SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE
(Autonomous)
[An Autonomous College Affiliated to Periyar University, Salem, Tamil Nadu]
[Accredited by NAAC with 'A' Grade with CGPA of 3.27]
[Recognized 2(f) & 12(B) Status under UGC Act of 1956]
Katteri – 636 902, Uthangarai (Tk), Krishnagiri (Dt)
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DEGREE OF MASTER OF SCIENCE IN ZOOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS AND SYLLABUS FOR

M.Sc. ZOOLOGY PROGRAMME
(SEMESTER PATTERN)

(For Students Admitted in the College from the Academic Year 2024-2025 Onwards)

REGULATIONS AND SYLLABUS FOR M.Sc. ZOOLOGY PROGRAM

(For Students Admitted in the College from the Academic Year 2024-2025 Onwards)

1. VISION OF THEDEPARTMENT

Empowering the Students to face the challenges in a holistic way

2. MISSION OF THE DEPARTMENT

To produce well disciplined, socially committed morally and educationally intellectuals through quality education and Research

3. DEFINITIONS

(i) Programme: Programme means a course of study leading to the award of the degree in a discipline.

(ii) Course: Course refers to the subject offered under the Degree Programme.

Programme Outcomes (POs)

PO1	**Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.
PO2	**Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making.
PO3	**Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.
PO4	**Communication Skill** Ability to develop communication, managerial and interpersonal skills.

PO5	**Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals.
PO6	**Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment.
PO7	**Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur
PO8	**Contribution to Society** Succeed in career endeavors and contribute significantly to society.
PO9	**Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective.
PO10	**Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conducting one's life.

Programme Specific Outcomes (PSOs)

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

4. ELIGIBILITY FORADMISSION

A Candidate who has passed B.Sc. Zoology or any other relevant Degree of Periyar University or any other University accepted by the Syndicate of the Periyar University as equivalent thereto, subject to such conditions as may be prescribed therefore are eligible for admission to Master of Science (M.Sc.) Degree Programme in Zoology and shall be permitted to appear and qualify for the (M.Sc.) Degree Examination in Zoology of this Autonomous College affiliated to Periyar University after a course of study of two academic years.

5. DURATION OF THE PROGAMME

The Programme for the Degree of Master of Science (M.Sc.) in Zoology shall consist of two academic years divided into four semesters. Each Semester consists of 90 working days (450 hours).

6.FEATURES OF CHOICE BASED CREADIT SYSTEM

Under Choice Based Credit System (CBCS), a set of Courses consisting of Core Courses, Elective Courses and Extra Disciplinary Course are offered. Beside the Core Courses, which are totally related to the major subjects, the students have the advantage of studying supportive courses and non-major courses. This provides ample opportunity for the students to learn not only the major subjects but also inter disciplinary and application oriented subjects.

7. SYLLABUS

The syllabus of the M.Sc. Zoology Degree Programme is divided into the following Courses:

(i) Core Courses: The Core Courses are related to the Programme concerned including practical's and project offered under the Programme.

(ii) Elective Courses: There are Two Elective Courses offered under the Programme related to the major or non-major but are to be selected by the students.

(iii) Extra Disciplinary Course (EDC): Chosen by the students from other disciplines / departments of the college.

(iv) Extra Credit Courses: In order to facilitate the students gaining extra credits, the Extra Credit Courses are offered. According to the guidelines of the UGC, the students are encouraged to avail this option of enriching the knowledge by enrolling themselves in the Massive Open Online Courses provided by various portals, such as SWAYAM, NPTEL,etc.

8.PROGRAMME OF STUDY

The Programme of study for the Degree shall be in the (Choice Based Credit System) with internal assessment comprised of instructions in the following subjects according to the syllabi and books prescribed from time to time.

9.CREADIT

Weightage given to each course of study is termed as Credit.

10.CREADITSYSTEM

The weightage of credits are spread over to four different semesters during the period of study and the cumulative credit point average shall be awarded based on the credits earned by the student. A total of 90 Credits are prescribed for the MSc. Degree Programme which is the minimum Credit requirement for the two years M.Sc. Zoology Degree Programme.

SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE (Autonomous)

Master of Sciences (M.Sc.) in Zoology

Programme Pattern and Syllabus (CBCS)

(For Students Admitted in the College from the Academic Year 2024-2025 Onwards)

Sl. No.	Nature of the Course	Course Code	Name of the Course	Hours/ Week	Credits	Marks		
						CIA	ESE	Total
SEMESTER I								
1	Core – I	24PZO1C01	Structure and Function of Invertebrates	7	5	25	75	100
2	Core – II	24PZO1C02	Comparative Anatomy of Vertebrates	7	5	25	75	100
3	Practical – I	24PZO1P01	Lab Course in Invertebrates & Vertebrates	4	4	40	60	100
4	Elective – I	24PZO1E01	Molecules and their interaction relevant to Biology	6	3	25	75	100
5	Elective – II	24PZO1E02	Biostatistics	6	3	25	75	100
Total				**30**	**20**	**140**	**360**	**500**
SEMESTER II								
8	Core – III	24PZO2C03	Cellular and Molecular Biology	6	5	25	75	100
9	Core – IV	24PZO2C04	Developmental Biology	6	5	25	75	100
10	Practical-II	24PZO2P02	Core Lab Course -II Biology	4	4	40	60	100
11	Elective – III	24PZO2E03	Economic Entomology	5	3	25	75	100
12	Elective – IV	24PZO2E04	Research Methodology	5	3	25	75	100
13	SEC- I	24PZO2S01	Poultry Farming	3	2	25	75	100
14	Common Course	24P2HR01	Human rights	1	1	25	75	100
Total				**30**	**23**	**190**	**510**	**700**

SEMESTER III								
15	Core – V	24PZO3C05	Genetics	6	4	25	75	100
16	Core – VI	24PZO3C06	Evolution	6	4	25	75	100
17	Core – VII	24PZO3C07	Animal Physiology	6	4	25	75	100
18	Practical-III	24PZO3P03	Core Lab Course -III	4	4	40	60	100
20	Elective – V	24PZO3E05	Medical Laboratory Techniques	5	3	25	75	100
	SEC- II	24PZO3S02	Dairy Farming	3	2	25	75	100
	Common course	23PZO3IN01	Internship* / Industrial	-	2			
Total				**30**	**23**	**165**	**435**	**600**
SEMESTER IV								
18	Core – VIII	24PZO4C08	Immunology	6	5	25	75	100
19	Core – IX	24PZO4C09	Ecology	6	5	25	75	100
20	Practical- IV	24PZO4P04	Core Lab Course -IV	4	4	40	60	100
21	Elective – VI	24PZO4E06	Aquaculture	5	3	25	75	100
22	Project	24PZO4PR	Project Work and Viva Voce	5	3	25	75	100
23	SEC- III	24PZO4S03	Animal behaviour	4	4	25	75	100
24	Common course	23P4EX01	Extension Activity	-	1	-	-	-
Total				**30**	**25**	**165**	**435**	**600**
Cumulative Total				**120**	**91**	**660**	**1740**	**2300**

Elective Courses

Semester	Course Code	Paper Title	Credits
Group – A			
Semester I	24PZO1E01	Molecules and their interaction relevant to Biology	3
	24PZO1E02	Biostatistics	3
Semester II	24PZO2E03	Economic Entomology	3
	24PZO2E04	Research Methodology	3
Semester III	24PZO3E05	Medical Laboratory Techniques	3
Semester IV	24PZO4E06	Aquaculture	3

SKILL ENHANCEMENT COURSES:

Semester	Course Code	Paper Title	Credits
Semester II	24PZO2S01	Poultry Farming	2
Semester III	24PZO3S02	Dairy Farming	2
Semester IV	24PZO4S03	Animal behavior	4

Note:-

CBCS– Choice Based Credit system,

CIA– Continuous Internal

ESE– End of Semester Examinations

BREAK-UP OF MARKS AND CREDITS

The break-up of marks and credits for the M.Sc. Zoology Degree Programme is as follows:

Subject	Number of Subjects	Total Marks	Total Credits
Core Courses	09	900	42
Elective Courses	06	600	18
Core lab Practical	04	400	16
Skill Enhancement Course	03	300	08
Human rights	01	100	01
Project work	01	100	03
Internship	01	-	02
Extension Activity	01	-	1
Grand Total	**26**	**2300**	**91**

11.EXAMINATIONS

The examinations consist of Continuous Internal Assessment (CIA) and end of semester examinations (ESE). The ESE shall be of Three Hours duration for each theory course at the end of every semester. The candidate failing in any course(s) will be permitted to appear for each failed course(s) in the subsequent examination. At the end of fourth semester, The Project Viva-voce will be conducted on the basis of the Dissertation/Project Report of the students by the evaluation of one internal and one external examiner.

To maintain uniformity, particularly for interdepartmental transfer of credits, there shall be a uniform pattern of examination to be adopted by all the teachers offering courses. There shall be three tests, one seminar and one assignment for CIA and ESE during each semester. The distribution of marks for CIA and ESE shall be 25 marks and 75 marks, respectively. Further, the distribution of CIA will be 10 marks for test, 5 marks for seminar/assignment, 5 marks for attendance and 5 marks for discipline. The average of the highest two test marks out of the three CIA tests will be taken for CIA.

COMPONENTS OF CONTINUOUS INTERNAL ASSESSMENT (CIA)

Components		Marks	Total Marks
Theory			
CIA TEST – I	75	(75+75 = 150/15) 10	25
CIA TEST – II	75		
Assignment		05	
Seminar		05	
Attendance		05	
Project			
Literature Collection		5	25
Data Collection		5	
Methodology		5	
Presentation of Result		10	
Grand Total		**100**	

12.QUESTION PAPERPATTERN

Bloom's Taxomy Based Assessment Pattern

(K1–Remember; **K2**– Understand; **K3**–Apply; **K4**– Analyze; **K5** –Evaluate; **K6 –** Create**)**

(I)Theory Examinations (CIA I& CIA II=25 Marks and ESE=75 marks)

Knowledge Level	Section	Marks	Description	Total Marks
K1	A (Answer ALL) Q1–Q15	15 × 1 = 15	Multiple Choice Questions (MCQ) (Three questions from each unit)	15
K2	B (Answer any THREE out of FIVE) Q16–Q20	3 × 5 = 15	Short Answers (One question from each unit)	15
K3 & K4	C (Either or	5 × 9 = 45	Descriptive /Detailed Answers (Two	45

	Pattern) Q20–Q25		questions from each unit)	
			Total Marks	**75**

Passing Minimum (CIA)
50% = 12Marks
Passing Minimum
(ESE) 50% = 38Marks
50Marks

(i) Project Viva-Voce (CIA = 25 Marks and ESE = 75 Marks)

Knowledge Level	Section	Marks	Total Marks
P K3, K4 & K5 a s	Project Dissertation	75	100
	Viva-voce	25	

sing Minimum (CIA)
50% = 20 Marks
Passing Minimum (ESE)
50% =30 Marks

50Marks

The candidate shall be declared to have passed the examination if the candidates secure not less than 38 marks out of 75 marks in the semester examination in each theory course and 12 marks out of 38 marks in the CIA and in total not less than 40 marks. For the practical course, 30 marks out of 60 marks in the semester examination and the record notebook taken together and 20 marks out of 40 marks in the CIA and in total 50 marks. There is no passing minimum for the record notebook. However, submission of the record notebook is necessary.

For the project work and Viva-voce, a candidate should secure 50% of the marks for pass. The candidate should compulsorily attend the Viva-voce examination to secure a pass in the project.

Candidate who does not obtain the required minimum marks for a pass in a Course/Practical/Project/Dissertation shall be declared Re-Appear (RA) and the candidate has to appear and pass the same at a subsequent appearance.

13.DISSERTATION

(a) Topic: The Topic of the dissertation shall be assigned to the candidate before the beginning of fourth semester and a copy of the same should be submitted to the COE for Approval.

(b) Number of Project/Dissertation copies to be submitted by the students

The students should prepare three copies of dissertation and submit the same for the evaluation by Examiners. After evaluation, one copy is to be retained in the College Library and one copy is to be submitted to the COE and the student can have the rest.

(c) Format to be followed

The format of the Project/Dissertation to be prepared and submitted by the students in Semester IV is given below:

Format for the preparation of Project Work:

(i) Title Page:

TITLE OF THE PROJECT/DISSERTATION

Project/Dissertation Submitted in partial fulfilment of the requirement for the award of the Degree of Master of Science in ZOOLOGY (under Choice Base Credit System) to the Sri Vidya Mandir Arts & Science College (Autonomous) Katteri – 636 902, Uthangarai, Tamil Nadu

By

(Studend 's Name)

(Register Number)

Under the Guidance of

(Guide Name and Designation)

(College Logo)

(Name of the Department) (College Address)

(Month and Year)

(ii) Bonafide Certificate:

CERTIFICATE

This is to certify that the dissertation entitled submitted in partial fulfillment of the requirement of the award of the Degree of Master of Science in ZOOLOGY (Under Choice Based Credit System) to the Sri Vidya Mandir Arts & Science College (Autonomous), Katteri – 636 902, Uthangarai, Tamil Nadu is a record of bonafide research work carried out by……..under my supervision and guidance and that no part of the dissertation has been submitted for the award of any degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journals or magazines.

Date:

Place: Signature of the Guide

Signature of the Head of the Department

(iii) Acknowledgement
(Drafted by the student)

(iv) Table of Contents:

TABLE OF CONTENTS

Chapter No.	Title	Page No.
1	Introduction	
2	Review of Literature	
3	Materials and Methods	
4	Results	
5	Discussion	
6	Conclusion	
7	References	

14. MAXIMUM DURATION FOR THE COMPLETION OF THE M.SC. ZOOLOGY PROGRAMME

The maximum duration for completion of the M.Sc. Zoology Programme shall not exceed eight semesters.

1. COMMENCEMENT OF THIS REGULATION

This regulation and syllabus shall take effect from the academic year 2023–2024 for students who are admitted to the first year of the Programme during the academic year 2023–2024 and thereafter.

2. GRADING

Once the marks of the cumulative CIA and ESE are available, they will be added. The marks thus obtained will then be graded as per details given below:

Marks and Grades:

The following table gives the marks grade points, letter grades and classification to indicate the performance of the candidate.

Range of Marks	Grade Points	Letter Grade	Description
90–100	9.0–10.0	O	Outstanding
80–89	8.0–8.9	D+	Excellent
75–79	7.5–7.9	D	Distinction
70–74	7.0–7.4	A+	Very Good
60–69	6.0–6.9	A	Good
50–59	5.0–5.9	B	Average
00–49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

Ci = Credits earned for course i in any semester

Gi = Grade Point obtained for course i in any

semester n = Semester in which such course

were credited

Grade Point Average (for a Semester)

Calculation of grade point average semester-wise and part-wise is as follows:

GRADE POINT AVERAGE [GPA] = Σi Ci Gi / Σi Ci

$$GPA = \frac{\text{Sum of the multiplication of grade points by the credits of the courses under each part}}{\text{Sum of the credits of the course under the each part of in a semester}}$$

Calculation of Grade Point Average (CGPA) (for the entire programme)

A candidate who has passed all the examinations under different parts (Part – I to V) is eligible for the following part wise computed final grades based on the range of CGPA.

CUMULATIVE GRADE POINT AVERAGE [CGPA] = ΣnΣiCniGni / ΣnΣiCni

$$GPA = \frac{\text{Sum of the multiplication of grade points by the credits of the entire program under each part}}{\text{Sum of the credits of the course under the each part of in a semester}}$$

15.Classification of Successful candidates

A candidate who passes all the examinations and securing following CGPA and Grades shall be declared as follows:

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5–10.0	O+	First Class – Exemplary
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	

16.RANKING

A candidate who qualifies for the M.Sc., Zoology, Passing all the Examinations in the first attempt within the minimum period prescribed for the Programme from the date of admission to the Programme and secures first or second class shall be eligible for ranking and such ranking will be confined to 10% of the total number of candidates qualified in that particular subject to a maximum of 10 ranks.

17.CONFERMENT OF THE DEGREE

No candidate shall be eligible for conferment of the Degree unless he/she has undergone the prescribed Programme of study for a period of not less than four Semesters in an Institution approved by and affiliated to the Periyar University and earns has passed the Examinations as have been prescribed.

18.TRANSITORY PROVISION

Candidates who have undergone the Programme of Study prior to the Academic Year 2020–2021 will be permitted to take the Examinations under those Regulations for a period of four years *i.e.* up to and inclusive of the Examination of April 2024. Thereafter, they will be permitted to take the Examination only under the Regulations in force at that time.

PROGRAMME SYLLABUS

Program: M.Sc. Zoology				
Core – I	**Course Code:** 24PZO1C01		**Course Title:** Structure and Function of Invertebrates	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I	7	**84**	5	100

Course objectives

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

UNIT-I

Structure and function in invertebrates:

Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy

UNIT-II

Organization of coelom: Acoelomates:

Pseudocoelomates; Coelomates: Protostomia and Deuterostomia; Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata

UNIT-III

Nutrition and Digestion:

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

UNIT-IV

Excretion:

Organs of excretion: coelom, coelomoducts, Nephridia and Malphigian tubules; Mechanisms of excretion; Excretion and osmoregulation.

Nervous system:

Primitive nervous system: Coelenterata and Echinodermata; **Advanced nervous system:** Annelida, Arthropoda (Crustacea and lnsecta) and Mollusca (Cephalopoda); Trends in neural evolution

UNIT-V

Invertebrate larvae:

Larval forms of free living invertebrates - Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor Phyla: Concept and significance; Organization and general characters.

Reading list

1. Barrington, E. J.W. 1979. Invertebrate Structure and Function. The English Language Book Society and Nelson, pp-765.

Recommended texts

1. Barnes, R. D. 1974. Invertebrate Zoology, (Second Edition), Holt-Saunders International Edition, pp-1024.

2.Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer.2013.TheInvertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.

3.Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited, pp-624.

CO Number	CO Statement	Knowledge Level
CO1	Re member the general concepts and major groups in animal N classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
CO2	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
CO3	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
CO5	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
CO5	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Mapping of Cos with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	S	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	S	S	M	M	S	S
CO4	S	M	S	M	S	S	M	M	S	M
CO5	S	M	S	M	S	S	M	M	S	M

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Core – II	**Course Code:** 24PZO1C02		**Course Title:** Comparative Anatomy of Vertebrates	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I	7	84	5	100

Course Objectives

1. Understanding the different systems in invertebrates & vertebrates.
2. Learning about various animal species, their phylogenetic affinities and their adaptive features
3. Imparting conceptual knowledge about the salient features and functional anatomy.
4. Developing the skill in mounting techniques of the biological samples.
5. Gaining fundamental knowledge on the skeletal system

UNIT-I

Origin of vertebrates:

Concept of Protochordata; The nature of vertebrate morphology; Definition, scope and relation to other disciplines; Importance of the study of vertebrate morphology.

UNIT-II

Origin and classification of vertebrates:

Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.

UNIT-III

General plan of circulation in various groups

Blood; Evolution of heart; Evolution of aortic arches and portal systems. Respiratory system: Characters of respiratory tissue; Internal and external respiration; Comparative account of respiratory organs

UNIT-IV

Skeletal system:

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

UNIT-V

Sense organs:

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

Reading list

1. SwayamPrabha
2. https://www.swayamprabha.gov.in/index.php/program/archive/9Yong,
3. J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.
4. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-600.

Recommended texts

1. A.J. Waterman (1971) Chordate Structure and Function, Collier Macmillan Ltd.
2. Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
3. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
CO2	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
CO3	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
CO4	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
CO5	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of Cos with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	M	L	S	M	S	M	S	M	S
CO2	S	L	L	S	M	S	M	M	M	M
CO3	S	M	L	S	M	S	M	L	M	M
CO4	S	L	L	S	L	S	M	L	M	L
CO5	S	M	L	S	S	S	M	S	M	M

***S – Strong** **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Core Lab – I	**Course Code:** 24PZO1P01		**Course Title:** Lab Course in Invertebrates & Vertebrates	
Semester I	**Hours/Week** 4	**Total Hours** 48	**Credits** 4	**Total Marks** 100

Course Objectives

The main objectives of this course are:

1. Understanding the different systems in invertebrates & vertebrates.
2. Learning about various animal species, their phylogenetic affinities and their adaptive features
3. Imparting conceptual knowledge about the salient features and functional anatomy.
4. Developing the skill in mounting techniques of the biological samples.
5. Gaining fundamental knowledge on the skeletal system

INVERTEBRATES

Dissection

Earthworm : Nervous system

Cockroach : Nervous system

Grasshopper : Digestive system and mouth parts

Prawn : Appendages, nervous and digestive systems

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

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

Spotters

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

Mounting (Any Two)

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

CHORDATES

Study the nervous system of Indian dog shark – Dissection

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

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

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

Study of the different types of scales in fishes

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

Study of the frog skeleton system (Representative samples)

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

Mounting

1. Weberian ossicles of fish

Text Books:

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

Reference Books:

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

Mapping of Cos with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	S	S	M	S	S	M	S	M	S
CO2	S	M	L	S	M	S	M	M	M	M
CO3	M	M	L	S	L	S	M	L	M	M
CO4	S	S	L	S	L	S	M	L	M	L
CO5	S	S	M	L	M	S	M	S	M	M

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

Program: M.Sc. Zoology				
Elective – I	**Course Code:** 24PZO1E01		**Course Title:** Molecules and their interaction relevant to Biology	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I	6	72	3	100

Course Objectives

1. Students should know the fundamentals of biochemistry

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Reading list

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

Recommended texts

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

Course Out comes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Learn the structure, properties, metabolism and bioenergetics of biomolecules	**K1 & K3**
CO2	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	**K1 & K2**
CO3	Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers	**K2 & K3**
CO4	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	**K2 & K4**
CO5	Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures	**K5 & K6**

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POS

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	M	S	M	S	L	S	M	S	M	M
CO2	S	S	L	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	S	S	S	L
CO4	S	M	S	M	S	M	S	S	S	M
CO5	M	S	S	M	M	S	M	L	S	M

***S – Strong** **M–Medium** **L –Low**

Program: M.Sc. Zoology

Elective – II	Course Code: 24PZO1E02	Course Title: Biostatistics		
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
I	6	72	3	100

Course Objectives

1. Students should know basic concepts in Biostatistics.

UNT-I

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

UNT-II

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

UNT-III

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

UNT-IV

Hypothesis testing: Student'*t*' test - paired sample and mean difference'*t*' tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients. Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.

UNT-V

Analysis of variance: one way and two way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).

Reading list

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

Recommended texts

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

Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	**K2 & K3**
CO2	Acquired skills to perform various statistical analyses using modern statistical techniques and software.	**K3 & K4**
CO3	Knowledge on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.	**K5 & K6**

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	M	L	M	S	S	M	S	M	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	M	S	S	S	S	S	S	S	S	L
CO4	M	M	S	L	M	M	M	S	L	M
CO5	M	M	S	L	M	S	M	L	S	M

***S – Strong M–Medium L –Low**

Program: M.Sc. Zoology				
Core – III	**Course Code:** 24PZO2C03		**Course Title: Cellular and Molecular Biology**	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	6	72	5	100

Course Objectives

1. To understand the ultra structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
2. To realize involvement of various cellular components in accomplishing cell division.
3. To enable a successful performance in cell biology component of CSIR-UGC NET.
4. To understand the ultra structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles

UNIT-I

Nutrition and Digestion

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Reference Books

1. Karp, G. 2010. Cell Biology (Sixth Edition), John Wiley & Sons, Singapore, pp-765.
2. Lodish, H., C. A. Kaiser, A. Bretscher, *et al*., 2013. Molecular Cell Biology (Seventh Edition), Macmillan, England, pp-1154
3. De Robertis, E.D.P. and E. M. F. De Robertis Jr, 1987. Cell and Molecular Biology. Info-Med, Hong Kong, pp-734
4. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007, Cell and Molecular Immunology (Sixth Edition), Saunders, Philadelphia, pp-566
5. Loewy, A.G., P. Siekevitz and J. R. Menninger, *et al*., 1991, Cell Structure and Function (Third Edition), Saunders, Philadelphia, pp-947
6. Watson, J. D., N.H. Hopkins, J.W. Roberts, *et al*., 1987, Molecular Biology of the Gene (Fourth Edition), Benjamin/Cummings, California, pp-1163
7. Han, S. S. and J. Holmstedt. 1979, Cell Biology, McGraw Hill, pp-319
8. Alberts, B., A. Johnson, J. Lewis, *et al*., 2015, Molecular Biology of the Cell (Sixth Edition), Garland Science, New York, pp-1342
9. Clark, D.P., 2005. Molecular Biology, Elsevier, China, pp-784
10. Tropp, B. 2008. Molecular Biology Genes to Proteins (Third Edition), Jones & Bartlett, US, pp-1000

Course Outcomes(COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the general concepts of cell and molecular biology.	K2
CO2	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.	K1 & K2
CO3	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	K3 & K4
CO4	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	K5
CO5	Understand the general concepts of cell and molecular biology.	K2

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COS with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	L	L	L	L	S	S	S	M	M	M
CO2	M	M	M	S	S	S	S	M	S	M
CO3	S	S	S	M	M	S	M	M	L	S
CO4	M	M	S	L	S	S	L	M	S	S
CO5	S	M	M	S	S	S	S	M	S	S

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Core – IV		**Course Code:** 24PZO2C04	**Course Title:** Developmental Biology	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	6	72	5	100

Course objectives

1. To Understand the process of gametogenesis, cleavage and gastrulation, embryonic development, extra embryonic membrane and placenta in various animals and human.
2. Learn the principles, methods and applications of cryo-preservation of gametes and embryo.

UNIT-I

Pattern of animal development: Chief events in animal development; History of thoughts and conceptual developments. Gametogenesis: Origin of germ cells, spermatogenesis - Sperm morphology in relation to the type of fertilization, Oogenesis - Oogenesis in insects and amphibians.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Reference Books

1. Balinsky, B. I. 1981. Introduction to Embryology (5th Edition), CBS College Publishers, New York, pp-782.
2. Gilbert. S. F. 2006. Developmental Biology, 8th Edition, INC Publishers, USA, pp-785.
3. Berrill, N.J. 1974. Developmental Biology, Tata Mc-Graw Hill Publications, New Delhi, pp-535.
4. Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
5. Subramoniam, T. 2011. Molecular Developmental Biology (2nd Edition), Narosa Publishers, India, pp-364.
6. www.easybiologyclass.com › developmental-biology-e
7. www.studocu.com › document › lecture-notes › view
8. *ocw.mit.edu* › courses › 7-22-developmental-biology-f.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Define the concepts of embryonic development	K1
CO2	Observe various stages of cell divisions under microscope	K2 & K3
CO3	Understand the formation of zygote	K4
CO4	Differentiate the blastula and gastrula stages	K4 & K5
CO5	Learn the distinguishing features of three different germ layers and formation of various tissues and organs	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	S	M	S	S	L	S	M	L	M
CO2	S	S	S	S	S	L	S	S	S	S
CO3	S	M	S	S	S	S	S	L	L	M
CO4	S	S	S	S	S	M	S	S	S	L
CO5	S	S	S	M	S	S	S	L	L	M

Mapping of COs with Pos

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Core Lab– II		**Course Code:** 24PZO2P02	**Course Title:** Lab Course in Cell Biology and Developmental Biology	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	6	48	4	100

Course objectives

1. To get Practical course aims at demonstrating significant cellular and molecular biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology, genetics and developmental biology into practical understanding.

CELL AND MOLECULAR BIOLOGY

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

DEVELOPMENTAL BIOLOGY

Gametogenesis - Observation of gametes from gonadal tissue sections

i. **Oogenesis:**

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

ii **Spermatogenesis:**

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

Fertilization

iii Induced spawning in polycheate worm *Hydroids elegans*

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

v Observation of egg developmental stages in *Emerita emeritus*

Embryogenesis

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

vii Chick embryonic stage - 24 hours of development

viii Chick embryonic stage - 48 hours of development

ix Chick embryonic stage - 72 hours of development

x Chick embryonic stage - 96 hours of development

Histological observation: Section through various developmental stages in chick embryo

Experimental Embryology

Regeneration in Frog Tadpoles

xi Blastema formation

xii Demonstration of regenerative process in tadpole

Metamorphosis

xiii Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine

Cryopreservation

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

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Acquire knowledge to differentiate the cells of various living organisms and become awares of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryo development.	K2
CO2	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.	K3
CO3	Develop handling - skills through the wet-lab course.	K6
CO4	Learn the method of culturing of *Drosophila* and identification of their wild and mutant strains	K1 & K2
CO5	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities	K1 & K2

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

S – Strong M–Medium L –Low

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	M	S	S	S	S	S	L	L	M
CO2	S	S	S	S	S	M	M	M	M	M
CO3	S	S	M	S	S	L	S	M	L	M
CO4	M	M	L	M	L	M	M	S	M	L
CO5	S	S	M	L	S	M	L	S	S	S

Program: M.Sc. Zoology				
Elective – III	**Course Code:** 24PZO2E03		**Course Title:** Economic Entomology	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	5	60	3	100

Course Objectives

1. To Students should acquire a fairly good understanding about the life of insects and their classification
2. The students with a basic background in biological sciences with a special emphasis on the study of insects including systematic, beneficial insects, destructive insects, integrated pest management and insects of medical and veterinary importance.

UNIT-I

Overview of insects and insect taxonomy: Insects and their biological success - Man and insects; Basic concepts in Insect Taxonomy and classification.

UNIT-II

Beneficial insects: Silkworms - types, life history, disease management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system) and management of bee hive - Lac insects-life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.

UNIT-III

Destructive insects: Insect pests - definition - Categories of pests - Types of damage to plants by insects - Causes of pest outbreak - Economic threshold level - Biology of the insect pests - Pests of paddy, cotton, sugarcane, vegetables, coconut and stored grains cereals.

UNIT-IV

Pest management/Control strategies: Methods and principles of pest control - Natural control, Artificial control, Merits and demerits - Development and uses of pest resistant plant varieties - Integrated pest management - Concepts and practice.

UNIT-V

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

Reference Books

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

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand taxonomy, classification and life of insects in the animal kingdom.	K1 & K2
CO2	Know the life cycle, rearing and management of diseases of beneficial insects.	K2 & K3
CO3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	K2 & K3
CO4	Recognize insects which act as vectors causing diseases in animals and human.	K2 & K4
CO5	Overall understanding on the importance of insects in human life.	K2 & K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	M	S	M	S	M	M	M	S	L	M
CO2	S	S	M	S	S	S	S	S	S	L
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	S	M	M
CO5	S	S	S	M	M	S	M	L	S	M

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Elective – IV		**Course Code:** 24PZO2E04		**Course Title:** Research Methodology
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	5	60	3	100

Course Objectives

1. Students understand the basic principle, methodology and applications of widely used instruments in biological sciences.
2. To Students should know the fundamentals of basic methods employed in experimental biology.

UNIT-I

Good laboratory practice (GLP) - pH, Electrodes and pH meter - Colorimeter and Spectrophotometry.

UNIT-II

Histology, Histochemistry, Bioinformatics and Electron microscopy.

Unit-III

Light Microscopy, Bright field, Phase contrast, DIC & Fluorescence microscopy, wide field and Confocal microscopy.

UNIT-IV

Centrifuges, Chromatography, Electrophoresis, ELISA and blotting.

UNIT-V

Principles and Applications of tracer techniques in biology, Animal cell culture techniques.

Reference Books

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

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the implications of GLP	K1
CO2	Learn the working principles of different instruments	K2
CO3	Gain the knowledge on techniques of histology and histochemistry	K2 & K4
CO4	Acquire knowledge on the basic principle and application of various modules of light and electron microscopy	K3 & K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	M	S	M	S	M	S	M	S	M	M
CO2	S	S	M	S	S	S	M	M	M	S
CO3	S	M	S	S	S	S	S	S	S	L
CO4	S	S	S	S	S	M	S	S	S	M
CO5	S	S	S	M	M	S	M	L	S	M

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
SEC- I		**Course Code:** 24PZO2S01		**Course Title:** Poultry Farming
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
II	2	30	2	100

Course Objectives

1. To Students should be aware of economic and cultural importance of Poultry farming.

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

Selection, care and handling of hatching eggs - Egg testing. Methods of hatching.- Brooding and rearing -. Sexing of chicks. - Farm and Water Hygiene - Recycling of poultry waste.

Reference Books

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

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To understand the various practices in Poultry farming. To know the needs for Poultry farming and the status of India in global market.	K2 & K3
CO2	To be able to apply the techniques and practices needed or Poultry farming.	K1, K2 & K3
CO3	To know the difficulties in Poultry farming and be able to propose plans against it.	K5 & K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COS with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	L	L	L	L	L	S	S	L	L
CO2	S	L	M	M	S	M	M	M	S	S
CO3	S	M	M	M	S	S	S	S	M	M
CO4	S	S	S	L	S	S	S	S	S	S
CO5	S	S	M	S	S	S	M	L	S	M

S – Strong M–Medium L –Low

Program: M.Sc. Zoology				
Common Course		**Course Code:** 24P2HR01	**Course Title: Human Rights**	
Semester II	**Hours/Week** 2	**Total Hours** 24	**Credits** 2	**Total Marks** 100

Course Objective

1. To learn about Basic Facets of Human Rights.
2. To understand the development of human rights in India.
3. To know the various rights pertaining to marginalized and other disadvantaged people.
4. To help the students to know various human rights movements.
5. To make the students to be aware of human rights redressal mechanisms.

Unit – I

Introduction: Meaning and Definitions of Human Rights – Characteristics and Importance of Human Rights – Evolution of Human Rights – Formation, Structure and Functions of the UNO - Universal Declaration of Human Rights – International Covenants – Violations of Human Rights in the Contemporary Era.

Unit – II

Human Rights in India: Development of Human Rights in India – Constituent Assembly and Indian Constitution – Fundamental Rights and its Classification – Directive Principles of State Policy – Fundamental Duties.

Unit – III

Rights of Marginalized and other Disadvantaged People: Rights of Women – Rights of Children – Rights of Differently Abled – Rights of Elderly - Rights of Scheduled Castes – Rights of Scheduled Tribes – Rights of Minorities – – Rights of Prisoners – Rights of Persons Living with HIVAIDS – Rights of LGBT.

Unit – IV

Human Rights Movements: Peasant Movements (Tebhaga and Telangana) – Scheduled Caste Movements (Mahar and Ad-Dharmi) – Scheduled Tribes Movements (Santhal and Munda) – Environmental Movements (Chipko and Narmada Bachao Andolan) – Social Reform Movements (Vaikom and Self Respect).

Unit – V

Redressal Mechanisms: Protection of Human Rights Act, 1993 (Amendment 2019) – Structure and Functions of National and State Human Rights Commissions – National Commission for SCs – National Commission for STs – National Commission for Women – National Commission for Minorities – Characteristics and Objectives of Human Rights Education.

Course Out Comes

CO1	Understand the basic facets of human rights	**PO4, PO6, PO1**
CO2	Comprehend the Constitutional provisions of human rights in India	**PO1, PO2**
CO3	Grasp the rights of the marginalized and other disadvantaged people in India	**PO4, PO5**
CO4	Know the historical background of the various human rights movement in India.	**PO6**
CO5	Understand the redressal mechanism of the human rights violations	**PO3, PO8**

References Books (Latest Editions)

1.Satvinder Juss, Human Rights in India, Routledge, New Delhi, 2020.

2.Namita Gupta, Social Justice and Human Rights in India, Rawat Publications, Jaipur, 2021.

3. Mark Frezo, The Sociology of Human Rights, John Willy & Sons, U.K. 2014.

4. Chiranjivi J. Nirmal, Human Rights in India: Historical, Social and Political Perspectives, Oxford University Press, New York, 2000.

Text Books

1.Dr. S. Mehartaj Begum, Human Rights in India: Issues and perspectives, APH Publishing Corporation, New Delhi, 2010.

2.Asha Kiran, The History of Human Rights, Mangalam Publications, Delhi, 2011.

3.Bani Borgohain, Human Rights, Kanishka Publishers & Distributors, New Delhi-2, 2007.

4.Jayant Chudhary, A Textbook of Human Rights, Wisdom Press, New Delhi, 2011.

5.Anju Soni, Human Rights in India, Venus Publication, New Delhi, 2019.

Web Resources

1.www.un.org/rights/HRToday

2.www.amnesty.org

3.www.hrweb.org

4.https://www.youtube.com/watch?v=vDizUvyQTuo

5.https://www.youtube.com/watch?v=WJsUfck01Js

CO-PO-PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	M	S	S	S	M	M	S	S	S	S
CO 2	S	S	S	S	S	S	M	S	M	S
CO 3	S	S	S	S	S	S	S	S	S	S
CO 4	S	S	S	S	S	S	S	S	L	S
CO 5	S	S	S	S	M	M	S	S	S	S

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

Program: M.Sc. Zoology				
Core – V		**Course Code:** 24PZO3C05		**Course Title:** Genetics
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	6	72	4	100

Course objectives

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Reference Books

1. Griffiths, A. J. F., H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart. 2012. An Introduction to Genetic Analysis. 11th Edition, W. H. Greeman. New York.
2. Snustad, D.P., Simmons, M.J. 2015. Principles of Genetics, John Wiley Publications, pp-784.
3. Watson, J. D., T. A. Baker, S. P. Bell, Alexander Gann, Michael Levine, Richard Losick. 2003. Molecular Biology of the Gene, (5^{th} Edition). Cold Spring Harbor Laboratory Press, pp-912.
4. Klug, W. S. and M. R. Cummings, C. A. Spencer. 2005. Concepts of Genetics, Benjamin - Cummings Publishing Company.
5. Harti, D. L. 2002. Essential Genetics, A Genomic Perspective, Jones & Bartlet.
6. Krebs, J. E., E.S. Goldstein, S.T. Kilpatrick. 2018. Lewin's Genes XII, Jones & Bartlet Publisher, pp-613.
7. Watson, J. D., T. A. Baker S. P. Bell, A. Cann, M. Levine and R. Losick, 2014. Molecular Biology of Gene 7th Edition, Pearson Education RH Ltd. India.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain the organization and functions of genetic material in the living system.	**K1 & K2**
CO2	Understand various sequential processes in protein synthesis	**K1 & K2**
CO3	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.	**K2 & K4**
CO4	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.	**K2 & K5**
CO5	Understand the principle and application of rDNA technology for the welfare of human being.	**K2 & K3**

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	M	L	L	S	S	S	L	M	S
CO2	S	M	M	M	S	M	M	M	L	S
CO3	M	S	L	L	M	S	M	L	S	L
CO4	S	M	S	M	M	S	S	S	S	S
CO5	S	S	S	M	E	S	M	S	M	M

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Core – VI	**Course Code:** 24PZO3C06		**Course Title:** Evolution	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	6	72	4	100

Course objectives

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

duplication and divergence

UNIT-V

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

Reference Books

1. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.
2. Hall B. K. and B. Hallgrimsson. 2014. Strickberger's Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642.
3. Barton, N.H., D. Briggs, J.A. Eisen David, D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.	**K1 & K3**
CO2	Study the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.	**K1 & K2**
CO3	Understand the major events in the evolutionary time scale; Origins of unicellular and multi-cellular organisms.	**K2 & K3**
CO4	Comprehend the origin of new genes and proteins; Gene duplication and divergence.	**K2 & K4**
CO5	Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift	**K4 & K5**

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	M	S	M	S	M	L	S	M	L	M
CO2	S	S	L	S	S	L	S	S	S	S
CO3	S	M	S	S	S	S	S	L	L	M
CO4	S	S	S	S	S	M	S	S	S	L
CO5	S	S	S	M	M	S	S	L	L	M

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Core – VII	**Course Code:** 24PZO3C07		**Course Title:** Animal Physiology	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	6	72	4	100

Course objectives

1. Students acquire the basic knowledge on physiology of different organs in animals and human. Learn the principles, methods and applications of cryo-preservation of gametes and embryo.
2. Understand the functions of different systems such as digestion, excretion, blood circulatory system, respiration and nervous system of animal relating them to structure and functions of various organs.

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

Digestive system: Digestion, absorption, energy balance, BMR. Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition,

regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance

UNIT-V

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

Reference Books

1. Shepherd, G. M. 1994. Neurobiology, OUP USA Publsiher, pp-774.
2. Hainsworth , F.R. 1981. Animal Physilogy: Adaptation in function, Addison Wesley Longman Publishers, pp-669.
3. Mcfarland, D. 1999. Animal Behaviour: Psychobiology, Ethology and Evolution, Longman Publisher, pp-592.
4. Gorden, M.S. *et al.*, 1977. Animal Physiology: Principles and Adaptation, New York, Third Edition.
5. Ahearn, G.A. *et al.*, 1988. Advances in Comparative and Environmental Physiology – 2, Springer Publishers, pp-252.
6. Hill, R.W. 1976. Comparative Physiology of Animals: Environmental Approach, Longman Higher Education Publisher, pp-656.
7. Withers, P.C. 1992. Comparative Animal Physiology, Brooks/Cole Publisher, pp-900.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the functions of different systems of animals	**K1**
CO2	Learn the comparative anatomy of heart structure and functions	**K2**
CO3	Know the transport and exchange of gases, neural and chemical regulation of respiration	**K2 & K4**
CO4	Acquire knowledge on the organization and structure of central and peripheral nervous systems	**K3 & K5**

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	M	S	M	S	M	L	S	M	S	S
CO2	S	S	M	S	S	S	S	M	S	S
CO3	S	M	S	S	S	M	L	S	M	S
CO4	S	S	S	S	S	L	M	S	S	M
CO5	S	S	S	M	M	M	M	L	L	M

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Core Lab -III		**Course Code: 24PZO3P03**		**Course Title: Genetics, Evolution and Animal Physiology**
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	4	48	4	100

Course Objectives:

The main objectives of this course are:

1. To learn on the transmission of heritable traits.
2. To have hands on experience in handling of hormone related disorders.
3. To study the significance of vestigial organs in humans

GENETICS

1. Observation of Mendelian traits
2. Identification of Human Syndromes – Specimen/Photograph
3. Study on polygenic inheritance – Specimen/Photograph
4. Pedigree Analysis of Genetic Disorder (Hemophilia and Night Blindness)

EVOLUTION

1. Identification of Vestigial organs
2. Study of fossils and living fossils from models/pictures
3. Problems related to changes in allelic frequencies using Hardy-Weinberg Law
4. Study of Homology and Analogy (Pictures)

ANIMAL PHYSIOLOGY

1. Pregnancy testing for HCG in urine samples
2. Identification of Thyroidism
3. Identification of Endocrine glands in mammals (Specimen)
4. Identification of Endocrine glands in insect (Specimen)

Text Books:

1. Nigam SC, Nigam SC and Omkar (2006) Experimental Animal Physiology and Biochemistry, New Age International.
2. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

Reference Books:

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

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Students will identify endocrine and pheromone glands in mammals and insects.	K2 & K3
CO2	Students will learn on vestigial organs and their role in evolution.	K2 & K3
CO3	Understand the transmission of different heritable traits.	K2 ,K3 & K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	S	S	S	M	S	M	S	M	S
CO2	S	M	L	S	M	S	M	M	M	M
CO3	M	M	L	S	L	S	M	L	M	M
CO4	S	S	L	S	L	S	M	L	M	L
CO5	S	S	M	L	M	S	M	S	M	M

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Elective – V		**Course Code:** 24PZO3E05		**Course Title:** Medical Laboratory Techniques
Semester III	**Hours/Week** 2	**Total Hours** 48	**Credits** 3	**Total Marks** 100

Course Objectives

1. Students should understand the different protocols and procedures to collect clinical samples.
2. Students should have a basic knowledge about medical laboratories and the works carried out by them.

UNIT-I

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

UNIT-II

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

Unit-III

Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome-Computer tomography (CT scan) - Magnetic Resonance imaging - flowcytometry - treadmill test - PET.

UNIT-IV

Cardiovascular system- Blood pressure - Pulse - regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) - significance - ultra sonography- Electroencephalography (EEG).

UNIT-V

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

Reference Books

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

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.	K2 & K3
CO2	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.	K3, K4 & K5
CO3	Evaluate the hematological and histological parameters of biological samples.	K3, K4, K5 & K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	M	M	M	L	L	M	M	L	M
CO2	S	S	M	S	S	S	L	M	S	S
CO3	M	S	S	S	S	S	S	S	S	L
CO4	S	S	M	M	L	M	L	M	M	S
CO5	M	M	S	S	M	S	L	L	S	S

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
SEC- II		**Course Code:** 24PZO3S02		**Course Title:** Dairy Farming
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
III	3	24	2	100

Course Objectives

1. To students should be aware of economic and cultural importance of Dairy farming.

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

Contagious disease - Common Bacterial - Protozoal - Helminth and Viral Diseases - Parasitic Infestation - Vaccination - Biosecurity.

Reference Books

1.The Veterinary Books for Dairy Farmers by Roger W. Blowey.

2. Hand Book of Dairy Farming by Board Eiri.

3. Handbook of animal husbandry TATA, S.N ed., ICAR 1990

4. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.

5. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea &Fabiger Publisher.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To understand the various practices in Dairy farming. To know the needs for Dairy farming and the status of India in global market.	K2 & K3
CO2	To be able to apply the techniques and practices needed for Dairy farming.	K1, K2 & K3
CO3	To know the difficulties in Dairy farming and be able to propose plans against it.	K5 & K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	M	S	L	L	S	S	M	S	L	M
CO2	M	S	S	S	M	S	M	L	S	S
CO3	M	S	S	S	S	S	S	S	S	M
CO4	M	S	S	S	M	M	L	L	M	M
CO5	S	S	S	M	S	M	S	L	S	S

S – Strong **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Core – VIII		**Course Code:** 24PZO4C08	**Course Title:** Immunology	
Semester IV	**Hours/Week** 6	**Total Hours** **72**	**Credits** 5	**Total Marks** 100

Course objectives

1. To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.
2. To enable a successful performance in Immunology component of CSIR-UGC NET.

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

Major effector components of humoral immune system: Antibodies - Primary structure, classification, variants and antigen-antibody interactions; Structural and functional characteristics of various antibody classes; Generation of diversity; Monoclonal antibodies: definition, production and applications; Antibody engineering and its applications. Complement system - Components, three major activation pathways, and immune functions including anaphylaxis and inflammation.

Cytokines - Definition and salient functional features; Interleukins: definition, types (lymphokines and monokines), and functions. Interferons - Origin, types and functions

UNIT-V

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

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Recommended texts

1. Weir, D. M and J. Stewart. 1997. Immunology, Churchill Livingstone, London, pp-362
2. Janeway, C. A and P. Travers. 1997. Immunology, Garland Publ. Inc., London, pp-904
3. Peakman, M and D. Vergani. 1997. Basic and Clinical Immunology, Churchill Livingstone, London, pp-366
4. Parham, P. 2009. The Immune System (Third Edition), Garland Science, USA, pp-506
5. Weissman, I. Hood, L. Wood, W. 1978. Essential Concepts in Immunology, the Benjamin/Cummings, California, pp-165.
6. Hood, L. Weissman, I. Wood, W. Wilson, J. 1984. Immunology (Second Edition), the Benjamin/Cummings, California, pp-558.
7. Coica, R and Sunshine, G. 2009. Immunology A Short Course (Sixth Edition), John Wiley & Sons, USA, pp-391.
8. Doan, T. Melvold, R. Viselli, S. *et al*., 2013. Immunology (Second Edition), Lippincott Williams & Wilkins, Maryland, pp-376.

Owen, J. A. Punt, J. Stanford, S. A. 2013. Kuby Immunology (7th Edition), Macmillan, England, pp-692.

CO Number	CO Statement	Knowledge Level
CO1	Various basic concepts in immunology and organization of immune systems.	K2
CO2	Mechanisms of immune response in health and their defects in various diseases.	K2 & K4
CO3	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.	K3 & K5
CO4	Vaccinology and its importance in disease management	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Mapping of Cos with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	M	S	S	S	S	M	S	S	S
CO2	S	S	M	S	S	S	M	M	S	S
CO3	S	M	M	S	S	S	S	S	S	M
CO4	M	S	M	M	S	S	S	S	S	M
CO5	M	S	S	S	M	S	M	S	S	M

***S – Strong** **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Core –IX	**Course Code:** 24PZO4C09		**Course Title:** Ecology	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	6	72	5	100

Course Objectives

1. Knowing the ecology and climatic changes at world level and its impact on natural resources.
2. Understanding the contributing factors for pollution in the environment and the ways in controlling and restoring to natural conditions

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change;

biodiversity management approaches - Waste management. Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Reading list

1. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
2. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.
3. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.
4. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.
5. Online courses.nptel.ac.in / noc 19 - g e 23/preview
6. Class central.com/course/swayam -ecology - and environment – 14021.

Recommended texts

1. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
2. Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.
3. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Learn about the ecosystem, biotic communities and utilizing the energy processing	**K2**
CO2	Study the various community and population and population control	**K2 & K3**
CO3	Understand the fundamentals of climatic conditions and its impact on environment	**K2 & K6**
CO4	Realizing the nature of pollution and the ways for its control/reduction	**K4 & K5**
CO5	Impact of environmental studies on solid waste management	**K2 & K6**

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of Cos with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	S	M	M	S	M	S	S	M	S
CO2	S	S	M	M	L	S	S	S	M	M
CO3	S	M	M	L	M	S	L	L	S	L
CO4	M	M	S	S	M	L	L	S	S	S
CO5	M	S	S	M	S	M	L	M	L	S

***S – Strong** **M–Medium** **L –Low**

Program: M.Sc. Zoology				
Practical- IV	**Course Code:** 24PZO4P04		**Course Title:** Lab Course in Immunology and Ecology	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	6	48	4	100

Course Objectives

1. To analyze environmental parameters.
2. To evaluate the physiochemical content of water .
3. To know the methodology of immunity

IMMUNOLOGY

1. Demonstration of lymphoid organs
2. Histological study of spleen, thymus and lymph nodes through slides/photographs
3. Preparation of stained blood film to study various types of blood cells
4. Ouchterlony‟s double immune-diffusion method
5. ABO blood group determination
6. Demonstration
   a) ELISA
   b) Immunoelectrophoresis

ENVIRONMENTAL SCIENCE:

1. Measurement of pH in a given sample.
2. Determination of dissolved oxygen in a water sample.
3. Determination of amount of free CO2 in a water sample.
4. Determination of total alkalinity of a water sample.
5. Measurement of turbidity in a given sample of water.
6. Estimation of calcium in water sample.
7. Total count of planktons (Fresh water or marine water planktons)
8. Identification of planktons – fresh water and marine water (Qualitative)
9. Identification – Secchi disc, Rainwater gauge and Respirometer.

Text Books:

1. Manual of Clinical Immunology. Front Cover. Noel R. Rose, Herman Friedman. American Society for Microbiology, 1976 - Allergy and Immunology - 932 pages ...

2. Manual of Clinical Laboratory Immunology. 1997 Rose, Noel R.,Conway De MacArio, Everly ,Folds, James D.

3. Environmental science - A practical manual Ramesh Thatikunta, Swarajya Lakshmi and Prabhu Prasadini April 2018 Publisher: BS Publications.

4. A Practical Manual for Ecology. Ratna Book Distributors, Kathmandu. Zobel, D.B., Behan, M.J., Jha, P.K. and Yadav, U.R.K. (1987)

Course Out comes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Acquire ability to perform/ demonstrate various basic concepts in immunology as well as applications of research methods for quantitative/ qualitative analysis of biochemical components.	K3 & K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Program: M.Sc. Zoology				
Elective – VI	**Course Code:** 24PZO4E06		**Course Title:** Aquaculture	
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	5	60	3	100

Course Objectives

1. Students should know basic concepts in Aquaculture.

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Reading list

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

Recommended texts

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

Course Out comes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To develop knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques	K1 & K2
CO2	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture	K3 & K4
CO3	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations	K5 & K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POS

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	S	M	M	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	M	S	S	S	S	M	M	S
CO5	S	S0	M	S0	M	S	M	L	S	S

***S – Strong** **M–Medium** **L –Low**

Program: M.Sc. Zoology				
SEC – III		**Course Code:** 24PZO4S03		**Course Title:** Animal behaviour
Semester	**Hours/Week**	**Total Hours**	**Credits**	**Total Marks**
IV	4	48	2	100

Course Objectives

1. Students should understand basic concepts in Animal behaviour.

UNT-I

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

UNT-II

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

UNT-III

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

UNT-IV

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

UNT-V

Organization of circadian system in multicellularanimals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to

Drosophila; Photoreception and photo- transduction; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.

Reading list

1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.
2. HarjindraSingh, 1990. A TextBook of Animal Behaviour, AnomolPublication, 293pp.
3. Hoshang S.Gundevia and Hare Goving Singh, 1996. Animal Behaviour,S.Chand&Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.

Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

Recommended texts

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.

Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Recall and record genetic basis and evolutionary history of behaviour.	K1 & K2
CO2	Analyse and identify innate, learned and cognitive behaviour and differentiate between various mating systems.	K3 & K4
CO3	Classify movement and migration behaviours and explain environmental influence upon behaviour.	K1, K4 & K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010
CO1	S	S	M	M	L	L	M	M	L	L
CO2	S	M	L	L	S	L	M	M	L	M
CO3	M	L	M	L	S	S	M	S	M	S
CO4	S	S	S	S	M	S	L	L	L	M
CO5	S	L	L	L	M	L	L	S	M	S

Mapping of COs with Pos

***S – Strong** **M–Medium** **L –Low**