotes - selection against dominants and selection without dominance. Selection and mutation – Estimation of mutation rates - selection against heterozygotes - Frequency – Dependent selection.

UNIT - II : Mechanism

i) Variation and evolution

Basic units of variability – effect and types. Genetic mutations - chromosomal rearrangements – change in chromosome number, chromosome segregation and recombination - crossing over - mutation and its role in evolution.

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

Direction of selection – centripetal selection – Centrifugal selection.

ii) Polymorphism and evolution:

Transient polymorphism and industrial melanism - Balanced and neutral polymorphism -genetic polymorphism - chromosomal polymorphism - criticism of the polymorphism concept - Evolutionary significance of polymorphism

ii) Polyploidy and evolution

Polyploidy in animal and plants - types of polyploids - direct effect of Polyploidy - origin of polyploidy and the origin of higher categories in plants – practical significance.

UNIT - III

i) Isolation and evolution:

Premating isolation mechanism – Geographical - Ecological seasonal - ethological – physiological and mechanical isolation.

Postmating isolation mechanism - Gametic – zygotic mortality - hybrid in viability-hybrid break down – genetic basis of reproductive isolation - origin – significance.

ii) Speciation and evolution:

Species concept - morphological – Genetic - Sterility based – Biological – sibling concepts- Monotypic and polytypic – Sub-species categories .

Types of speciation: Mechanism of speciation - allopatric speciation sympatric – speciation - quantum evolution - evolutionary significance.

UNIT - IV

i) Adaptation Mimicry and colouration:

Mimicry – Protective – aggressive - conscious sound and scent mimicry - Batesian and Mullerian mimicry- Experimental proof of mimicry – evolution of mimicry-significance.

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

UNIT - V:

i) Trends and rates

Evolutionary trends: Phylogenetic patterns, - Micro, macro and mega evolution - adaptive radiation trend – convergent - parallel – orthogenetic - non adaptive and interactive trends in evolution.

Evolutionary rates: Morphological rate of evolution - Taxonomic rate - Molecular rate - the role of extinction in macro evolution - measuring of extinction rate.

ii) Mankind evolution

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

Present evolution: Cultural and social evolution of hominids.

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

Practicals:

1. Genetic drift in small and large population using dummy materials
2. Sexual selection(a) Secondary sexual characters, e.g. Chimeroïd 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. Umboonium shells, (c) Balanced Polymorphism
4. Genetic Assimilation – in *Drosophila*
5. Identification of male and female *Drosophila*
6. Mimicry and Colouration- Concealing mimicry, e.g. Kallima butterfly, Geometrid moth, Stick insect, Leaf insect.
Warning mimicry-Viceroy and Monarch butterfly, Batesian and Mullerian mimicry.
7. Paleontology: Invertebrate fossil - Trilobite, Vertebrate Fossil - Archaeopteryx.
8. Osteology: Evolution of reptilian skull and its interrelationship
9. Evolution of mankind- similarities and differences between apes and man. Evolution of human skull.

Text book:

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.

Reference:

1. Darwin, C. The Origin of species, Te. Pup. Desmond Morris, (1990). *Animal Watching* (Field Guide), Crown Pup Co., London.
2. Dobzhansky,T. (1951), *Genetics and the origin of species*, Columbia University Press, USA.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
C01	3	3	3	3	1	3	3	3	2	3	3	3	3	3	3
C02	3	3	3	2	1	3	3	3	3	3	3	2	3	2	3
C03	3	2	3	3	1	3	2	3	3	3	3	3	2	3	3
C04	3	3	3	3	1	3	3	3	3	3	2	3	3	3	3

Semester	19ZOOC302: ENVIRONMENT AND BIODIVERSITY CONSERVATION	L	T	P	C
III		4	0	0	4

Learning Objective (LO):

LO1	To gain awareness about the basic concepts of environment and ecology
LO2	To create a mindset for conservation of biodiversity
LO3	To familiarize the concept of environmental impact assessment
LO4	To understand the significance of natural resources and sustainable development
LO5	To create awareness about environmental pollution and its prevention
LO6	To learn the phenomenon of global warming and its prevention

Course Outcomes (CO)

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

CO1	Analyse and appreciate the basic ecological concepts
CO2	Critically assess environmental disasters and suggest counter measures
CO3	Develop a mind set to safeguard natural resources and take forward the concept of sustainable development
CO4	Protect the environment by acting against pollution, Take up employment in environment related agencies and institution and Educate the public regarding the importance of rain water harvesting and water Conservation

UNIT - I: Basic concepts and environmental impact assessment

Concept of ecosystem, environment and biosphere. Biogeochemical cycles - carbon, nitrogen and phosphorous cycles. Environmental impact assessment (EIA): Objectives: General operational procedures and process, concerns in EIA, environmental planning and decision making. Describe properties of EIA methods. General procedures for environmental audit.

UNIT - II: Natural resource and sustainable development

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

UNIT - III: Environmental pollution and disaster management

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

UNIT - IV: Biodiversity and its conservation

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

UNIT - V: Global warming and water conservation

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

Current Streams of Thought (Not for final exam): Anthropocene biodiversity crisis and genesis of anthropocene. Salient markers of anthropocene and its impending dangers. Possible sixth mass extinction and probable means to avert it.

Practicals:

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

Text books:

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. Pandey S.N. and S.P. Misra (2011). *Environment and ecology*. Ane Books Pvt. Ltd , New Delhi, India.
7. Agarwal, K.C. (1999). *Environmental Biology*. Agro Botanica, New Delhi, India.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO2	3	2	3	2	1	3	2	3	3	3	2	3	3	2	3
CO3	3	3	3	3	1	3	3	3	2	3	3	2	3	3	3
CO4	3	3	2	3	1	3	3	3	3	3	3	3	3	3	2

Semester	19ZOOC303: ANIMAL BEHAVIOUR	L	T	P	C
III		4	0	0	4

Learning Objective (LO):

LO1	To gain awareness about the basic concepts of animal behaviour
LO2	To understand the genetic principles behind behavioral patterns
LO3	To familiarize the concept of sociobiology
LO4	To understand the significance of Territoriality

Course Outcomes (CO)

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

CO1	Master the theoretical as well as practical knowledge in the field of animal behaviour
CO2	Interpret the genetic basis of behavioral patterns
CO3	Appreciate the socio-biological elements in the behavior of various animal groups and their significance.
CO4	Understand the impact of hormones in the manifestation of various behaviours

UNIT - I: Introduction

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

UNIT - II: Communication behaviour

Communication and programmed behaviour – Visual communication – Dance languages of honey bee - Melody dance of birds - Auditory communication - songs of birds and sounds of mammals – chemical communications - pheromones of insects – pheromones of mammals – migration of fishes and birds - mechanism of migration.

UNIT - III: Behavioural genetics

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

UNIT - IV: Social behaviour

Introduction to Sociobiology, Social organization in animals – social behaviour - habitat selection – Advantages of social behaviour – conflict - situations. Conflict behaviours. Sexual selection - courtship behaviour - mechanism of courtship – courtship in fishes -

courtship mating in amphibians, reptiles, birds and mammals - Parental care in insects, fishes, amphibians, birds and mammals.

UNIT - V: Territoriality

Territoriality – characters of territoriality - functions of territoriality - group foraging – Game theory model and strategies. Effects of hormones on behaviour – aggression and aggressive behavior. Drugs and behaviour.

Practicals

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

Text Book

1. Agarwal, V. K. (2019). *Animal behaviour (Ethology)* - S. Chand & Co.Ltd, New Delhi.
2. Aubrey Manning and Marian Stamp Dawkins. (2015). *An Introduction to Animal Behaviour*. Cambridge University Press, London, UK.
3. Hoshang S. Gundevia and Hare Govind Singh. (2016). *A text book of Animal Behaviour*. S. Chand & company, New Delhi

Reference Books

1. Prakash, M. (1994). *Recent Advances in Animal behaviour*, Anmol. Publishers, Delhi.
2. Reena Mathur (2014). *Animal behaviour*, Rastogi & Co, Meerut.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	1	3	3	3	3	3	3	2	3	3	3
CO3	2	3	3	3	1	3	2	3	3	3	3	3	2	3	3
CO4	3	3	3	3	1	3	3	3	3	2	3	3	3	2	3

Semester	19ZOOC304: BIOTECHNOLOGY	L	T	P	C
III		4	0	0	4

Learning Objective (LO):

LO1	To learn the basic concepts in biotechnology
LO2	To learn the various techniques used in biotechnology
LO3	To acquire biotechnological knowledge related to medical, agricultural and environmental disciplines

Course Outcomes (CO)

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

CO1	Master the theoretical as well as practical knowledge in various field of biotechnology
CO2	Perform various experiments related to biotechnology
CO3	Carry out biotechnological applications in the fields of medicine, agriculture and environmental fields
CO4	Equip the students to take up jobs in various biotechnological companies and labs

UNIT - I: Basic Biotechnology

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

UNIT - II: Techniques in Biotechnology

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

UNIT - III: Medical Biotechnology

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

UNIT - IV: Agricultural Biotechnology

Micropropagation, protoplast culture, Biofertilizers - Symbiotic and Non symbiotic nitrogen fixation, Biofertilizers - Mass production of BGA, VAM Rhizobium. Biopesticides - Transgenic plants and animals. Mushroom culture. single cell protein-Bio control of insect pests.

UNIT - V: Microbial and Environmental Biotechnology

Bioreactor, Growth curve, primary metabolites – Vitamins, alcohols, Secondary metabolites – Antibiotics, Toxins, Microbial enzyme production – amylase. Biomass as a source of energy. Biogas production, Bioremediation, Microbial leaching - Vermicomposting. Ethical issues and Biosafety regulations, Intellectual Property Right (IPR) and Protection (IPP).

Current Streams of Thought (Not for final exam): Recent discoveries in Biotechnological field – Nobel prize in biotechnology research-Stem cell -definition-preservation, sources, culture-characterization- uses- stem cell therapy.

PRACTICALS

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

TEXT BOOKS

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) Kumaresan, V. and N. Arumugam. (2016). *Fundamentals of Biotechnology*, Saras Publications, Nagercoil, Tamil Nadu.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO2	2	3	3	3	1	3	2	3	3	3	2	3	2	3	3
CO3	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO4	3	3	2	3	1	3	3	2	3	3	3	3	3	3	2

Semester	19PSCXI300-CONSTITUTION OF INDIA	L	T	P	C
III		2	0	0	2

Learning Objective (LO):

LO1	To understand the basic features of Indian Constitution.
LO2	To grasp about the basic Rights & duties of Indian Citizenry
LO3	To ponder over the form of Indian Political System.
LO4	To have broad understanding about the pivotal provisions related with liberty, Equality and fraternity.

Course Outcomes (CO)

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

CO1	Imbibe about the basic features of Indian Political System.
CO2	Enlighten with the rights & duties of Indian Citizens.
CO3	Understand the significance of rule of law.
CO4	Inculcate with basic liberties.

Unit I : Introduction

Meaning of the Constitutional law and Constitutionalism – Historical Perspective of the Constitution of India – Salient features Characteristics of the Constitution of India

Unit II : Rights and Duties

Scheme of the Fundamental Rights – The scheme of the Fundamental Duties and its legal status – The Directive Principles of State Policy-Its importance and implementation

Unit III : Centre State Relationship

Federal Structure and distribution of legislative and financial powers between the union and the states- Parliamentary form of Government in India – The Constitution powers and status of the president of India.

Unit IV : Amendments and Provisions

The Historical perspectives of the constitutional amendments in India – Emergency Provision: National Emergency, President Rule. Financial Emergency

Unit V: Institutions

Judiciary –Judiciary Activism – Amending Procedures- Recent Trends –Rights to Information- Lokpal and LokAyukta

Text Books :

1. Bipan Chandra, Mridula Mukherjee, AdityaMakherjee (2016). India after Independence 1947-2000, Penguin Publishers, New Delhi.
2. Durga Das Basu, (2018). Introduction to the Constitution of India Prentice Hall, New Delhi.
3. Jogendra Yadav (2000). Transforming India: Dynamics of Democracy, Oxford University Press New Delhi

Supplementary Readings:

1. The Constitution of India (1950). (Bare Act), Government Publications.
2. Busi S.N Ambedkar B.R (2015). Framing of Indian Constitution
3. Jain M.P . (2014). Indian Constitution Law Lexis Nexis
4. Paul R.Brass (1999). The politics of India Since Independence Cambridge University Press
5. Granvila Austin (2006). The Indian Constitution: Cornerstone of a Nation, Oxford University Press, New Delhi

OUTCOME MAPPING

CO/PO	PO												PSO				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
CO1		3	3		2					2			3	2			
CO2		3	2		3	2							2			3	2
CO3	3	2		3	2					2					3	2	2

***1-Low *2-Medium *3-Strong**

Semester	19ZOOC401: BIOCHEMISTRY	L	T	P	C
IV		4	0	0	4

Learning Objective (LO):

LO1	To learn classification and metabolism of carbohydrates
LO2	To understand the structure and metabolism of protein
LO3	To learn the structure and functions of lipids
LO4	To acquire knowledge about various enzymes and hormones and their actions
LO5	To acquire knowledge about the significance of vitamins

Course Outcomes (CO)

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

CO1	Understand various micro and macro molecules and their significance
CO2	Discriminate various metabolic disorders
CO3	Take up jobs in clinical labs
CO4	Analyze biological samples of bio-chemical importance

UNIT - I: Buffers and Carbohydrate.

- i). pH and buffers – Water, carbondioxide and oxygen, properties, outlines of Biochemical energies.
- ii). Carbohydrates: Methods of study of intermediary metabolism of Carbohydrates;
A general account of classification – Structure and properties of mono and polysaccharides - metabolism of carbohydrates, glycolysis, Citric acid cycle, Gluconeogenesis - defect in carbohydrate metabolism.

UNIT - II : Proteins:

Classification and isolation - The fundamental physiochemical principles and structure of amino acids, peptides and proteins - protein metabolism – Metabolism of amino acids in general.

UNIT - III: Lipids:

Classification of lipids - Structure and chemistry of single and compound lipids; metabolism of fats and fatty acids - Defects in lipid metabolism.

UNIT - IV: Enzymes and Hormones

- i) Enzymes : Classification – Enzyme kinetics - Effects of substrate concentration – Inhibition and mechanism of enzyme action - Co-enzymes.

- ii) Hormones: Classification, biosynthesis and function – Pancreatic and thyroid hormones.

UNIT - V: Nucleic acids and Vitamins

Composition and structure of nucleic acids: RNA and DNA - Major pathways in the synthesis of RNA and DNA.

Vitamins – occurrence – grouping - deficiency diseases.

Current Streams of Thought (Not for final exam) : Recent discoveries in Biochemical field – Nobel prize in biochemical (or) medical research-New method uses fluorescence to identify disease-causing forms of proteins.

Practicals:

Preparation and use of buffers.

1. Qualitative tests for carbohydrates, Amino acids, proteins lipids and nucleic acids; amines urea;(thiourea).
2. Determination of the molecular weight of a monocarboxylic amino acid by sorenson formol titration
3. Determination of isoelectric pH of a protein.
4. Estimation of glycogen, phosphate, cholesterol and protein in tissues.
5. Determination of protein digestion by trypsin. Fractionation and estimation of serum proteins.
6. Estimation of RNA and DNA in tissues.
7. Kinetics or enzyme action-effect of substrate concentration (Calculation of M), temperature (calculation of energy of activation)
8. Enzyme concentration and pH on enzyme activity.
9. Determination of AChE activity in brain.
10. Paper chromatography of sugars and amino acids-column chromatography of separation of amino acids
10. Paper electrophoresis of proteins.
11. Colour reactions of urine composition.

Text books

1. Vasudevan,, D.M., S. Sreekumari and Kannan Vaidyanathan. (2019). *Textbook Of Biochemistry For Medical Students*, Jaypee Brothers Medical Publishers, New Delhi.
2. Victor W. Rodwell (2018). *Harper's Illustrated Biochemistry*, McGraw-Hill Education.
3. Satyanarayana, U and U.Chakrapani. (2017). *Biochemistry*, Elsevier New Delhi.
4. Annie Ragland and N. Arumugam. (2015). *Biochemistry and Biophysics*, Saras Publications, Nagercoil, Tamil Nadu.
5. Agarwal, R.A., Anil K.; Srivastava and Kaushal Kumar, (2014). *Animal Physiology and Biochemistry*. S. Chand and Company. New Delhi
6. Sastry, K.V. (2011). *Animal Physiology and Biochemistry*. Rastogi Publications, Meerut. New Delhi

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1. Segal, I.H (2015). *Biochemical Calculations*, John Wiley and Sons
2. Creighton, T.E. (2012) . *Protein Structure and Molecular properties* , W.H. Freeman & Co.
3. Nelson, D.L. and M.M. Cox. (2013). *Lehninger principles of Biochemistry*, W.H. Freeman.
4. Firley, Jems, L. and Gardon L. Kilgour. (1971). *Essentials of Biological chemistry*, Affiliated East West press, London.
5. Voet, D. and J.G. Voet. (2005). *Biochemistry* John Wiley & Sons.
6. Freifelder, D. (2007). *Physical Biochemistry* W.H. Freeman & Co.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	2	1	3	3	3	3	3	3	3	3	3	3
CO3	2	3	3	3	1	3	3	3	3	3	3	2	3	3	3
CO4	3	3	3	3	1	3	3	3	3	3	3	3	3	3	2

Semester	19ZOOC402: ENDOCRINOLOGY	L	T	P	C
IV		4	0	0	4

Learning Objective (LO):

LO1	To learn general concepts of hormones and pituitary gland
LO2	To understand structure and functions of thyroid and parathyroid gland
LO3	To learn the structure and functions of pancreas and adrenal glands
LO4	To acquire knowledge in the endocrinological basis of vertebrate reproduction
LO5	To understand endocrinology of insects and crustaceans.

Course Outcomes (CO)

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

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

UNIT - I: General concept of Hormones and pituitary Gland

General characteristics of hormones – concept of hormone secretion – hormones as messengers – classification of hormones - steroid hormones – peptide hormones – mechanism of hormone action- Cell signaling – Signal transduction.

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 and parathyroid gland

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

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

UNIT - III: Pancreas and adrenal glands

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

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.

UNIT - IV: Vertebrate Reproductive Endocrinology

Structure of mammalian testis and ovary – male, female sex accessory organs – hormones of testis and ovary – estrus and menstrual cycle – hormones of pregnancy – parturition – hormonal control of lactation.

UNIT - V: Insect and Crustacean Endocrinology

The concepts of neurosecretion – Endocrine systems in crustacea – endocrine control of moulting and metamorphosis – Neuroendocrine system in insects - endocrine control of development – thorocotrophic hormones – ecdysone - Juvenile hormone functions moulting in adult insects.

PRACTICAL

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

TEXT BOOKS

1. Shlomo Melmed , Kenneth S. Polonsky , P. Reed Larsen and Henry M. Kronenberg . (2017). *William's textbook 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* 5thEd. 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.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
C01	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
C02	3	3	3	3	1	3	2	3	3	3	3	3	3	3	3
C03	3	2	3	3	1	3	3	3	3	3	3	3	3	3	2
C04	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3

Semester	19ZOOD404: PROJECT DISSERTATION AND VIVA-VOCE	L	T	P	C
IV		0	0	12	6

DEPARTMENT ELECTIVE COURSE

Semester	19ZOOE215 : ENTOMOLOGY	L	T	P	C
II		3	0	0	3

Learning Objective (LO):

LO1	To learn various insects and their classification
LO2	To learn the morphological, anatomical and physiological systems in insects
LO3	To learn knowledge in agricultural entomology as well as beneficial insects
LO4	To learn vector insects and their role in public health
LO5	To learn knowledge on pest management

Course Outcomes (CO)

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

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

UNIT - I: Insect Morphology

Insect taxonomy up to orders – Salient features with suitable examples of the insect orders – Thysanura, Odonata, Isoptera, Orthoptera, Hemiptera, Coleoptera, Lepidoptera, Hymenoptera and Diptera - Insects collection – Preservation – Identification - insect head – types of antennae – mouth parts and wing venation – Abdomen.

UNIT - II: Insect Physiology

Structure and Physiology of integumentary, Digestive system: Foregut, Midgut, Hindgut, Salivary gland and Physiology of digestion.

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

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

Reproductive system: Male reproductive system, Testis – Vasa deferens – Seminal vesicle - accessory glands and Female excretory system – Ovaries – Ovariole – types-oviduct – spermatheca - accessory glands.

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

UNIT - III: Agricultural Entomology

Insect pest - pest outbreak – assessment of insect population - Identification, seasonal history, biology, nature of damage and control measures of major pests of paddy, sugarcane, Vegetables (Brinjal).

UNIT - IV: Principles and methods of Pest Management

Principles of Insect control – Prophylactic measures – cultural, mechanical, physical methods – Genetic control and quarantine. Biological control: parasitoids, Predators and Microbial agents. Chemical methods: Pesticides - general classification – classification based on mode of action and mode of entry Biopesticides: Integrated Pest Management (IPM) – definition, Integration of methods – potential components – need for IPM and uses.

UNIT - V: Beneficial insects and Vector insects

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

TEXT BOOKS

1. Chapman, F., S.J.Simpson and A.E.Douglas. (2017). *The Insects structure and function*, Cambridge University Press, UK.
2. Temphare D. B. (1984). *A Text Book of Insect Morphology, Physiology and Endocrinology*. S. Chand and Co., New Delhi.
3. Chapman R. F. (1982). *The Insect Structure and Functions*. English Language Book society, Harvard University Press, USA.
4. Temphare, D. B., (2011). *Modern Entomology*, Himalaya publishing, Mumbai.

REFERENCE BOOKS

- 1) Vasantharaj David B. and V.V. Ramamurthy. (2016). *Elements of Economic Entomology*. Brillion Publishing, New Delhi.
- 2) Prasad T. V. (2019). *Handbook of Entomology*. New Vishal Publications, New Delhi.
- 3) Ganga G. and J. Sulochana Chetty. (2019). *Introduction to Sericulture*. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
- 4) Jayashree K. V., C. S. Tharadevi and N. Arumugam. (2014). *Apiculture*. Saras, Nagercoil, Tamil Nadu.
- 5) Ashok Kumar Sharma. (2012). *Anatomy and Physiology of Insects*. Oxford Book Company, New Delhi.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3

Semester	19ZOOE216: PUBLIC HEALTH AND HYGIENE	L	T	P	C
II		3	0	0	3

Learning Objective (LO):

LO1	To learn important vector borne diseases of human being
LO2	To understand diseases caused by protozoans
LO3	To acquire knowledge in diseases caused by helminthes
LO4	To learn common air, food and water borne disease.

Course Outcomes (CO)

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

CO1	Analyse various common vectors and diseases, causing
CO2	Impart skills the general Public for public health and hygiene
CO3	Work in clinical labs
CO4	Take up research on issues related to public health and hygiene

UNIT - I: Introduction to Important Diseases to Human Beings

Mosquito borne diseases – malaria, filariasis and chikungunya – symptoms and treatments. Morphology, life cycle and control measures of vector mosquitoes - Anopheles, Culex and Aedes species and vector management.

UNIT - II: Vector borne Diseases to Human Beings

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

UNIT - III: Protozoan Diseases to Human Beings

Protozoan diseases – Trypanosomiasis, Leishmaniasis and Trichomoniasis symptoms and treatments - Morphology, life cycle and control measures of Trypanosoma, Leishmania and Trichomona.

UNIT - IV: Helminthes Diseases to Human Beings

Helminthes diseases - Taeniasis, Schistosomiasis and Ascariasis – symptoms and treatments - Morphology, life cycle and control measures of Taenia solium, Schistosoma and Ascaris.

UNIT - V: Air, Food and Water borne diseases

Air borne diseases: Tuberculosis, Diphtheria and pneumonia. Food and water borne diseases: sources of water pollutants – cholera, botulism, shigellosis and typhoid fever. Cancer – sources, different types of tumors and treatment.

TEXT BOOKS

1. Rathinasamy G. K., (1974). *A Handbook of Medical Entomology and Elementary Parasitology*. Viswanathan Printers and Publication Pvt., Ltd., Chennai
2. Dubey, R. C. and D. K. Maheswari, (2005). *A text book of Microbiology*, S.Chand & Company Ltd., New Delhi.
3. Gupta, P. K and V. Ramprakash, (1985). *Advance in Toxicology and Environmental Health*. Jagmender Book Agency, New Delhi
4. Jordon, E. L. and P. S. Verma, (2005), "*Invertebrate Zoology*", S. Chand & Company Ltd., New Delhi.
5. Parthiban, M. and B. Vasantharaj David, (2007). "*Manual of Household & Public Health pests and their control*", Namrutha Publications, Chennai.

REFERENCE BOOKS

- 1) Mark F. Wiser. (2012). *Protozoa and Human Disease*. Garland Science, New York, United States.
- 2) Burton J. Bogitsh, Clint E. Carter and Thomas N. Oeltmann. (2012). *Human Parasitology*. Academic Press, USA.
- 3) Ruth Leventhal. (2011). *Medical Parasitology*. F.A. Davis Company, USA.
- 4) Sudhir R. Wagh and Vishnu K. Deshmukh. (2015). *Medical Entomology*. Success Publications, Tiruchirappalli, Tamil Nadu.
- 5) Kenrad E. Nelson and Carolyn Williams. (2013). *Infectious Disease Epidemiology*. Jones and Bartlett Publishers, USA.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3

Semester	19ZOOE315: FISHERIES AND AQUACULTURE	L	T	P	C
III		3	0	0	3

Learning Objective (LO):

LO1	To learn the principles and practices followed in Inland fisheries and aquaculture
LO2	To learn biology and fisheries potential of marine fisheries
LO3	To acquire skills in culturing finfishes
LO4	To develop skill on fin fish culture
LO5	To learn fish harvesting and post harvesting technology

Course Outcomes (CO)

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

CO1	Understand and analyse various issues related to fisheries and aquaculture
CO2	Take up jobs in fisheries and aquaculture sectors
CO3	Start aquaculture activities on their own
CO4	Take up jobs in marine product export sectors and also take up research activities in various fisheries institutions and Universities

UNIT - I: Inland fisheries

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

UNIT - II: Marine Fisheries

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

UNIT - III: Fin Fish culture

Types of culture, types of ponds, fish pond preparation, algal bloom and its eradication. Stocking of seeds, feeding. Predators and their control. Sampling and harvesting. Transport of fish seed. Major diseases, symptoms and treatment.

UNIT - IV: Shell fish and sea weed culture

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

UNIT - V: Harvesting and Post harvest technology and Economics of Aquaculture

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

TEXT BOOKS

1. Gupta, S.K. and P.C.Gupta.(2017). *General and Applied Ichthyology (Fish & Fisheries)*, S. Chand and Co., New Delhi.
2. Pillay, T. V .R., (1995). *Aquaculture Principles and Practices*. Fishing News Books, Blackwell Science Ltd., Oxford.
3. Jhingran, V. J., (1991). *Fish and Fisheries of India*. Hindustan Publishing Corporation, New Delhi.
4. Santhanam, R., Sugumaran, N. and P. Natarajan, (1997). *A Manual of Fresh Water Aquaculture*. Oxford and IBH Pub. Co., Ltd., New Delhi.
5. Biswas, K.P. (2012). *Advancement of Fish, Fisheries and Technology*, Narendra Publishing House, New Delhi.
6. Lakshmi Prasad, T. and K.Ramasway. (2014). *Fish Processing Technology*, Crescent Publishers Corporation, New Delhi.

REFERENCE BOOKS

- 1) Singh B. and Dey A. (2017). *Fish and Fisheries*. Invincible Publishers, Haryana.
- 2) Dholakia, A.D. (2016). *Fisheries and Aquatic Resources of India*, Daya Publishing House, New Delhi.
- 3) Arumugam N. (2014). *Aquaculture and Fisheries*. Saras publications, Nagercoil, Tamil Nadu.
- 4) Vishwas B. Sakhare. (2013). *Inland Fisheries*. Daya Publishing House, New Delhi.
- 5) Pillay T. V .R. and M. N. Kutty. (2011). *Aquaculture: Principles and Practices*. Wiley India Pvt. Ltd.
- 6) Rajendra Kumar Rath. (2011). *Freshwater Aquaculture*. Scientific Publishers, Jodhpur.

Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
C01	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
C02	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
C03	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
C04	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3

Semester	19ZOOE316: TOXICOLOGY	L	T	P	C
III		3	0	0	3

Learning Objective (LO):

LO1	To learn the concepts and processes involved in toxicology
LO2	To understand the various methods to know absorption and distribution of toxicants
LO3	To study the biotransformation and excretion of toxicants
LO4	To learn the impacts of toxicants and human beings.
LO5	To learn the application of anti dotes and Biomonitoring

Course Outcomes (CO)

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

CO1	Carry out toxicological analysis of various environmental samples
CO2	Make observations and biochemical analysis of biological samples
CO3	Carry out toxicological testing using live specimen to determine toxicity of toxicants
CO4	Take up jobs in toxicological research institutions and clinical labs

UNIT - I: Introduction to Toxicology

Definition – Brief history of toxicology — Disciplines of toxicology – Scope of toxicology – Toxicity methods – Acute toxicity tests – Sub-acute toxicity test – Chronic toxicity test – Bio-assay – Determination of LC50 and LD50 – Dose - Response relationship – Indices of toxicity – Threshold dose – Margin of safety and therapeutic index - Selective toxicity - Response of toxicity - Factors influencing toxicity – Chemical interaction – Types of interactions.

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: Introduction – Factors determining the distribution – Binding of plasma protein – The storage depots – Liver, Kidney, Fat and Bone – Membrane barriers.

UNIT - III: Biotransformation and Excretion of Toxicants

Biotransformation: Introduction – Pattern of Biotransformation - Phase I reaction – Oxidation – Mixed Function Oxidase System – Reduction reaction – Hydrolysis – Phase II reaction – Biochemical conjugation – Glucuronidation – conjugation with Glutathione – Sulfate conjugation – Acetylation and Methylation – Amino acid conjugation -

Deactivation versus Bioactivation.

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

UNIT - IV: Toxic effects on human

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

UNIT - V: Antidotes and Biomonitoring

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

Biomonitoring: Introduction – Objectives – Biological Monitoring Programme – Parameters for Biomonitoring – Bioindicators and Environmental Monitoring – Classification of Bioindicators – Criteria for Selection of Bioindicators – Traditional Bioassays – Biotechnology Based Bioassays – Microbial Indicators – Plant Indicators – Animal Indicators – Aeroallergens – Human System – Benefits and Disadvantages of Bioindicators.

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

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- 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) Kamaleswar Pandey, J. P. Shukla and S. P. Trivedi. (2011). *Fundamentals of Toxicology*. New Central Book Agency, New Delhi.

Outcome Mapping

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CO2	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3