



பெரியார் பல்கலைக்கழகம்
PERIYAR UNIVERSITY
DEPARTMENT OF ZOOLOGY

Salem-636 011, Tamil Nadu
State University - NAAC 'A++' Grade - NIRF Rank 94

OBE REGULATIONS AND SYLLABUS

(With effect from the academic year 2026-2027 onwards)

M.Sc. ZOOLOGY PROGRAMME

[Choice Based Credit System (CBCS)]

(For those admitted in the academic year 2026-2027 onwards)

1. Preamble

Department of Zoology was started in the year 2012 with M.Sc., M.Phil., and Ph.D. courses. This Department strives to create a suitable environment that enables teaching and research to attain high levels of excellence (through Publications and Patents) and in which its members can achieve their full potential right from Molecular Cell Physiology to understanding and targeting diseases like cancer and vector borne diseases, impact of climate change on insect diversity and bat behavior, Cultivation to commercialization of earthworms etc. Zoology is central to our understanding of the world. Zoologists seek to discover the fundamental principles that pinpoint animal life focusing on the diversity, function and evolution of animals and thus providing the scientific basis for our knowledge regarding the life style, physiology, diseases and their curative measure in the natural environment by conducting research in insects to mammalian cells.

2. Vision

This Department strives to create a suitable an environment that enables teaching and research to attain high levels of excellence (through Publications and Patents) and in which its members can achieve their full potential right from Molecular Cell Physiology to understanding and targeting diseases like cancer and vector borne diseases, impact of climate change on insect diversity and bat behavior, Cultivation to commercialization of earthworms etc. In addition to the routine work, the Faculties actively engaging in research and also have collaboration with other Universities/ Research Institutions at national as well as International level. So far the Department of Zoology received more than a Crore of Rupees as research grant from various funding agencies like DST, UGC etc.

3. Mission

- Providing advanced knowledge and practical training in animal sciences through a research-oriented curriculum that integrates contemporary developments in zoology.
- Developing critical thinking, scientific inquiry, analytical skills, and problem-solving abilities to address challenges in biological sciences and related disciplines.
- Promoting innovation, interdisciplinary learning, and research competence through laboratory training, field studies, project work, and the application of modern scientific tools and technologies.
- Instilling ethical values, environmental consciousness, and a commitment to biodiversity conservation, sustainable development, and responsible scientific practices.
- Preparing graduates for successful careers in higher education, research, biotechnology, healthcare, environmental management, industry, government services, entrepreneurship, and lifelong learning by fostering leadership, communication, and professional skills.

4. General Graduate Attributes

By studying this programme students get state of the art knowledge about the Zoology and also the opportunities available by studying this course. Student get the aptitude for most of the job oriented course opportunities as well as ability to get success in various competitive exams such as TNPSC, UPSC and Indian forest service etc.

5. Learning Outcomes

The Learning Outcomes outlined below define the minimum knowledge, skills, attitudes, values, and competencies expected of every student upon successful completion of the programme. These outcomes provide a common academic framework for curriculum

development, teaching–learning, assessment, and continuous quality improvement. Programme Outcomes (POs) and Course Outcomes (COs) have been designed to align with and contribute to the achievement of these Learning Outcomes.

LO1: Disciplinary knowledge:
Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.
LO2: Communication Skills:
Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's Views and express herself / himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
LO3: Critical thinking:
Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
LO4: Problem solving:
Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
LO5: Analytical reasoning:
Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyse and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
LO6: Research-related skills:
A sense of inquiry and capability for asking relevant/ appropriate questions, problematising, synthesising and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.
LO7: Cooperation/Team work:
Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.
LO8: Scientific reasoning:
Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open minded and reasoned perspective.
LO9: Reflective thinking:
Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.
LO10: Information/digital literacy:
Capability to use ICT in a variety of learning situations, demonstrate ability to access,

evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.
LO11: Self-directed learning:
Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
LO12: Multicultural competence:
Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
LO13: Moral and ethical awareness/reasoning:
Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.
LO14: Leadership readiness/qualities:
Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.
LO15: Lifelong learning:
Ability to acquire knowledge and skills, including 'learning how to learn', that are necessary for participating in learning activities throughout life, through self paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling

6. Programme Specific Qualification Attributes

By studying this programme the students get the eligibility and capability to clear SET and CSIR NET in Zoology and get eligibility to become Assistant Professors in Zoology as well as NET qualified research scholars. The students also become entrepreneurs and develop their own business and give employment to others.

- **Knowledge and understanding level (K1 and K2)**

This course imparts knowledge which will be helpful to clear the competitive examinations in the field of Zoology. Students can understand the nature, physiology, biochemical and evolutionary aspects of all animals.

- **Application level (K3)**

On completion of this course students can start the clinical and diagnostic labs in the field of biomedicine. They will also be capable of opening sericulture, apiculture and aquaculture industries.

- **Analytical level (K4)**

Students can analyze each and every aspects of pathophysiology and biochemical reaction in animals including human being.

- **Evaluation capability level (K5)**

Students can evaluate environmental conditions, animal metabolism, and human pathological conditions.

- **Scientific or synthesis level (K6)**

By studying this course they can develop new drugs and patenting skills. They can also develop new hybrids using genetic engineering.

7. Programme Objectives and Outcomes

Spelt the PEOs (Programme Educational Objectives), Programme Specific Objectives (PSOs) and Programme Outcomes (POs)

Programme Educational Objectives

- To train our stakeholders to transform their theoretical knowledge into practical for the benefit of our society.

Programme Specific Objectives

- To motivate our stake holders to adopt fundamental mathematical tools (statistics) and physical Principles (physics, chemistry) to the analysis of relevant biological situations.
- The outgoing students must be talented to identify the major groups of organisms (invertebrates and chordates) with an emphasis on animals and be able to classify them within a phylogenetic framework (Evolution).
- Students will be able to compare and contrast the characteristics of animals that differentiate them from other forms of life (Comparative Biology).
- Our Stake holders would be clever to explain how organisms function at the level of the gene, genome, cell, tissue (Genetics, Cell Biology, Molecular Biology), organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behaviour of different forms of animals.
- To develop our students to apply their scientific knowledge to formulate testable hypotheses, gathering data that spell out these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their society.

Outcome of the Programme

- Zoology program offered by the University will mould our students to transform their theoretical knowledge into practical for the benefit of our Society by promoting agriculture and health care products. Our stake holders will get an opportunity to serve for our Government as Zoologist at ZSI, Entomologist in ICAR institutes, Aqua-culturist, Sericulture Specialist as an entrepreneur. There is an opportunity for our young minds to serve as conservators, Educators as teacher, professors etc.

Further after successful completion of the M.Sc. Zoology programme, students will be able to:

PO1	Demonstrate comprehensive knowledge of animal diversity, structure, function, development, behavior, and evolutionary relationships.
PO2	Apply principles of cell biology, molecular biology, biochemistry, genetics, microbiology, immunology, and physiology to understand life processes in animals.
PO3	Analyze biological data using appropriate experimental, statistical, and computational approaches relevant to zoological research.
PO4	Perform laboratory techniques and field-based methods safely and effectively in areas such as microscopy, molecular biology, microbiology, physiology, and biotechnology.
PO5	Integrate interdisciplinary knowledge to address problems in applied zoology, including sericulture, aquaculture, poultry farming, vermiculture, and animal biotechnology.
PO6	Identify animal diseases, pests, and environmental stressors and suggest appropriate management, prevention, and control strategies.
PO7	Apply ethical principles, biosafety guidelines, intellectual property rights, and environmental sustainability concepts in biological research and professional practice.
PO8	Design and execute independent research projects, including problem identification, literature review, experimentation, data interpretation, and scientific reporting.
PO9	Communicate scientific concepts, experimental findings, and research outcomes effectively through oral presentations, written reports, and extension activities.
PO10	Demonstrate employability, entrepreneurship, and leadership skills for careers in academia, research institutions, healthcare, industry, environmental management, and allied life-science sectors.

8. Candidate's eligibility for admission

Candidates who have qualified B.Sc., Zoology / Animal Science / Any other Degree related to Zoology / Life Sciences approved by the Syndicate of Periyar University, Salem.

9. Duration of the programme

The duration of the M.Sc. Zoology Course shall be over a period of **Two Years** from the commencement of the course. A student shall obtain the M.Sc. Degree in Zoology if he/she has registered, undergone and secured the required minimum credits for all the Core and Elective courses and completed the Project Work / Dissertation within the stipulated time.

10. M.Sc. Zoology Programme Structure-Course work, contact hours, credits and maximum internal and external marks for the students admitted from 2026-2027 onwards

Sem	Course Code	Title of Course Work	Contact Hr/Week	Credit	Int. Mark	Ext. Mark	Total Mark
I	26UPZOO1C01	Structure and functions of Invertebrates	5	4	25	75	100
I	26UPZOO1C02	Comparative Anatomy of Vertebrates	4	4	25	75	100
I	26UPZOO1C03	Cell and Molecular Biology	5	4	25	75	100
I	26UPZOO1C04	Biochemistry	5	4	25	75	100
I	26UPZOO1L01	Lab Course – I (Core I – IV)	6	3	40	60	100
I	26UPZOO1E01 26UPZOO1E02	Economic Entomology/ Forensic Science	3	3	25	75	100
I	26UPZOO1S01	Skill Enhancement Course [SEC] – I: Biosafety and Bioethics	2	2	25	75	100
			30	24			700
II	26UPZOO1C05	Genetics	5	4	25	75	100
II	26UPZOO1C06	Animal Physiology	4	4	25	75	100
II	26UPZOO1C07	Microbiology	4	4	25	75	100
II	26UPZOO1C08	Evolution	4	4	25	75	100
II	26UPZOO1L02	Lab Course – II (Core V-VIII)	6	3	40	60	100
II	26UPZOO1E03 26UPZOO1E04	Animal Biotechnology/ Vermitechnology	3	3	25	75	100
II	26UPZOO1S02	Skill Enhancement Course [SEC] – II: Intellectual Property Rights (IPR)	2	2	25	75	100
II	26UPPGC1H01	Human Rights	2	1	25	75	100
II	26UPZOO1N01	Non-Major Elective [NME] – I / Swayam Course	-	2	-	-	-
			30	27			900
III	26UPZOO1C09	Immunology	4	4	25	75	100
III	26UPZOO1C10	Developmental Biology	4	4	25	75	100
III	26UPZOO1C11	Research Methodology	4	4	25	75	100
III	26UPZOO1C12	Animal Behaviour	4	4	25	75	100
III	26UPZOO1L03	Lab Course – III (Core IX-XII)	6	3	40	60	100
III	26UPZOO1E05 26UPZOO1E06	Aquaculture and Fisheries / Sericulture	3	3	25	75	100
III	26UPGEN1V01	Value added course - Peace education	2	2	25	75	100
III	26UPZOO1F01	Internship / Field Survey / Industrial Activity (Internship must be completed during First Year Vacation period of minimum 15 days)	-	2	-	-	-
III	26UPZOO1N02	Non-Major Elective [NME] – II Cancer Therapeutics	3	2	25	75	100
III	26UPZOO1N03	*Non-Major Elective [NME]-III- Bat Ecology	-	2	-	-	-
			30	30			900
IV	26UPZOO1C13	Environmental Biology	5	4	25	75	100
IV	26UPZOO1P01	Core – XIV: Project with viva voce	20	15	100	50+50	200
IV	26UPZOO1E07 26UPZOO1E08	Stem Cell Biology/ Poultry Farming	3	3	25	75	100
IV	26UPZOO1I01	Industry Entrepreneurship Course: Medical Laboratory Technique	2	2	25	75	100
IV	26UPZOO1X01	Extension Activity	-	1	-	-	-
			30	25			500
		Total	120	106	--	--	3000

* For Swayam Repeaters-Only for Zoology students

Value Added Courses (Certificate will be issued separately – Through Online Mode) *				
Course Code	Title of Course Work	Contact Hours	Marks	Credit
23UPZOO1V01	3D Cell Culture & Tissue Engineering	36 hrs per course	100	2
23UPZOO1V02	Genotoxicology	36 hrs per course	100	2
23UPZOO1V03	Insect-Host Interaction	36 hrs per course	100	2
23UPZOO1V04	Medical Entomology	36 hrs per course	100	2
Add-on Courses (Certificate will be issued separately- Through Online Mode) *				
23UPZOO1A01	PCR Technology/ Genomics	36 hrs per course	100	2
23UPZOO1A02	Ornithology	36 hrs per course	100	2

11. Examinations

Examinations are conducted in semester pattern. The examination for the Semester I & III will be held in November/December and that for the Semester II and IV will be in the month of April/May in every academic year.

Candidates failing in any subject (both theory and practical) will be permitted to appear for such failed subjects in the same syllabus structure at subsequent examinations within next 5 years. Failing which, the candidate has to complete the course in the present existing syllabus structure.

12. Scheme for Evaluation and Attainment Rubrics

Evaluation will be done on a continuous basis and will be evaluated four times during the course work. The first evaluation will be in the 7th week, the second in the 11th week, third in the 16th week and the end – semester examination in the 19th week. Evaluation may be by objective type questions, short answers, essays or a combination of these, but the end semester examination is a University theory examination with prescribed question paper pattern.

Attainment Rubrics for Theory Courses

Internal (Max. Marks - 25)

S.No	Approaches	Marks
1	Internal tests (Best two tests out of 3)	10
2	Attendance	5
3	Seminar	5
4	Assignment	5
Total		25

External (Max. Marks - 75)

Section	Approaches	Mark Pattern	Level	CO Coverage
A	Objective Type (Answer all questions)	20X1 = 20 (Multiple Choice Questions)	✓	✓
B	Descriptive Type (100 to 200 words) (Answer any three out of five questions)	3X5 = 15 (Analytical type questions)	✓	✓
C	Essay Type (500 to 1000 words) (Answer all questions with internal choice)	5X8 = 40 (Essay type questions)	✓	✓

Attainment Rubrics for Lab Courses

Internal (Max. Marks-40)

S.No.	Approaches	Marks
1	Practical tests (Best two tests out of 3)	30
2	Attendance	5
3	Record	5
Total		40

External (Max. Marks - 60)

Section	Approaches	Mark Pattern	K Level	CO Coverage
A	Major practical	1X20 = 20	✓	✓
B	Minor practical	1X10 = 10	✓	✓
C	Spotters	4X5 = 20	✓	✓
D	Viva-voce & Record	10	✓	✓
Total		60		

Attainment Rubrics for Research**Internal (Max. Mark - 100)**

S.No.	Approaches	Marks
1	Manual involvements in experiments	30
2	Attendance	10
3	Submission of Dissertation	60
Total		100

External (Viva Voce) (Max. Mark - 100)

S.No.	Approaches	Marks
1	Viva Voce- Internal Examiner	50
2	Viva Voce- External Examiner	50
Total		100

Grading System

Evaluation of performance of students is based on ten-point scale grading system as given below.

Ten Point Scale			
Grade 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

M.Sc. Zoology Course – SEMESTER - I

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

STRUCTURE AND FUNCTIONS OF INVERTEBRATES

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C01	Structure and functions of invertebrates	Core Course-1	4	5	25	75	100
Course Objectives: The main objectives of this course are: 1. To understand the concept of classification and their characteristic features of major group of invertebrates. 2. To realize the range of diversification of invertebrate animals. 3. To enable to find out the ancestors or derivatives of any taxon. 4. To know the functional morphology of system biology of invertebrates.							
Pre-requisite: Students should know the taxonomical classification of invertebrate animals in relation to their functional morphology.							
Course Outcome:							
CO1	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.					LO1, LO3, LO8	
CO2	Understand the evolutionary process. All are linked in a sequence of life patterns.					LO1, LO5, LO6, LO8	
CO3	Apply this for pre-professional work in agriculture and conservation of life forms.					LO1, LO3, LO5, LO8	
CO4	Analyze what lies beyond our present knowledge of life process.					LO1, LO3, LO5, LO8	
CO5	Evaluate and to create the perfect phylogenetic relationship in classification.					LO1, LO5, LO8, LO13	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Units		Content					
I		Structure and function in invertebrates: Principles of Animal taxonomy; Binomial Nomenclature, Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy; Molecular Taxonomy, AI Tools, r-RNA sequencing, Phylogeny of invertebrates					
II		Organization of coelom: Acoelomates; Pseudocoelomates; Coelomates: Protostomia and Deuterostomia; Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata					
III		Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca and Echinodermata. Circulation: Open and Closed Circulatory System, Evolution of Circulatory system; Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments; Mechanism of respiration					
IV		Excretion: Organs of excretion: coelom, coelomoducts, Nephridia and Malpighian tubules; Mechanisms of excretion; Excretion and osmoregulation. Flight					

	mechanism in Insects; Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda); Trends in neural evolution. Reproduction: Asexual reproduction in Protozoans and Polychaetes.									
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									
Text books:										
1. Ruppert, E., Fox, R.S. and Barnes, R.D. 2003. Invertebrate Zoology, (7 th Edition), Holt-Saunders International Edition.										
2. Veer Bala Rastogi (2017) Invertebrate Zoology, Kedar Nath Ram Nath Publications, India.										
3. Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer. 2013. The Invertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.										
4. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited, pp-624.										
5. Kotpal, R.L., 2019. Modern Text Book of Zoology Invertebrates, 11 th Edition, Rastogi Publications.										
Reference books:										
1. Comparative Vertebrate Anatomy - Hyman (Libbie. Henrietta) - The University Of Chicago Press, 1992										
2. Invertebrate Zoology - Hegner (Robert.W); Engemann (Joseph.G)- Macmilan Publishing Company, 1968										
3. The Invertebrata- Borradile, L.A.- Cambridge University Press.										
Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	S	S	M	M	S	S
CO4	S	M	S	M	S	S	M	M	S	M
CO5	S	M	S	M	S	S	M	M	S	M

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

M.Sc. Zoology Course – SEMESTER - I

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

COMPARATIVE ANATOMY OF VERTEBRATES

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C02	Comparative Anatomy of Vertebrates	Core Course-2	4	4	25	75	100
Course Objectives: The main objectives of this course are: 1. To exemplify the Chordate origin and the intermediary position of Prochordates between invertebrates and vertebrates. 2. To acquire the knowledge on origin, evolution, general organization of vertebrates and their integumentary system. 3. To compare the evolution of the heart, aortic arches and the respiratory organs in vertebrates. 4. To impart conceptual knowledge on the skeletal system and dentition in humans, flight adaptation behaviour in birds and also compare the excretory systems in vertebrates. 5. To understand various sense organs, physiology and behaviour of mammalian pheromones and compare the anatomy of brain in vertebrates.							
Pre-requisite: Understanding animal groups like prochordates, agnatha and gnathostomata, Structure and functions of different organs in vertebrates.							
Course Outcome:							
CO1	Students will recall and explain the fundamental concepts of origin, ancestry and general organization of vertebrates.					L01, L03, L04, L05	
CO2	Students will be able to acquire knowledge on the general structures of integumentary system and their derivatives.					L01, L03, L05	
CO3	Students will be able to compare and interpret the evolution of the heart, aortic arches, respiratory organs and kidneys in various vertebrates.					L03, L04, L06, L09	
CO4	Students will compare and study the skeletal system, dentition in humans, and flight adaptation behaviour in birds.					L01, L03, L04, L08	
CO5	Students will be able to understand various sense organs, physiology and behaviour of mammalian pheromones and compare the anatomy of brain in vertebrates.					L01, L03, L04, L05, L06, L08	
LO1: Disciplinary Knowledge - LO2: Communication Skills - LO3: Critical thinking - LO4: Problem Solving - LO5: Analytical Reasoning - LO6: Research- related Skills - LO7: Cooperation/ Team Work - LO8: Scientific Reasoning - LO9: Reflective Thinking - LO10: Digital Literacy - LO11: Self-directed Learning - LO12: Multicultural Competence - LO13: Moral and Ethical awareness/ reasoning - LO14: Leadership qualities - LO15: Lifelong Learning.							
Units		Content					
I		General Characters and outline classification of Chordata – Origin of chordates in the light of recent theories. General organization and affinities of Prochordates. Interrelationship of Hemichordata, Urochordata and Cephalochordata and their relationship with other Deuterostomes. Reproduction in Tunicates and Retrogressive Metamorphosis. Molecular taxonomy of vertebrates. The Nature of vertebrate morphology.					
II		Origin, evolution, general organization and affinities of Ostracoderms. General organization of cyclostomes. Origin, evolution, general organization and affinities					

	of Placoderms. General account of Elasmobranchs, Dipnoi and Crossopterygians. Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs. Terrestrialization in amphibians/reptiles. Flight adaptation in birds.
III	General plan of circulation in various groups; Blood; Evolution of heart, aortic arches and portal systems. Comparative anatomy of gills, lungs, air bladders, and cutaneous respiration. Accessory respiratory organs.
IV	Skeletal system: Form, function, body size and skeletal elements of the body; Comparative account of jaw suspensorium, Types of Vertebrae; Vertebral column; Limbs and girdles; Dentition in Mammals, Dental formula of man; Comparative study of Prototheria, Metatheria, and Eutheria. Excretory system – Comparative account of excretory organs.
V	Sense organs: Simple receptors; Organs of Olfaction and taste; Vomeronasal/Jacobson's organ in reptiles; Lateral line system; Electroreception in fish. Nervous system: Comparative anatomy of the brain in relation to its functions; Nerves-Cranial, Peripheral and Autonomous nervous systems. Physiology and behavior of mammalian pheromones.

Text books:

1. Kardong, K. 2018. Vertebrates: Comparative Anatomy, Function, Evolution, 8th Edition, McGraw Hill, pp.816.
2. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.
3. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp.750.
4. Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
5. Kotpal, 2019. R.L. Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp.968.

Reference books:

1. Hildebrand, M. and Goslow, G. 2001. Analysis of Vertebrate Structure, 5th Edition, John Wiley, pp.656.
2. Young, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp.645.
3. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp.600.

Web Resources:

1. <https://pressbooks.palni.org/comparativevertebrateandhumananatomy/>
2. <https://funaab.edu.ng/funaab-ocw/opencourseware/Comparative%20Vertebrate%20Anatomy.pdf>
3. <https://ia801408.us.archive.org/33/items/in.ernet.dli.2015.120846/2015.120846.Comparative-Anatomy-Of-The-Vertebrates.pdf>
4. https://upload.wikimedia.org/wikipedia/commons/4/4e/Comparative_anatomy_of_vertebrates_%28IA_cu31924002902389%29.pdf
5. <https://pmc.ncbi.nlm.nih.gov/articles/PMC9338813/>

Mapping with Programme Outcomes*

COs	PO 1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	L	L	M	S	M	M
CO2	S	S	L	S	S	-	M	M	M	S
CO3	M	M	M	S	M	L	S	S	S	L
CO4	S	M	S	M	S	-	S	S	S	M
CO5	M	S	S	M	M	L	M	L	S	M

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

M.Sc. Zoology Course – SEMESTER - I

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

CELL AND MOLECULAR BIOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C03	Cell and molecular biology	Core Course-3	4	5	25	75	100
Course Objectives: The main objectives of this course are: <							

II	Ultrastructure of Cell Wall of bacterial and plant cells. Types of Ion Transport mechanism with an example – Active, Passive, Simple Diffusion, Facilitated diffusion, Role of carrier proteins in ion transport. Uniport, Symport and Antiport mode of ion transport in prokaryotes. Structure and functions of aquaporin. Types and mechanism of exocytosis and endocytosis. Ion transport related diseases and disorders. Ultrastructure and functions of Endoplasmic Reticulum (ER), Types of endoplasmic reticulum, Types of ER- Rough ER, Smooth ER, Cis and Trans acting element. Mechanism of Protein synthesis in RER at cell biology level. Mechanism of Detoxification in SER at Cell Biology level. ER stress associated diseases.
III	Ultrastructure of Golgi apparatus and their functions in post translational modification of proteins and other functions of Golgi apparatus. Biological importance of Trans-golgi-network in mammalian cells. Biology of Exosomes and their application in biomedical sciences. Ultrastructure and functions of perisomes. Ultrastructure and functions of Mitochondria, Mitochondria as a semi-autonomous organelle and Power house of the cell. Mitochondrial dysfunctions and related diseases. Central Dogma of Life : Transcription & Post Transcription, Translation & Post Translation in eukaryotes. Mechanism of Protein Synthesis in prokaryotes.
IV	Ultrastructure, types and functions of Ribosomes. Types of Ribosomal RNA and DNA and its associated role in molecular taxonomy of animals and plants. The ribosomal proteins and their biological significance. Ultrastructure and functions of Lysosome in eukaryote and Mesosome in bacteria. Lysosome as a suicidal bag. Ultrastructure and functions of Nucleus and Nucleolus: Nuclear envelope, Ultrastructure of Nuclear pore complex. Nuclear proteins and their functions at cell biological level.
V	Ultrastructure of chromosomes, Euchromatin and Heterochromatin. Types of Cell Division: Mitosis and Meiosis. Significance of mitosis and meiosis. Biology of Cell Cycle and its relevance to diseases and disorders. Mechanism of Cell Cycle Arrest and cell cycle check points associated cyclin and cyclin dependent kinases in mammalian cells. Mechanism of cell cycle regulation in diseased condition like diabetes, cancer and hypertension treatment. Mechanism of host-pathogen interaction, plasma membrane receptors for bacteria (Any two) and Viruses (Any Two). Molecular mechanism of pathogen invading into mammalian cells. CO and LO mapping for Cell and Molecular Biology Course

Text books:

1. Gerald Karp, Janet Iwasa, Wallace Marshall. 2016. Cell Biology (8th Edition), John Wiley & Sons, Singapore.
2. Lodish, H., C. A. Kaiser, A. Bretscher, et al., 2021. Molecular Cell Biology (9th Edition), Macmillan, England

Reference books:

1. De Robertis, E.D.P. and E. M. F. De Robertis Jr, 2017. Cell and Molecular Biology. Eighth Edition, Lippincott Williams & Wilkins HongKong.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter, 2022. Molecular Biology of the Cell (Seventh Edition), Garland Science, New York.
3. Geoffrey M. Cooper, Kenneth E. Adams, 2023. The Cell: A Molecular Approach, 9th Edition, Oxford University Press.

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - I

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

BIOCHEMISTRY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C04	Biochemistry	Core Course-4	4	5	25	75	100
Course Objectives: The main objectives of this course are: 1. To understand the biophysical and biochemical principles governing molecular structure, bonding, pH, and energy changes in biological systems. 2. To explain carbohydrate metabolism, energy production, and metabolic disorders with emphasis on cellular oxygen sensing. 3. To describe protein structure and synthesis and the mechanisms and regulation of enzyme action. 4. To understand lipid metabolism and cholesterol biosynthesis and their role in obesity and related disorders. 5. To explain genetic information flow and the regulatory roles of vitamins and hormones in physiological homeostasis.							
Pre-requisite: Basic knowledge of general chemistry, organic chemistry, cell biology, and fundamental biological processes							
Course Outcome:							
CO1	Students will be able to apply biophysical and biochemical principles to explain molecular interactions, pH regulation, and energy changes in biological systems.					LO1, LO3, LO8	
CO2	Students will be able to analyze carbohydrate metabolic pathways, energy production, and metabolic disorders including cellular oxygen sensing mechanisms.					LO1, LO5, LO6, LO8	
CO3	Students will be able to interpret protein structure–function relationships and evaluate enzyme mechanisms, kinetics, and inhibition.					LO1, LO3, LO5, LO8	
CO4	Students will be able to explain lipid metabolic pathways and assess their biomedical significance in obesity and related metabolic disorders.					LO1, LO3, LO5, LO8	
CO5	Students will be able to describe genetic information flow and evaluate the regulatory roles of vitamins and hormones in physiological homeostasis.					LO1, LO5, LO8, LO13	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Units		Content					
I		Introduction to biophysical chemistry and biochemistry: Structure and models of atoms; molecules, chemical bonds & biomolecular interactions. pH, buffer, Henderson– Hasselbalch equation, reaction kinetics, thermodynamics and colligative properties.					
II		Carbohydrates: Structure, function and classification. Carbohydrate metabolism: Anabolism – Glycogenesis and Gluconeogenesis. Catabolism – Glycolysis, Kreb's cycle and Glycogenolysis. Electron Transport Chain. Metabolic disorder: Diabetes					

	and their biomedical significance. Cell sensing – Adaptation to oxygen availability (Noble laureate William Kaelin Jr, Sir Peter Ratcliffe and Gregg Semenza).
III	Protein: Amino acids - Structure, function and classification. Essential amino acids and Nonessential amino acids, glycogenic and ketogenic amino acids. Proteins: Classification of proteins- Primary, Secondary, Tertiary and Quaternary structure of protein. Protein synthesis. Enzymes: mechanism of enzyme action, enzyme kinetics, enzyme inhibitors.
IV	Lipids: Structure, function and classification. Fatty acid oxidation: Beta, alpha and omega oxidation. Biosynthesis of fatty acids. Cholesterol: Structure, function and biosynthesis. Biomedical importance of lipids in Obesity.
V	Nucleic acids: Structure and classification: DNA and RNA; chemical composition, types, and biological functions. Organization of genetic material in prokaryotes and eukaryotes. DNA replication, transcription, and translation. Vitamins: Classification - fat-soluble and water-soluble vitamins - Sources, recommended dietary allowances and deficiency disorders. Hormones: Classification based on chemical nature (peptide, steroid, and amino acid-derived hormones). Mechanism of hormone action through membrane and intracellular receptors. Signal transduction pathways.

Text books:

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2012. 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. 2018. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.
5. Satyanarayana U. and U. Chakrapani, 2020. Biochemistry. (3rd Edition). Books and Allied (P)
6. Voet D. and J.G. Voet. 2019. Biochemistry. (6th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp- 1428.

Reference books:

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

Mapping with Programme Outcomes*

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

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

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

Subject Code	Name of the Subject	Category	Credits	Hours/Week	Marks		
					CIA	External	Total
26UPZOO1L01	Lab Course – I	Lab Course	3	6	40	60	100
Course Objectives:							
The main objectives of this course are:							
1. To develop practical skills in animal dissection, specimen identification, and microscopic examination of invertebrates and chordates. 2. To train students in fundamental cell biology and molecular biology techniques for the analysis of cells, chromosomes, DNA, and proteins. 3. To provide hands-on experience in biochemical experiments for the study of biomolecules, enzymes, buffers, chromatography, and bioinformatics tools. 4. To enhance competency in the use of laboratory instruments, preparation of biological specimens, and interpretation of experimental observations. 5. To cultivate scientific inquiry, laboratory safety, accurate record-keeping, and ethical practices in biological research.							
Pre-requisite:							
Students should possess a fundamental understanding of animal diversity, anatomy, cell and molecular biology, biochemistry, microscopy, basic laboratory techniques, scientific methods, and laboratory safety practices to perform biological experiments effectively and responsibly.							
Course Outcome:							
CO1	Perform dissections, prepare permanent mounts, and identify important zoological specimens and histological slides with their diagnostic features.					LO1, LO6, LO8, LO11	
CO2	Apply microscopy and molecular biology techniques to determine cell characteristics and analyze DNA, chromosomes, and proteins using standard laboratory methods.					LO1, LO5, LO6, LO10	
CO3	Conduct biochemical experiments to evaluate enzyme activity, estimate biomolecules, prepare buffers, perform chromatographic separation, and analyze protein–ligand interactions.					LO3, LO4, LO5, LO8	
CO4	Operate common biological laboratory instruments and interpret experimental results using appropriate scientific principles and analytical skills.					LO1, LO5, LO8, LO10	
CO5	Demonstrate proficiency in laboratory practices by maintaining accurate records, following biosafety guidelines, and communicating scientific observations effectively.					LO2, LO7, LO13, LO15	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Content							
INVERTEBRATES							
<u>Dissection</u>							
1. Earthworm : Digestive and Nervous system 2. Cockroach : Digestive, Nervous & Reproductive system							

Mounting

1. Earthworm : Body setae & pineal setae
2. Insects : Mouth parts
3. Prawn : Appendages

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

1. Plasmodium
2. Paramecium
3. Hydra with bud
4. Sporocyst – Liver fluke
5. Earthworm - CS

Spotters

1. Jelly fish
2. Nereis
3. Sepia
4. Scorpion
5. Sea Urchin

CHORDATES

Dissection

1. Nervous system of Rat/Mouse
2. Urinogenital system of Rat/Mouse
3. Respiratory and circulatory system of Rat/Mouse

Study of the following slides with their structure and functions

1. CS of liver, kidney, heart and brain

Spotters

1. Amphioxus
2. Indian oil Sardine
3. Hyla (The Tree Frog)
4. Bronze back tree snake
5. Bat

Study of the different types of scales in fishes

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

CELL AND MOLECULAR BIOLOGY

Experiments

1. Determination of cell size using micrometer
2. Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus
3. Isolation of genomic DNA from eukaryotic tissue
4. Agarose gel electrophoresis of DNA
5. SDS-Polyacrylamide gel electrophoresis

Spotters

1. UV-Visible Spectrophotometer
2. Barr Body
3. PCR
4. Laminar air flow chamber
5. Mitosis and meiosis

BIOCHEMISTRY

Experiments

1. Preparation of buffers and pKa value determination
2. Estimation of Blood sugar Post prandial for students and teachers (Glucometer and Anthrone method)
3. Effect of temperature and pH on amylase activity of your saliva.
4. Column Chromatographic separation of secondary metabolites/protein/lipids/fatty acids
5. Molecular Docking protein- ligand interaction (using free online software)

Spotters

1. Gout
2. Gaucher disease
3. Lesch-Nyhan syndrome
4. Menkes syndrome
5. pH meter

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
4. CPCSEA Guidelines

Reference books:

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

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - I

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

ECONOMIC ENTOMOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1E01	Economic Entomology	Elective Course-1	3	3	25	75	100
Course Objectives: The main objectives of this course are: 1. Students should acquire a fairly good understanding about the life of insects and their classification.							
Pre-requisite: Students have basic knowledge in various insect pests and its management.							
Course Outcome:							
CO1	Understand taxonomy, classification and life of insects in the animal kingdom.					LO1, LO3, LO8	
CO2	Know the life cycle, rearing and management of diseases of beneficial insects.					LO1, LO5, LO6, LO8	
CO3	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control					LO1, LO3, LO5, LO8	
CO4	Recognize insects which act as vectors causing diseases in animals and human.					LO1, LO3, LO5, LO8	
CO5	Overall understanding on the importance of insects in human life.					LO1, LO5, LO8, LO13	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Units		Content					
I		Overview of insects and insect taxonomy & Morphology: Insects and their biological success Life cycle & development; Basic concepts in Insect Taxonomy and classification.					
II		Beneficial insects: Silkworms - types, life history, disease management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive - Lac insects-life history, lac cultivation; Pollinators, predators, parasitoids, scavengers, weed killers, soil-builders.					
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.					
IV		Pest management/Control strategies: Methods and principles of pest control - Natural control, Artificial control, Merits and demerits in pest management - Development and uses of pest resistant plant varieties - Integrated pest management - Concepts and practice.					
V		Vector biology: Vectors of veterinary and public health importance - Mosquitoes as potential vectors of human diseases-control measures.					

Text books:

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

Reference books:

1. Chapman, R.F., S.J. Simpson and 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. Oxford & IBH Publishing Co., pp-912.
7. Wigglesworth, V.B. 1972. The Principles of Insect Physiology, ELBS & Chapman and Hall, London, pp-827.

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - I

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

FORENSIC SCIENCE

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1E02	Forensic science	Elective Course-2	3	3	25	75	100
Course Objectives: The main objectives of this course are: 1. To understand the basics of forensic investigations 2. To know about the postmortem examination procedures and identification of dead 3. To gain knowledge about the forensic serology 4. To discriminate between natural and synthetic fibres. 5. To describe about different types of methods used for the analysis of biological samples.							
Pre-requisite: Basic knowledge in the biology and chemistry							
Course Outcome:							
CO1	Students know about the basics of forensic science and deduction methods					LO1, LO3, LO8, LO11	
CO2	Students gain knowledge about different divisions of Forensic science department and the collection of evidences.					LO1, LO2, LO6, LO10	
CO3	To know about the postmortem procedures for the identification of the crime					LO1, LO5, LO8	
CO4	Students will able to discriminate between the blood and stains					LO4, LO5, LO8, LO10	
CO5	Students will able to know the mechanism of advanced equipment in the forensic science labs and their help in the prevention of wildlife trade					LO1, LO6, LO8, LO15	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Units		Content					
I		Introduction to Forensic Science- Forensic Science and its scope- Crime investigation methods – Locard's Principles of exchange- Importance of physical evidences over human witness, motivation of crime, Methods of enquiry-forensic analysis, interviews and interrogations, and surveillance					
II		Units of Forensic Science- Biology division- Serology division- Chemistry division- Toxicology division- Physics division- Prohibition and excise division- Narcotics division- Document examination unit- Ballistics/Firearms division- Explosive division- Photography unit- Fingerprint Unit- Polygraph unit					
III		Medical evidence- Identification of living and dead- Rigor mortis- Stages of decomposition- Identification of gender of the decomposed- Forensic entomology- Blood smear, Hair and other evidences- Finger Print Evidence- Voice pattern analysis					
IV		Forensic serology: Identification of blood- Function and composition of blood (RBCs, WBCs, plasma, platelets). Blood grouping- Interpretation of bloodstain patterns to reconstruct events. Identification of other biological materials,					

V	Methods in Forensic Biology- Immunoassay techniques (ELISA, RIA) for drugs and specific proteins. DNA fingerprinting, PCR. Mitochondrial DNA (mtDNA) analysis. Role of Forensic science in the prevention of Illegal animal trade- Illegal animal trade materials- Differentiate animal hair from other materials
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Text books:

1. Gunn. A (2010) Essentials of Forensic Biology, 424 Pp. Willey- Blackwell, II edition, USA
2. James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press, USA
3. Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi.
4. Saferstein, R and Roy, T. (2025) Introduction to forensic science, 580 Pp. Pearson Education, India

Reference books:

1. Nabar, B.S. (2007). Forensic Science in Crime Investigation, 3rd Edition, Hyderabad: Asia Law House.
2. Sharma B.R. (2007). Forensic Science in Criminal Investigation and Trials Universal Law Pub. Co. Pvt. Ltd.
3. Saferstein Richard, (1982). Forensic Science Handbook, Prentice, Hall Inc., (also refer Criminalistics – by the same author)
4. Nickolas L.C, (1956). The Scientific Investigation of Crime. Butterworth and Co. Publishers, Ltd.
5. Bridges, B.B., August Velma & Moner, M. (2000), Criminal Investigation, Practical Fingerprinting Thumb impression, Handwriting expert testimony, Opinion Evidence, The University Book Agency, Allahabad.

Mapping with Programme Outcomes*

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

M.Sc. Zoology Course – SEMESTER - I

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

BIOSAFETY AND BIOETHICS

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1S01	Biosafety and Bioethics	Skill Enhancement Course [SEC] – I	2	2	25	75	100
Course Objectives: The main objectives of this course are: 1. Recall the fundamental concepts of biosafety, bioethics, intellectual property rights, patents, and regulatory frameworks in biotechnology. 2. Explain the principles of biosafety, ethical issues, intellectual property rights, patent systems, and biotechnology regulations governing research and applications. 3. Apply biosafety guidelines, ethical principles, patent procedures, and regulatory policies in biotechnology research, development, and commercialization. 4. Analyze biosafety risks, ethical dilemmas, intellectual property issues, patent regulations, and national regulatory frameworks related to biotechnology and genetically modified organisms. 5. Evaluate the ethical, legal, social, and regulatory implications of biotechnological innovations and propose responsible strategies for safe research, intellectual property management, and sustainable biotechnology practices.							
Pre-requisite: Basic knowledge of Biotechnology, Molecular Biology, Genetics, Microbiology, and Recombinant DNA Technology.							
Course Outcome:							
CO1	Describe the principles of biosafety, bioethics, intellectual property rights, patents, and regulatory frameworks in biotechnology.					LO1	
CO2	Students will be able to explain biosafety guidelines, ethical issues, patent laws, and biotechnology regulations applicable to research and development.					LO4	
CO3	Students will be able to apply biosafety practices, ethical principles, patent procedures, and regulatory guidelines in biotechnology laboratories and research activities.					LO4, LO5	
CO4	Students will be able to analyze biosafety risks, ethical concerns, intellectual property issues, and regulatory requirements associated with biotechnology and genetically modified organisms.					LO6, LO8	
CO5	Students will be able to evaluate the legal, ethical, social, and environmental implications of biotechnological innovations and recommend appropriate biosafety measures, intellectual property protection, and regulatory compliance.					LO11, LO15	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Units		Content					
I	Biosafety: Introduction, Historical prospective, objectives, risk assessment in biotechnological research and their regulation, physical and biological						

	contaminants, field trial and planned introduction of GMOs, Biosafety guidelines in India, Biosafety levels for animal and microbial researches.
II	Bioethics: Introduction, Ethical issues related to biotechnology, legal and socioeconomic impacts of biotechnology, health and safety issues, possible benefits of successful cloning, Ethical concerns of gene cloning, hazards of environmental engineering, Ethical issues in Human Cloning and stem cell research.
III	Intellectual Property Right: Introduction, intellectual property: trade secret, patent, copyright, patent law, Choice and management of IPRs, advantage and limitations of IPRs.
IV	Patents and patent processing: Introduction, Essential requirements, International scenario of patents, patenting of biological materials, significance of patents in India, Patent application, Procedures and granting, protection of biotechnological inventions, Patent Act (1970), Patent (Amendments) Act (2002).
V	Regulatory framework in Biotechnology: Regulation of RDT research, Regulatory framework in India governing GMOs, Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic ANIMALS (1998). Roles of Institutional Biosafety Committee, Ethical implications of biotechnological products and techniques. Social and ethical implications of biological weapons

Text books:

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers.
3. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
4. The law and strategy of Biotechnological patents by Sibley. Butterworth publications.
5. Intellectual property rights – Ganguli – Tat McGraw-Hill
6. Biotechnology-B. D. Singh- Kalyani Publications
7. Biosafety and Bioethics – S. Ignacimuthu. Tata McGraw-Hill Education. (Reprint/Latest edition available, 2021).
8. Intellectual Property Rights – Neeraj Pandey. PHI Learning Pvt. Ltd., 2022.

Reference books:

1. Bioethics: Principles, Issues and Cases – Lewis Vaughn. Oxford University Press, 2023.
2. Biotechnology: Applying the Genetic Revolution – David P. Clark and Nanette J. Pazdernik. Academic Press (Elsevier), 2021. (*Chapters on biosafety, ethics, and regulations.*)
3. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology – Padma Nambisan. Academic Press (Elsevier), 2021.

Web Sources:

1. Department of Biotechnology (DBT), Government of India – Biosafety Guidelines
DBT Biosafety Guidelines
2. Department of Biotechnology (DBT) – Biosafety Regulation and Indian Biosafety Framework
DBT Biosafety Regulation
3. Indian Council of Medical Research (ICMR) – Guidelines and Ethical Frameworks
ICMR Guidelines

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - II

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

GENETICS

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C05	Genetics	Core Course-5	4	5	25	75	100
Course Objectives: The main objectives of this course are: 1. Understanding DNA as genetic material, fine structure of DNA & RNA molecules, as well their physico-chemical properties. 2. To analyse different patterns of inheritance in single-gene diseases using a pedigree chart. 3. To learn the structure and function of chromosomes and the role of chromosomal aberrations in various human genetic disorders. 4. To acquire knowledge on gene transfer mechanisms in microbes. 5. To provide information about rDNA technology and its application in human welfare.							
Pre-requisite: Basic knowledge on molecular biology and genetics.							
Course Outcome:							
CO1	Describe DNA structure, properties, and the central dogma (DNA to RNA to protein).					L01, L03, L04	
CO2	Understand various sequential processes in protein synthesis, transcription, translation and regulation of gene expression					L01, L03, L05, L09	
CO3	Explicate the structures and functions of chromosomes and identify the diseases caused by various chromosomal abnormalities through pedigree analysis.					L01, L03, L04, L05, L06, L09	
CO4	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.					L01, L03, L04, L06	
CO5	Students will understand and apply the principles and applications of rDNA technology in human welfare and have opportunities in R&D Laboratories, pharmaceutical Companies and Clinical Laboratories.					L01, L03, L04, L05, L08, L09	
LO1: Disciplinary Knowledge - LO2: Communication Skills - LO3: Critical thinking - LO4: Problem Solving - LO5: Analytical Reasoning - LO6: Research- related Skills - LO7: Cooperation/ Team Work - LO8: Scientific Reasoning - LO9: Reflective Thinking - LO10: Digital Literacy - LO11: Self-directed Learning - LO12: Multicultural Competence - LO13: Moral and Ethical awareness/ reasoning - LO14: Leadership qualities - LO15: Lifelong Learning.							
Units		Content					
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, T _m and cot values, hybridization.					
II		Genetic code - Methods of deciphering the genetic code and general features of the code word dictionary. Chromosomal genetics: Molecular structure of chromosomes - mini, artificial, double miniature chromosomes. Principles and applications of microdissection of chromosomes. Chromosomal aberration: Variation in chromosome number and structure - Chromosome nomenclature - Chromosomal syndromes – Pattern of inheritance in single gene diseases using Pedigree analysis.					
III		Microbial Genetics: Genetics of Virus – Viral chromosome, Lytic cycle, Lysogenic cycle - Bacterial genetics -Bacterial genome – LAC & TRP Operon Model - Gene					

	transfer mechanisms in bacteria and virus - conjugation, transduction, sex-duction, and transformation. 1983 Nobel Prize for the discovery of Mobile Genetic Element (Transposons).
IV	Recombinant DNA technology: Recombinant DNA technology - Overview - Tools for Recombinant DNA Technology. Comparison of DNA replication and cloning, Principle and applications of different types of cloning methods – Vectors - types - Cloning and expression vectors, Significance of T7 RNA polymerase - Techniques used in recombinant DNA technology - generation of DNA fragments - Restriction endonucleases, DNA modifying enzymes, Ligases.
V	Introduction of rDNA into host cell - calcium chloride mediated gene transfer - <i>Agrobacterium</i> mediated gene 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. Types of genome editing and RNAi technology - 2020 Nobel Prize in Chemistry for discovery of Genome editing-CRISPR/CAS9 Model.

Text books:

1. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2017. Lewin's Genes XII. 12th Revised Edition, Jones and Bartlett Publishers.
2. Strickberger M.W. 2015. Genetics. 3rd Edition, Prentice India.
3. Gardner, E. J., M. J. Simmons and D.P. Snustad. 2006. Principles of Genetics. 8th Edition, John Wiley & Sons. INC. New York, pp-740.
4. Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th Edition, McGraw Hill Publsiher, pp-880.
5. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd Edition). Pearson/Benjamin Cummings, San Francisco, pp-850.
6. Tamarin, R.H. 2017. Principles of Genetics. 7th Edition, McGraw Hill Education.

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, (5th 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. 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.

Web Resources:

1. <https://learn.genetics.utah.edu/>
2. <https://le.ac.uk/vgec>
3. <https://www.yourgenome.org/>
4. <https://www.genome.gov/event-calendar/Current-Topics-in-Genome-Analysis>
5. <https://www.nature.com/ng/>

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - II

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

ANIMAL PHYSIOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C06	Animal Physiology	Core Course-6	4	4	25	75	100
Course Objectives: The main objectives of this course are: 1. Recall the basic concepts of all animal physiological systems. 2. Explain the functions of major body systems and their regulation. 3. Apply physiological principles to understand body functions. 4. Analyze how different organ systems work together to maintain homeostasis. 5. Evaluate and integrate physiological concepts to solve biological problems.							
Pre-requisite: Basic understanding of Human body organs and organ systems, Fundamental concepts of physiology and homeostasis.							
Course Outcome:							
CO1	Students will be able to recall the basic concepts, terminology, structures, and functions of major physiological systems in animals					LO1	
CO2	Students will be able to explain the physiological mechanisms involved in animals.					LO4	
CO3	Students will be able to apply the principles of animal physiology to interpret normal body functions.					LO5	
CO4	Students will be able to analyze the interrelationship between different organ systems.					LO11	
CO5	Students will be able to evaluate physiological responses to internal and external changes and integrate knowledge of multiple body systems.					LO6, LO7, LO11, LO15	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Units		Content					
I		Homeostasis in animals- Thermoregulation: Temperature compensation in poikilotherms, and homeotherms, Physical, chemical and neural regulation. Osmotic and ionic regulation in fishes. Digestive system: Digestion, absorption, energy balance, BMR. Role of gastrointestinal hormones in digestion.					
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. Circulatory system: Comparative anatomy of heart structure, myogenic heart, cardiac cycle, heart as a pump, blood pressure, blood volume regulation, neural regulation, ECG - its principle and significance					
III		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.					

	Muscle system: Types of Muscles- Striated and non-striated, voluntary and involuntary, Ultra structure of muscle fibre, Chemistry and Molecular mechanism of muscular contraction. Neuromuscular coordination
IV	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.
V	Reproductive System: Structure and functions of Male and Female Reproductive organs. Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

Text books:

1. Richard W. Hill, Gordon A. Wyse & Margaret Anderson Animal Physiology 4th Edition Sinauer Associates / Oxford University Press **Year:** 2016
2. Christopher D. Moyes & Patricia M. Schulte Principles of Animal Physiology 3rd Edition Pearson 2021
3. Arthur C. Guyton & John E. Hall Textbook of Medical Physiology 14th Edition [Elsevier](#) 2021
4. K. V. Sastry Animal Physiology and Biochemistry Rastogi Publication **Year:** Commonly used university edition
5. K. Sembulingam & Prema Sembulingam Essentials of Medical Physiology 8th Edition Jaypee Brothers Medical Publishers, **Year:** 2023

Reference books:

1. Jain, A.K (2021). Textbook of Physiology. (Volume I), APC Book Publisher.
2. Hoar, W.S. (2004). General and Comparative Physiology. III Edition, Prentice Hall of India Pvt. Ltd., New Delhi.
3. Hall, J.E. and Hall, M.E. (2020). Textbook of Medical Physiology. III South Asia Edition, Elsevier Health Science.
4. Kay, D.I. (2020). Introduction to Animal Physiology. United States: CRC Press.

Web Sources:

1. https://swayam.gov.in/nd1_noc20_bt42/preview
2. <https://www.classcentral.com/course/swayam-animal-physiology-12894>
3. https://swayam.gov.in/nd1_noc20_hs33/preview

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - II

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

MICRBIOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C07	Microbiology	Core Course-7	4	4	25	75	100
Course Objectives: The main objectives of this course are: 1. Recall the fundamental concepts of microbiology, including microbial diversity, culture techniques, microbial genetics, host–pathogen interactions, and industrial applications. 2. Explain the classification, characteristics, growth, genetics, pathogenicity, and industrial significance of microorganisms. 3. Apply microbiological techniques for isolation, staining, identification, sterilization, and interpretation of microbial processes. 4. Analyze microbial genetic mechanisms, host–pathogen interactions, disease transmission, and the role of microorganisms in health and industry. 5. Evaluate the effectiveness of microbial control methods, disease prevention strategies, and industrial microbiological applications.							
Pre-requisite: Basic understanding of elementary understanding of microorganisms and human health.							
Course Outcome:							
CO1	Explain the history, scope, and classification of microbiology, including Five-kingdom system and distinguish between prokaryotic and eukaryotic microorganisms, as well as cellular and acellular microbes.					LO1	
CO2	Students will be able to Demonstrate techniques for isolation, cultivation, identification, staining, sterilization, and microbial growth analysis of microorganisms.					LO4	
CO3	Students will be able to Describe microbial genetics including gene transfer mechanisms, mutations, mutagenesis, DNA repair, and applications of microbial genomics and metagenomics.					LO4, LO5	
CO4	Students will be able to Analyze host–pathogen interactions and explain the causes, transmission, symptoms, and prevention of major microbial diseases such as Tuberculosis, Malaria, Dengue, and COVID-19.					LO6, LO8	
CO5	Students will be able to evaluate industrial applications of microbiology including fermentation, production of antibiotics, vitamins, vaccines, and environmental applications such as bioremediation					LO11, LO15	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Units		Content					
I	History and Scope of Microbiology: Whittaker's Five Kingdom concept- Difference between prokaryotic and eukaryotic microorganisms. A cellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.						

II	Culture and Characterization: Isolation and identification of bacteria. Techniques of pure culture methods. Phases of growth. Microbial control – Physical and chemical agents. Methods of sterilization and disinfection. Staining: Simple and differential staining; Gram staining; acid fast staining; endospore staining; capsule staining and flagella staining.									
III	Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction. Mutations and mutagenesis: Definition and types of Mutations Physical and chemical mutagens; Uses of mutations, DNA repair mechanisms. Microbial Genomics: Genome project of <i>Escherichia coli</i> and <i>Yeast</i> . Metagenomics concepts and Significance									
IV	Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection. Bacterial diseases - Tuberculosis, Plague, Anthrax. Viral disease - Rabies, Dengue, AIDS, Corona, swine flu, Chikungunya. Protozoan diseases - Amoebiasis and Malaria.									
V	History and developments in industrial microbiology: Microbial fermentation Microbial production of Antibiotics: penicillin, streptomycin, Vitamin B12 Vaccines – genetic recombinant vaccines. Bioremediation- Principles and applications.									
Text books: 1. Atlas RM (2015) Principles of Microbiology. 2nd edition, McGraw-Hill. 2. Dubey RC and Maheswari DK (2018) Textbook of Microbiology. S. Chand and Co. 3. Prescott LM (2016) Microbiology. 6th Edition. McGraw-Hill. 4. Stanier R, Ingraham J, Wheelis M and Painter P (2014) General Microbiology. 5th Edition, Macmillan Press. 5. Kathleen Park Talaro and Barry Chess Foundations in Microbiology10th Edition. 2018 Mc Graw Hill Education Publishers, USA. 6. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Microbiology: An Introduction, 12 th Edition (2017) Pearson publishers, USA.										
Reference books: 1. J. Tortora, Christine L. Case, Warner B. Bair, Derek Weber, Berdell R. Funke Microbiology: An Introduction — Gerard 14th Edition (2024/2025) 2. Patricia M. Tille Bailey & Scott's Diagnostic Microbiology — 16th Edition (2024)										
Web Sources: 1. NCBI (National Center for Biotechnology Information) — Genomics, metagenomics, microbial genetics 2. CDC — Disease information (TB, Dengue, Rabies, etc.) 3. WHO — Global infectious disease updates 4. Microbiology Society — Educational resources 5. PubMed — Research papers and recent studies										
Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	-	M	-	L	-	M	L
CO2	S	S	S	M	M	-	M	M	L	L
CO3	S	S	S	M	M	-	M	M	M	L
CO4	S	S	S	M	M	-	M	S	M	M
CO5	S	S	M	L	M	L	S	M	S	M

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

M.Sc. Zoology Course – SEMESTER - II

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

EVOLUTION

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C08	Evolution	Core Course-8	4	4	25	75	100
Course Objectives: The main objectives of this course are: 1. To understand the historical development of evolutionary thought, mechanisms of speciation, and major species concepts explaining biological diversity. 2. To analyze the evidences and genetic forces driving evolution and the role of reproductive isolation in species formation. 3. To explain the mechanisms and models of natural selection and their influence on population structure and geographic variation. 4. To interpret major evolutionary patterns, phylogenetic relationships, and molecular approaches used to trace evolutionary history. 5. To evaluate evolutionary innovations, human evolution, and the role of molecular tools and extinction processes in modern evolutionary biology.							
Pre-requisite: Basic understanding of general zoology, genetics, cell biology, and ecological principles.							
Course Outcome:							
CO1	Students will be able to explain the development of evolutionary theories, speciation processes, and species concepts underlying biological diversity.					LO1, LO2, LO8	
CO2	Students will be able to analyze evolutionary evidence, genetic forces, and reproductive isolation mechanisms contributing to evolution.					LO3, LO5, LO8	
CO3	Students will be able to interpret models of natural selection and their effects on population structure and geographic variation.					LO4, LO5, LO8, LO10	
CO4	Students will be able to assess evolutionary patterns, phylogenetic relationships, and molecular methods used in evolutionary analysis.					LO5, LO6, LO8, LO10	
CO5	Students will be able to evaluate evolutionary innovations, human evolution, and the impact of molecular tools and extinction events in modern evolutionary biology.					LO1, LO3, LO6, LO15	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I		Origin of evolutionary ideas; origin of life; biological evolution and creationism. Lamarckism and Neo-Lamarckism. Charles Darwin and the voyage of the Beagle; Neo-Darwinism and the Modern Synthesis. Macroevolution and speciation: allopatric, peripatric, parapatric, and sympatric speciation. Species concepts: morphological, ecological, and biological.					
II		Evidence for evolution from comparative anatomy, morphology, vestigial organs, and fossil records. Causes of evolution: mutation, gene flow, genetic drift, non-random mating, and natural selection. Hardy–Weinberg equilibrium. Reproductive isolation: pre-zygotic and post-zygotic mechanisms.					
III		Natural selection: components and models—stabilizing, directional, and disruptive selection. Group selection, kin selection, and sociobiology. Ecogeographic rules.					

	subspecies concepts, clines, and hybrid zones.
IV	Patterns of evolution: anagenesis and cladogenesis; phyletic gradualism and punctuated equilibrium. Monophyletic, paraphyletic, and polyphyletic groups. Convergent and divergent evolution; adaptive radiation. Phenetics (brief) and cladistics. Molecular clock and phylogenetic reconstruction.
V	Evolutionary innovations and origin of higher taxa. Human evolution. Molecular biological and immunological evidence for evolution. Neutral theory of molecular evolution / Evo-Devo (one). DNA barcoding in evolutionary studies. Extinction: causes and patterns.

Text books:

1. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution, Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756.
2. Jobling, M., E. Hollox, M. Hurles, T. Kivisild and C. T. Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650.
3. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590.
4. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.

Reference books:

1. Hall B. K. and B. Hallgrimsson. 2014. Strickberger's Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642.
2. 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.

Web Sources:

1. <https://www.flipkart.com/books/evolution~contributor/pr?sid=bks>
2. <http://www.evolution-textbook.org/>
3. <https://onlinelibrary.wiley.com/journal/15585646>
4. <http://darwin-online.org.uk/>

Mapping with Programme Outcomes*

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

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

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

Subject Code	Name of the Subject	Category	Credits	Hours/Week	Marks		
					CIA	External	Total
26UPZOO1L02	Lab Course – II	Lab Course	3	6	40	60	100
Course Objectives: The main objectives of this course are: 1. To gain first-hand experience in recording human physiological parameters like blood pressure and pulse rate using Digital BP Monitor and Smart Watch. 2. To construct and interpret pedigree charts and human karyotypes. 3. To test population genetics models like the Hardy-Weinberg Equilibrium using empirical class data. 4. To study homologous and analogous structures from physical specimens or fossil models to infer common ancestry. 5. To teach students core technical skills like aseptic handling, microscopy, and culturing.							
Pre-requisite: Students should possess a fundamental understanding of genetics, physiology, evolution, microbiology, basic laboratory techniques, scientific methods, and laboratory safety practices to perform biological experiments effectively and responsibly.							
Course Outcome:							
CO1	Detect chromosomal aneuploid anomalies like Trisomy 21 (Down syndrome), Trisomy 18, or sex chromosome variations (Turner and Klinefelter syndromes).					LO3, LO5, LO6, LO8, LO11	
CO2	Capacity to connect laboratory findings and numerical results with underlying human health conditions and pathologies.					LO2, LO3, LO4, LO5, LO8	
CO3	Capability to trace genetic disorders, inheritance patterns in single gene diseases.					LO3, LO4, LO5, LO8	
CO4	Ability to calculate genotypic, phenotypic, and allelic frequencies within a sample population.					LO3, LO4, LO5, LO8, LO9	
CO5	Estimate microbial loads in samples like water, air, or food using serial dilutions.					LO2, LO3, LO6, LO11	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Content							
GENETICS							
<u>Experiments</u>							
1. Observation of Mendelian traits Among Student Volunteers 2. Identification of Human Syndromes – Voucher Specimen 3. Study on polygenic inheritance – Voucher Specimen 4. Pedigree Analysis of Single Gene Diseases (Autosomal Dominant, Autosomal Recessive, X-lined Dominant, X-linked Recessive, Y-linked, and Mitochondrial) 5. Genetic Counseling methods (Among Student Volunteers)							

Spotters

1. Sick cell anemia
2. Cri-Du-Chat Syndrome
3. Werewolf Syndrome
4. Hypertrichosis Pinnae
5. Neurofibromatosis Type 1

ANIMAL PHYSIOLOGY

Experiments

1. Resting, Normal walk and fast running effects on heart beat (using smart phone/smart watch)
2. Determination of Blood pressure for students and teachers using Digital Blood Pressure Monitor
3. Effect of pH on opercular movement in fish
4. Effect of temperature on opercular movement in fish
5. Pregnancy testing for hcG in urine samples

Spotters

1. ECG (electrocardiogram) machine
2. Kymograph
3. Cross Section of mammalian testis
4. Cross Section of mammalian ovary
5. Cross Section of Liver Cells

EVOLUTION

Experiments

1. Identification of Vestigial organs in human by Student Volunteers
2. Study of fossils and living fossils from models/pictures
3. Problems related to changes in allelic frequencies using Hardy-Weinberg Law
4. Construction of phylogenetic trees with the help of open source bioinformatics tools and its interpretation
5. Study of Homology and Analogy from suitable specimens

Spotters

1. Coccyx
2. Peripatus
3. Horseshoe Crab
4. Coelacanth
5. Duck-billed platypus

MICROBIOLOGY

Experiments

1. Methods of sterilization and Media Preparation
2. Pure Culture methods for Bacterium
3. Isolation, culture and identification of human / air / soil borne bacteria
4. Isolation, culture and identification of fungi from soil / rotten vegetables
5. Identification of Gram +ve and Gram -ve bacteria – Differential staining technique

Spotters

1. Autoclave
2. Laminar Air Flow
3. BOD Incubator
4. Hot air oven
5. Deep Freezer

Reference books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjee, P. Chattopadhyay. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.
3. Borah D (2012) Biotechnology Lab Practices, Global Academic Publisher, India.
4. Singh, S. R., & Sagolsem, D. (2021). Karyotyping and chromosome banding. In Principles of genetics and cytogenetics practical manual (pp. 30–35). Central Agricultural University.
5. Verma, P. S., & Tyagi, B. S. (2018). Practical zoology: Animal physiology and biochemistry. S. Chand & Company.
6. Cappuccino, J. G., & Welsh, C. T. (2020). Microbiology: A laboratory manual (12th ed.). Pearson.
7. Ridley, M. (2021). Simulating natural selection and genetic drift. In J. A. Endler (Ed.), Practical guides in evolutionary ecology (pp. 112–125). Oxford University Press.

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - II

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

ANIMAL BIOTECHNOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1E03	Animal Biotechnology	Elective Course-3	3	3	25	75	100
Course Objectives: The main objectives of this course are: 1. To introduce a detailed achievements of Biotechnology, Genetic Engineering and r-DNA technology principles. 2. To gain knowledge on cloning vectors and their uses in gene cloning technologies. 3. Principles of Cloning strategies and screening analysis of Re-combinations. 4. To apply principles of Biotechnology concepts in production of Transgenic animals, Artificial insemination, Invitro fertilization, Embryo transfer technology. 5. Application of Biotechnological principles in Medicine and Gene transfer techniques.							
Pre-requisite: Basic understanding of Human body organs and organ systems, Fundamental concepts of physiology and homeostasis.							
Course Outcome:							
CO1	Students will be able to explain the aim, scope, achievements, and applications of biotechnology in agriculture, medicine, industry, and the environment.					LO1	
CO2	Students will be able to describe the basic tools of gene manipulation, including cloning vectors, restriction enzymes, transformation techniques, and the construction of genomic and cDNA libraries.					LO4	
CO3	Students will be able to apply different gene transfer techniques in animals, such as microinjection, lipofection, embryonic stem cell-mediated, and viral-mediated gene transfer methods.					LO5	
CO4	Students will be able to analyze the generation and characterization of genetically modified animals, including transgenic, chimeric, knockout animals, gene silencing, and CRISPR-Cas9 technology					LO11	
CO5	Students will be able to evaluate the applications of transgenic animals in pharmaceutical production, organ transplantation, and gene therapy, considering their scientific and societal significance.					LO6, LO7, LO11, LO15	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Units		Content					
I		Aim and scope; Achievements and applications in biotechnology					
II		Basic Tools for Gene Manipulation: Cloning vectors: Plasmids, Cosmids, Phagemids, Restriction enzymes; Transformation techniques: Calcium chloride method, electroporation and biolistic methods, construction of genomic and cDNA libraries.					
III		Gene transfer methods in Animals – Microinjection, lipofection, Embryonic Stem cell and viral mediated gene transfer techniques					
IV		Genetically Modified Animals: Generation of chimeric, transgenic and knockout mice and other animals and their characterization. Gene editing- Gene silencing- CRISPR-associated protein-9nuclease (Cas9) technology					

V	Applications of transgenic animals; Production of pharmaceuticals, production of donor organs. Gene therapy									
Text books:										
1. Brown, T. A. (2021). Gene Cloning and DNA Analysis: An Introduction (8th ed.). Wiley-Blackwell. 2. Primrose, S. B., & Twyman, R. M. (2020). Principles of Gene Manipulation and Genomics (8th ed.). Wiley-Blackwell. 3. Glick, B. R., Pasternak, J. J., & Patten, C. L. (2021). Molecular Biotechnology: Principles and Applications of Recombinant DNA (6th ed.). ASM Press. 4. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2018). Molecular Biology of the Gene (7th ed.). Pearson.										
Reference books:										
1. Lodish, H., Berk, A., Kaiser, C. A., et al. (2021). <i>Molecular Cell Biology</i> (9th ed.). W.H. Freeman. 2. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). <i>Molecular Biology of the Cell</i> (7th ed.). Garland Science. 3. Freshney, R. I. (2021). <i>Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications</i> (8th ed.). Wiley-Blackwell. 4. Clark, D. P., & Pazdernik, N. J. (2021). <i>Biotechnology</i> (3rd ed.). Academic Press. 5. Green, M. R., & Sambrook, J. (2019). <i>Molecular Cloning: A Laboratory Manual</i> (4th ed.). Cold Spring Harbor Laboratory Press.										
Web Sources:										
1. Addgene (Plasmid Repository and Educational Resources) – https://www.addgene.org/ 2. Nature Biotechnology – https://www.nature.com/nbt/ 3. Cell Press – https://www.cell.com/ 4. American Society for Microbiology (ASM) – https://asm.org/ 5. CRISPR Medicine News – https://crisprmedicineneeds.com/										
Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	-	M	-	L	-	M	L
CO2	S	S	S	M	M	-	M	M	L	L
CO3	S	S	S	M	M	-	M	M	M	L
CO4	S	S	S	M	M	-	M	S	M	M
CO5	S	S	M	L	M	L	S	M	S	M

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

M.Sc. Zoology Course – SEMESTER - II

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

VERMITECHNOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1E04	Vermitechnology	Elective Course-4	3	3	25	75	100
Course Objectives: The main objectives of this course are: 1. To focus on organic waste recycling and green entrepreneurship, while outcomes deliver practical organic farming and self-employment skills. 2. To employ the principles and techniques for Vermicomposting. 3. To encourage students about culture and management of Earthworms. 4. To know the difficulties in Vermiculture and be able to propose plans against it. 5. To aware the students about diseases and pests of earthworms and their management.							
Pre-requisite: Basic understanding in earthworm taxonomy, anatomy, life cycles, and ecological role.							
Course Outcome:							
CO1	Students will understand the various practices involved in vermiculture.					L01, L03, L04, L06	
CO2	Safely construct, maintain, and harvest small-scale or commercial vermicompost beds and vermiwash collection units.					L01, L03, L06, L011	
CO3	Apply vermicompost to improve soil structure, water retention, and crop yield naturally.					L01, L03, L06, L08	
CO4	Students will understand various applications of earthworms in organic solid waste management, soil fertility, and bioremediation.					L01, L03, L06, L07, L08, L011	
CO5	Create self-employment opportunities or work as technical operators and consultants in organic farming and waste management sectors.					L03, L04, L05, L06, L014, L015	
LO1: Disciplinary Knowledge - LO2: Communication Skills - LO3: Critical thinking - LO4: Problem Solving - LO5: Analytical Reasoning - LO6: Research- related Skills - LO7: Cooperation/ Team Work - LO8: Scientific Reasoning - LO9: Reflective Thinking - LO10: Digital Literacy - LO11: Self-directed Learning - LO12: Multicultural Competence - LO13: Moral and Ethical awareness/ reasoning - LO14: Leadership qualities - LO15: Lifelong Learning.							
Units		Content					
I		Earthworms - Taxonomic position, Ecological grouping – Epigeic, Anecic and Endogeic species; morphology and anatomical features - shape, size, colour, segmentation, setae & clitellum. Body wall, coelom- locomotion, digestive, circulatory, respiratory, excretory & nervous system. Reproductive system-Male & Female, copulation, cocoon formation & fertilization, development of earthworm.					
II		Vermitechnology- Definition, history, growth and development in India and other countries. Vermiculture - definition, identification of composting species for culture; Environmental parameters; culture methods – wormery - breeding techniques; indoor and outdoor cultures - monoculture and polyculture - merits and demerits. Vermibed preparation.					
III		Methods of Vermicomposting - Vermicomposting of wastes in field pits, ground heaps, tank method – Four tank, well ring method, HDPE Bag method, Roof shed method, Static pile windrows, Top fed windrows, Wedges & Bin method, Harvesting the compost and storage.					

IV	Applications of vermiculture - Vermiculture Bio-technology, vermicomposting, use of vermicastings in organic farming/horticulture, earthworms for management of municipal/selected industrial sludge; biomedical solid wastes; as feed/bait for capture/culture fisheries; forest regeneration. Vermiwash preparation and application.
V	Prospects of vermiculture as a self-employment venture. Potentials and constraints for vermiculture in India. Marketing the products of vermiculture - quality control, market research, marketing techniques – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing. Physicochemical Analysis: Test and monitor carbon-to-nitrogen (C:N ratios, pH and Electrical Conductivity (EC), and macronutrient profiles of the substrates and final product.

Text books:

1. Dash, M. C. 2012. Charles Darwin's plough: Tool for vermiculture. MacMillan Publishers India.
2. Edwards, C.A. Arancon, N.Q. and Sherman, R. 2011. Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management. CRC Press, Boca Raton, FL.
3. Ranganathan, L.S. 2006. Vermibiotechnology – From Soil Health to Human Health. Agrobios, India.
4. Ismail, S.A. 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
5. Ismail, S.A. 1997. Vermiculture: The Biology of Earthworms, Orient Longman, India.

Reference books:

1. Bhat, R. A., Jagran, K., Vig, A. P., & Sandhu, S. S. (Eds.). 2025. Vermiculture: Economic, environmental and agricultural sustainability. Springer Nature.
2. Karaca, A. 2011. Biology of Earthworms (Soil Biology Book-24). Springer Publishers.
3. Edwards, C.A. 2004. Earthworm Ecology. CRC Press, Boca Raton, FL.
4. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.

Web Resources:

1. https://www.kngac.ac.in/elearning-portal/ec/admin/contents/4_18K4ZEL02_2021012803204629.pdf
2. <https://www.sciencedirect.com/science/article/abs/pii/S2213343719305159>
3. https://www.vbu.ac.in/ftpwebapps/vbu/resources/vbu_web/dept/Biotechnology/Kumar%20Anand%20Research%20Paper-6.pdf
4. [http://globalsciencebooks.info/Online/GSBOOnline/images/2010/DSDP_4\(SI1\)/DSDP_4\(SI1\)22-47o.pdf](http://globalsciencebooks.info/Online/GSBOOnline/images/2010/DSDP_4(SI1)/DSDP_4(SI1)22-47o.pdf)
5. <https://www.studocu.com/in/document/sam-higginbottom-university-of-agriculture-technology-and-sciences/horticulture/vermiculture-lecture-notes-2-3/24833267?sid=f510bcca-7ce3-4ff9-8ba9-00840bc6f1711785129610>

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - II

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

INTELLECTUAL PROPERTY RIGHTS

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1S02	Intellectual Property Rights	Skill Enhancement Course [SEC] – II	2	2	25	75	100
Course Objectives: The main objectives of this course are: 1. Understand the fundamental concepts, principles, evolution, and significance of Intellectual Property Rights (IPR) and the national and international legal frameworks governing IPR. 2. Acquire knowledge of the procedures, legal provisions, and regulatory mechanisms for obtaining and protecting patents, copyrights, geographical indications, trademarks, trade secrets, and semiconductor integrated circuit layout designs. 3. Develop an understanding of intellectual property protection related to biological innovations, plant varieties, and breeders' rights, with emphasis on relevant national and international agreements. 4. Familiarize themselves with the application procedures, registration processes, validity, infringement issues, and enforcement mechanisms of different forms of intellectual property in India. 5. Appreciate the role of Intellectual Property Rights in promoting scientific research, innovation, technology transfer, entrepreneurship, biodiversity conservation, and sustainable development in the life sciences.							
Pre-requisite: Basic understanding of biological sciences, research methodology, and scientific ethics							
Course Outcome:							
CO1	Explain the fundamental concepts of Intellectual Property Rights, international IPR frameworks, and the roles of national and global IPR organizations.					LO1, LO8	
CO2	Demonstrate knowledge of patent and copyright laws, registration procedures, patentability criteria, and protection mechanisms.					LO3, LO6, LO8	
CO3	Analyze the legal provisions, registration procedures, and protection mechanisms of Geographical Indications and Semiconductor Integrated Circuit Layout Designs.					LO4, LO5, LO6, LO9	
CO4	Apply the principles and legal procedures for the registration, protection, and management of trademarks and trade secrets.					LO5, LO6, LO8,	
CO5	Evaluate the legal framework for plant variety protection and breeders' rights, and assess the current status and significance of IPR systems in India and globally.					LO1, LO3, LO5	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I	Introduction to IPRs, Basic concepts and need for Intellectual Property Rights- IPR in India and Abroad - Genesis and Development - The way from WTO to WIPO. Organogram of Patent Office in India and its functions. International Treaties and						

	Conventions on IPRs, TRIPS Agreement, PCT Agreement, Paris Conventions.
II	PATENTS: Acts and Laws, Requirements for Obtaining a Patent. Patent Filing Mechanism through online, Search for patentable product or process, Inventions Eligible for Patenting, Non-Patentable Matters, Patent Infringements, Validity of Patent Protection and fee structure. COPY RIGHTS: Acts and Laws, Registration of Copy Rights, significance of copy rights and its validity. How to process the application to obtain copy rights.
III	GEOGRAPHICAL INDICATIONS: Acts, Laws and Rules Pertaining to GI, Ownership of GI, Registered GI in India, Identification of Registered GI, Classes of GI, Non-Registerable GI, Protection of GI, Procedure for GI Registration, GI Ecosystem in India. SEMICONDUCTOR INTEGRATED CIRCUITS LAYOUT DESIGN: Duration of Registration, Infringements, SICLD Registry, Procedure for Registration, Forms and Fee, Acts and Laws.
IV	TRADEMARKS: its Acts and Law, Method of trademark registration, Applications and fee structure for trademark. TRADE SECRETS: Acts and Laws, Method of trade secret registration, Applications and fee structure for trade secret. Validity of trademark and trade secrets.
V	PROTECTION OF PLANT VARIETIES AND PLANT BREEDERS RIGHTS: Need for Plant Protection as an IP, International Agreements/Treaties for Plant Protection, Conditions for Registration of New Plant Variety, Types of Plant Varieties Registered Under the PVP&FR Act, 2001, Process of Registration, Fee Structure and Duration of Plant Variety Protection in India, Interesting Cases Related to Plant Variety Protection in India. Current status of IPR in India and Abroad.

Reference books:

1. Rupinder Tewari and Mamta Bhardwaj, 2021. Intellectual Property: A Primer for Academia, Publication Bureau, Panjab University, Chandigarh.
2. M. Geethavani and C. Ramakrishna, A Textbook of Intellectual Property Rights, Publication Bureau of Balaji College of Pharmacy, Ananthapur.
3. The Patent Information Centre, Tamil Nadu State Council for Science and Technology, IPR Information Booklet, Published by Ministry of Science and Technology, India.

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - II

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

HUMAN RIGHTS

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPPGC1H01	Human Rights	Compulsory Course	1	2	25	75	100
Course Objectives: The main objectives of this course are: 							
Pre-requisite: Students should possess a basic understanding of Indian society, constitutional values, citizenship, and contemporary social issues acquired through school education. The course is introductory in nature and does not require any prior knowledge of human rights, law, political science, or related disciplines.							
Course Outcome:							
CO1	Understand the basic facets of human rights					LO1, LO3, LO13	
CO2	Comprehend the Constitutional provisions of human rights in India					LO1, LO5, LO13	
CO3	Grasp the rights of the marginalized and other disadvantaged people in India					LO1, LO3, LO12, LO13	
CO4	Know the historical background of the various human rights movement in India.					LO1, LO5, LO9, LO15	
CO5	Understand the redressal mechanism of the human rights violations					LO1, LO4, LO10, LO13	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
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.					
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.					
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.					
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).									
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.									
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.										
Reference books: 1. Sudarshanam Gankidi, Human Rights in India: Prospective and Retrospective, Rawat Publications, Jaipur, 2019. 2. Satvinder Juss, Human Rights in India, Routledge, New Delhi, 2020. 3. Namita Gupta, Social Justice and Human Rights in India, Rawat Publications, Jaipur, 2021. 4. Mark Frezo, The Sociology of Human Rights, John Willy & Sons, U.K. 2014. 5. Chiranjivi J. Nirmal, Human Rights in India: Historical, Social and Political Perspectives, Oxford University Press, New York, 2000.										
Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	-	-	-	-	-	S	-	L	L
CO2	-	-	-	-	-	-	S	-	M	L
CO3	-	-	-	-	L	-	S	-	M	M
CO4	-	-	-	-	-	-	M	-	M	L
CO5	-	-	-	-	-	-	S	-	M	M

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

M.Sc. Zoology Course - SEMESTER-III

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

IMMUNOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C08	Evolution	Core Course-8	4	4	25	75	100
Course Objectives: The main objectives of this course are: 1. To understand the history of immunology 2. To know about innate and acquired immunity 3. To gain knowledge about the organs of immune system 4. To differentiate different types of antibodies 5. To evaluate diseases and control measures using vaccines							
Pre-requisite: Basic understanding of general zoology, genetics, cell biology, and ecological principles.							
Course Outcome:							
CO1	Students will be able to explain about the role of important scientists in the field of immunology					LO1, LO3, LO4	
CO2	Students will be able to differentiate innate and acquired immunity					LO1, LO2, LO4, LO5	
CO3	Students will be able to explain the role of different immune organs in host defence					LO5, LO6, LO7, LO8	
CO4	Students will be able to identify the different types of antibodies and their role					LO2, LO3, LO5, LO6	
CO5	Students will be able to evaluate disease control by the immune system					LO7, LO8, LO9, LO11	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I	Introduction to Immunology: History-Contributions of Edward Jenner and Louis Pasteur- Types of immunity: innate and acquired -External (first line / innate) defense system: components, distribution, salient functions; Internal (second line / acquired) immune system: cellular and humoral immune components- primary and secondary immune responses;						
II	Antigens: Definition, characteristic features and classification; Avidity and affinity, Epitope & Paratope - Antigen-antibody interactions. Adjuvants: definition, types and applications. Cytokines - Definition and salient functional features; Interleukins: definition, types (lymphokines and monokines), and functions. Interferons - types and functions						
III	Immune tissues / organs: types, anatomical location, and structure- Cells of immunity- and Major effector components of cellular immune system: Lymphocytes - types, morphology, Maturation of B and T- Lymphocytes; Antigen presenting cells: antigen processing and presentation, MHC molecules- MHC molecule types and their immunologic significance						
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; Monoclonal antibodies:						

	definition, production and applications. Complement system - Components, three major activation pathways, and immune functions including anaphylaxis and inflammation.
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). COVID-19 infection, quarantine, control measures Vaccines: types, preparations, efficacies and recent developments. Cancer Vaccines.

Text books:

1. Kuby, J. 1997. Immunology. W. H. Freeman & Co., New York, pp-670.
2. Male, D. J. Brostoff, D. B. Roth and I. Roitt. 2006. Immunology (7th edition), Mosby / Elsevier, Philadelphia, pp-472
3. Abbas, A. K and A. H. Lichtman. 2007. Cellular and Molecular Immunology (6th edition), W. B. Saunders, Philadelphia, pp-564
4. Coica, R. Sunshine, G. 2015. Immunology (Seventh Edition), Wiley Blackwell, UK, pp-406.

Reference books:

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.

Web Sources:

1. <https://iuis.org/immunopaedia-advancing-global-immunology-education/>
2. <https://www.immunology.org/public-information/bitesized-immunology>
3. <https://www.bio-rad-antibodies.com/immunology-resources.html>
4. <https://www.cell.com/immunity/home>

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - III

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

DEVELOPMENTAL BIOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C10	Developmental Biology	Core Course-10	4	4	25	75	100
Course Objectives: The main objectives of this course are: 1. 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.							
Pre-requisite: Students have fundamental knowledge in embryo and its developmental process.							
Course Outcome:							
CO1	Define the concepts of embryonic development					LO1, LO3, LO8	
CO2	Observe various stages of cell divisions under microscope					LO1, LO5, LO6, LO8	
CO3	Understand the formation of zygote					LO1, LO3, LO5, LO8	
CO4	Differentiate the blastula and gastrula stages					LO1, LO3, LO5, LO8	
CO5	Learn the distinguishing features of three different germ layers and formation of various tissues and organs					LO1, LO5, LO8, LO13	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I		Pattern of animal development: Chief events in animal development; History of thoughts and conceptual developments. Gametogenesis: Origin of germ cells, Seven Stages of Spermatogenesis - Sperm morphology in relation to the type of fertilization, Oogenesis - Oogenesis in insects and amphibians; Origin of stem cell and ovulation in mammals; Composition and synthesis of yolk in invertebrates (insects & crustaceans) and vertebrates; Genetic control of vitellogenin synthesis in amphibians.					
II		Fertilization: Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitation 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; Abnormality in fertilization- infertility, antifertility and organ dysfunction with reference to male and female gametes.					
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. Isolation of stem cells from cleavage, Blastula & concept of super ovulation.					

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.
V	Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - 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 associated with regeneration. Aging and senescences: Biology of senescences- cause of aging- mechanism involved in apoptosis. Experimental Embryology: Induced ovulation in humans – Cryopreservation of gametes/embryos - Ethical issues in cryopreservation – Artificial insemination – IUI – IVF Techniques. Embryo selection by AI tools.

Text books:

1. Balinsky, B. I. 1981. Introduction to Embryology (5th Edition), CBS College Publishers, New York, pp-782.
2. Barresi, M., and Gilbert. S. F. 2023. Developmental Biology, 13th 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.

Reference books:

1. Wilt, F.H. and N.K. Wessel. 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
2. Slack J.M.W. 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
3. Mari-Beffa, M. and J. Knight. 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - III

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

RESEARCH METHODOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C11	Research Methodology	Core Course-11	4	4	25	75	100
Course Objectives: The main objectives of this course are: 1. Recall the principles of animal ethics, GLP, microbiological techniques, instrumentation, biostatistics, and bioinformatics. 2. Explain the principles and applications of microscopy, molecular techniques, laboratory instruments, and statistical methods. 3. Apply laboratory techniques, molecular tools, statistical methods, and bioinformatics resources in biotechnology. 4. Analyze biological data and evaluate laboratory techniques using appropriate statistical tools. 5. Evaluate and design biotechnology experiments using laboratory techniques, statistical analysis, and bioinformatics.							
Pre-requisite: Basic knowledge of Cell Biology, Microbiology, Biochemistry, Molecular Biology, and basic laboratory techniques.							
Course Outcome:							
CO1	Describe laboratory techniques, instrumentation, biostatistics, and bioinformatics concepts					LO1	
CO2	Students will be able to explain the principles and applications of laboratory and molecular techniques.					LO4	
CO3	Students will be able to perform microbiological, molecular, and statistical analyses using standard laboratory methods.					LO5	
CO4	Students will be able to analyze experimental data using statistical and bioinformatics tools.					LO3, LO8, LO9	
CO5	Students will be able to evaluate research findings and select appropriate laboratory and bioinformatics techniques.					LO6, LO15,	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I		CCSEA guidelines: IAEC Composition, Responsibilities of IAEC members, Establishment of Animal House - Strategies and Laws. Maintenance of Animal House - Dos and Don'ts. Good laboratory practice (GLP) - pH, Electrodes and pH meter - Colorimeter and Spectrophotometry. Microbiological Techniques - Media Preparation and sterilization - Inoculation and growth monitoring, Microbial identification					
II		Principles and Applications of Light Microscopy, Bright field, Phase contrast, Differential interference Contrast (DIC) & Fluorescence microscopy and Confocal microscopy. Electron microscopy (FE-SEM & HR-TEM).					
III		Principle and applications of Centrifuges, Chromatography, principle type and application. Electrophoresis, Principles, types and applications -PAGE and agarose					

	gel electrophoresis. Polymerase chain reaction (PCR), RT-PCR Blotting DNA Sequencing types and applications. Principle and Applications of Flow cytometry.
IV	Definition - scope of biostatistics Measures of central tendency – arithmetic mean, median and mode. Measures of dispersion - range, mean deviation, standard deviation, Standard error. Co-efficient of variation, types of correlation, linear regression analysis. Basics of Probability and Probability distribution
V	Statistical hypothesis – types, testing (hypothesis, null hypothesis, alternate hypothesis Parametric tests – Student's t-Test; Analysis of Variance (ANOVA or F-Ratio: One way and Two-way analysis); Chi-square test (Test of Independence and Test of Goodness of Fit) Correlation and regression analysis concepts and their application. Scope, importance and status of Bioinformatics. Biological databases (Gene bank and Protein sequence database) Big Data Analysis

Text books:

1. Mahajan B. K., Arun Bhadra Khanal (2008). Methods in Biostatistics: For Medical Students. 7th Edition. JPB Publishers.
2. Nageswara Rao G (2018). Biostatistics & Research Methodology. BSP Books Pvt. Ltd.
3. Wilson K & K.W. Goulding (2017). A Biologists Guide to Principles and Techniques of Practical Biochemistry. ELBS publications.
4. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, 9th Ed., 2023.
5. Molecular Biology of the Cell, 7th Ed., 2022.
6. Biostatistics: A Foundation for Analysis in the Health Sciences, 12th Ed., 2024.

Reference books:

1. Bioinformatics and Functional Genomics, 4th Ed., 2024.
2. Lehninger Principles of Biochemistry, 9th Ed., 2025.

Web Sources:

1. <https://ccsea.gov.in>
2. <https://www.icmr.gov.in>
3. <https://www.ncbi.nlm.nih.gov>
4. <https://www.uniprot.org>
5. <https://www.ebi.ac.uk>

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - III

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

ANIMAL BEHAVIOUR

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C12	Animal Behaviour	Core Course-12	4	4	25	75	100
Course Objectives: The main objectives of this course are: 1. To learn the basics of animal behaviour 2. To know about different methods used for the study of animal behaviour 3. To gain knowledge about various methods of animal learning and its relevance to animal welfare. 4. To understand animal signalling and its significance for the animal survival 5. To describe about reproductive and social behaviour of animals.							
Pre-requisite: Basic knowledge in the biology and chemistry							
Course Outcome:							
CO1	Students know about the history and the different patterns of animal behaviour					LO1, LO8, LO15	
CO2	Students learn about different types of methods used for the study of animal behaviour.					LO1, LO5, LO6, LO10	
CO3	To know about the animal learning and its significance to the wildlife conservation					LO1, LO3, LO8, LO13	
CO4	Students will be able to discriminate between the deceptive and honest signalling of animals.					LO3, LO5, LO8	
CO5	Students will be able to know about the social and reproductive behaviour of animals.					LO1, LO8, LO12, LO15	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I		Introduction- History of Animal behaviour- Contributions of Tinbergen, Carl Von Fritz and Konrad Lorenz, proximate vs. ultimate causes of behavior, and Tinbergen's four questions. Patterns of Behavior: Reflexes, instincts, fixed action patterns (FAPs), and sign stimuli.					
II		Methods of studying animal behaviour- Recording behaviour- <i>Adlibitum</i> sampling, All occurrence sampling, One-Zero sampling and focal animal sampling- Ethograms-Instruments: Audio and video recording and analysis- Mist netting and marking animals-Radio-telemetry.					
III		Learning: Habituation, Trial and error learning, classical and operant conditioning, Insightful learning or Cognitive learning and imprinting. Applied behavioural science in wildlife conservation, captive animal welfare, and human-wildlife conflict.					
IV		Animal signaling- chemical (pheromones), visual, auditory- echolocation in bats and dolphins, and tactile signals- Honest signaling- Aggressive colouring, Stotting behaviour and emitting sound, Zahavi's Handicap Principle, Deceptive signaling, mimicry and camouflage					
V		Foraging behaviour- Solitary and group foraging- Advantages and disadvantages- Social and reproductive behaviour: Social organization in insects and mammals-					

	Mating system: Monogamy, Polygyny, Polyandry and Lek, Parental care and infanticide- Kin selection, altruism, reciprocal altruism, and Hamilton's rule.
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Text books:

1. Agarwal, V. K (2010) Animal Behaviour. S Chand & Company, India
2. Mahur, R (2021) Animal Behaviour, Rastogi Publications, India.
3. Ridley, M. (1995) Animal Behavior. Second Edition. Blackwell Scientific Publications. USA.
4. Rubenstein, D. (2023) Animal Behavior. 12th Edition. OUP, USA.

Reference:

1. Sih, A., et al. (2004). Behavioural syndromes: An ecological and evolutionary overview. Trends in Ecology & Evolution.
2. Martin, P., & Bateson, P. (2007). Observing Animal Behaviour: Design and Analysis of Quantitative Data. Oxford University Press.
3. Mendl, M., & Burman, O. H. P. (2011). Animal Behaviour Desk Reference. CRC Press.
4. Wolf, M., & Weissing, F. J. (2012). Animal personalities: consequences for ecology and evolution. Trends in Ecology & Evolution.

Mapping with Programme Outcomes*

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

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

Subject Code	Name of the Subject	Category	Credits	Hours/Week	Marks		
					CIA	External	Total
26UPZOO1L03	Lab Course – III	Lab Course	3	6	40	60	100
Course Objectives: The main objectives of this course are: 1. To develop basic laboratory skills in immunology, haematology, embryology, and molecular biology. 2. To train students in the identification and analysis of biological specimens and wildlife diversity. 3. To impart practical knowledge of diagnostic and analytical techniques used in biological sciences. 4. To develop proficiency in bioinformatics tools for sequence analysis and interpretation. 5. To enhance scientific observation, data recording, and laboratory safety practices.							
Pre-requisite: Students should possess a fundamental understanding of cell biology, genetics, immunology, zoology, and laboratory safety.							
Course Outcome:							
CO1	Perform fundamental laboratory techniques in immunology, haematology, and clinical biology.					LO1, LO4, LO8, LO13	
CO2	Identify and interpret embryological stages, biological specimens, and ecological components.					LO1, LO3, LO5, LO8	
CO3	Apply molecular biology and bioinformatics tools for biological data analysis.					LO5, LO6, LO8, LO10	
CO4	Demonstrate skills in biodiversity assessment, animal behaviour studies, and specimen collection.					LO1, LO6, LO7, LO11	
CO5	Record, analyse, and communicate experimental observations following standard laboratory practices.					LO2, LO5, LO9, LO13	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Content							
IMMUNOLOGY, DEVELOPMENTAL BIOLOGY, RESEARCH METHODOLOGY & ANIMAL BEHAVIOUR							
<u>Experiments</u>							
1. Determination of ABO blood groups and Rh typing from human blood samples. 2. A rapid screening test for the diagnosis of pregnancy. 3. Radial Immunodiffusion for antigen and antibody precipitation 4. Double immunodiffusion (Ouchterlony Technique). 5. Immunoelectrophoresis 6. Preparation of Haemin crystals of the blood fish and rat. 7. Estimation of Haemoglobin by haemometer. 8. Enumeration of RBC and WBC counts by haemocytometer. 9. Identification of fauna in the Periyar University ecosystem. 10. Collection and mounting of zoo planktons.							

11. To study geotaxis behaviour in earthworm.
12. To study nests and nesting behaviour of the birds and social insects.
13. BLAST search for identification of Protein sequence
14. BLAST search for conversion of DNA sequence into Protein sequence

Spotters

1. ELISA
2. Western blot for antigen determination
3. Incubation and identification of different stages of chick embryos – 24 hrs, 48 hrs, 72 hrs and 96 hrs.
4. Blastula and Gastrula stages in Embryo
5. UV Spectrophotometer
6. PCR
7. PAGE and agarose gel electrophoresis
8. Flow Cytometry
9. Biodiversity Hotspots of India
10. Major Wildlife Sanctuaries of Tamil Nadu.
11. Round dance and Waggle dance

Text books:

1. Verma, P. S. & Agarwal, V. K. (2022). *Practical Zoology*. New Delhi: S. Chand Publishing. Approx. 700 pages.
2. Goldsby, R. A., Kindt, T. J., Osborne, B. A., & Kuby, J. (2007). *Kuby Immunology* (6th ed.). New York: W. H. Freeman & Company. 574 pages.
3. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). *Roitt's Essential Immunology* (13th ed.). Oxford: Wiley-Blackwell. 576 pages.
4. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). New York: Garland Science. 1464 pages.
5. Sharma, P. D. (2022). *Ecology and Environment*. Meerut: Rastogi Publications. Approx. 700 pages.

Reference books:

1. Murphy, K. & Weaver, C. (2016). *Janeway's Immunobiology* (9th ed.). New York: Garland Science. 904 pages.
2. Lodish, H., Berk, A., Kaiser, C. A., et al. (2016). *Molecular Cell Biology* (8th ed.). New York: W. H. Freeman. 1280 pages.
3. Gilbert, S. F. & Barresi, M. J. F. (2019). *Developmental Biology* (11th ed.). New York: Oxford University Press. 814 pages.
4. Mount, D. W. (2004). *Bioinformatics: Sequence and Genome Analysis* (2nd ed.). New York: Cold Spring Harbor Laboratory Press. 692 pages.
5. Hall, J. E. (2021). *Guyton and Hall Textbook of Medical Physiology* (14th ed.). Philadelphia: Elsevier. 1152 pages.
6. Godkar, P. B. & Godkar, D. P. (2020). *Textbook of Medical Laboratory Technology*. Mumbai: Bhalani Publishing House. Approx. 1000 pages.

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - III

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

AQUACULTURE AND FISHERIES

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1E05	Aquaculture and Fisheries	Elective Course - 5	3	3	25	75	100
Course Objectives: The main objectives of this course are: 1. Students should know basic concepts in Aquaculture.							
Pre-requisite: Students should know the fin fishes and shell fishes of commercially important candidate species.							
Course Outcome:							
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					LO1, LO3, LO8	
CO2	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture					LO1, LO5, LO6, LO8	
CO3	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations					LO1, LO3, LO5, LO8	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I	Importance of aquaculture- Present status, prospects and scope in India. Freshwater aquaculture- Brackishwater aquaculture- Mariculture - Metahaline culture in India. Types of fish culture -Types of fish ponds for culture practice and its management. Control of parasites, predators and weeds in culture ponds. Fish farm implements - Secchi disc - aerator - pH meter - tools for hypophysation - feeding trays – Fishing gears and crafts used in aqua farming.						
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.						
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						

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. Fish processing and preservation.
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.

Text books:

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

Reference books:

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

Web Sources:

1. <https://mpeda.gov.in/>
2. <https://www.cift.res.in/>
3. <https://cftri.res.in/>

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - III

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

SERICULTURE

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1E06	Sericulture	Elective Course-6	3	3	25	75	100
Course Objectives: The main objectives of this course are: 1. To introduce the economic importance of sericulture and the basic biology and life cycle of the silkworm <i>Bombyx mori</i>. 2. To understand mulberry cultivation practices and the nutritional requirements of silkworms for efficient cocoon production. 3. To explain silkworm reproduction, development, endocrinology, and the basic principles of genetic improvement. 4. To understand the major diseases and pests of silkworms and their preventive and control measures. 5. To familiarize students with silkworm rearing practices and silk reeling processes influencing silk quality and yield.							
Pre-requisite: Students should have basic knowledge of invertebrate zoology, insect morphology and physiology, life cycles of insects, and elementary genetics, preferably acquired through undergraduate Zoology							
Course Outcome:							
CO1	Students will be able to explain the economic significance of sericulture and the biology and life cycle of <i>Bombyx mori</i> .					LO1, LO2, LO8, LO15	
CO2	Students will be able to describe mulberry cultivation practices and assess leaf quality in relation to silkworm nutrition.					LO1, LO3, LO4, LO8	
CO3	Students will be able to explain silkworm reproduction, development, hormonal regulation, and basic genetic improvement strategies.					LO1, LO5, LO6, LO8	
CO4	Students will be able to identify major silkworm diseases and pests and suggest appropriate preventive and control measures.					LO1, LO3, LO4, LO8	
CO5	Students will be able to describe silkworm rearing operations and silk reeling processes affecting silk yield and quality.					LO1, LO5, LO7, LO8	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I		Introduction to Sericulture and Silkworm Biology History, scope, and economic importance of sericulture. Types of silk and silk-producing insects and their distribution. <i>Bombyx mori</i> —life cycle, morphology of larva, pupa, and moth. Structure and function of silk gland. Factors influencing growth and development.					
II		Moriculture Mulberry—distribution and important varieties. Methods of mulberry cultivation and field preparation. Leaf harvesting, transportation, and preservation. Nutritional requirements of silkworm and factors affecting leaf quality. Overview of major pests and diseases of mulberry.					

III	Silkworm Reproduction, Development, and Genetics Reproductive biology and development of silkworms. Voltinism in mulberry silkworms. Brief account of tasar, eri, and muga silkworms. Role of hormones in growth and molting. Basics of silkworm genetics and strain improvement.									
IV	Diseases and Pests of Silkworm Major viral (Grasserie), bacterial (Flacherie), fungal (Muscardine), and protozoan (Pebrine) diseases of silkworm—symptoms, transmission, and preventive measures. Common silkworm pest - Uzi fly and its menace. Integrated disease and pest management practices.									
V	Silkworm Rearing and Silk Reeling Rearing house design and rearing operations. Incubation, hatching, brushing, feeding, and cocoon harvesting. Reeling methods and silk processing—lacing, skinning, and re-reeling. Quality of silk and factors affecting yield.									
Text books: 1. Bukhari, R. & Bhat, R. (2021). <i>Fundamentals of Sericulture</i>. Narendra Publishing House, India. ISBN: 9789390611652. 2. Johnson, M. & Kesary, M. (2019). <i>Sericulture</i>. Saras Publication, India. ISBN: 9789386519580. 3. Hasan, W., Ashaq, M., Abhishek, G. J., et al. (Eds.). (2026). <i>Sericulture: Principles, Practices, Biotechnology and Breeding</i>. CRC Press (Taylor & Francis). ISBN: 9781041205647 4. Elumalai, D., Mohan Raj, P., Ramamoorthy, R., Mohan, C. & Poovizhiraja, B. (2021). <i>Introduction to Non-Mulberry Silkworms</i>. CRC Press (Taylor & Francis). ISBN: 9781032053998										
Reference books: 1. Ganga, G. & Sulochana Chetty. (2nd ed.). <i>An Introduction to Sericulture</i>. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. 2. Rangaswamy, G. (1987). <i>Manual on Sericulture</i>. FAO & CSB, Bangalore, India. 3. Shekar, P. & Hardingham, M. (1995). <i>Sericulture and Silk Production: A Handbook</i>. ITDG Publishing (Intermediate Technology), UK.										
Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	-	-	S	L	L	-	L	M
CO2	M	S	L	M	S	M	M	-	L	M
CO3	S	S	M	M	S	L	L	M	L	M
CO4	M	S	M	M	S	S	S	L	L	M
CO5	M	M	L	S	S	M	M	-	M	S

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

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPGEN1V01	Peace Education	Value added course	2	2	25	75	100
Course Objectives: The main objectives of this course are: 1. To introduce the fundamental concepts, objectives, and significance of peace education and the peace initiatives of HWPL 2. To develop an understanding of personal peace, diversity, harmony, and responsible interpersonal relationships 3. To foster core peace values that promote mutual respect, empathy, forgiveness, and ethical living 4. To equip students with the knowledge and attitudes required to become responsible, law-abiding, and peace-promoting citizens 5. To inspire students to become committed peace messengers by applying peace principles in their personal and social lives							
Pre-requisite: No formal prerequisite; students should possess a willingness to learn, respect diversity, and actively participate in collaborative and reflective activities on peace and human values.							
Course Outcome:							
CO1	Understand the importance of peace					LO1, LO3, LO13	
CO2	Explain how to recover the state of peace					LO2, LO4, LO8	
CO3	Internalize and practice the values of peace					LO9, LO11, LO13	
CO4	Understand the sustainable peace and the role of oneself					LO5, LO12, LO15	
CO5	Become the peace messenger who spreads the culture of peace					LO2, LO1, LO14	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units	Content						
I	Introduction to Peace Education and HWPL Aim and objective of Peace Education – Development of Peace work of HWPL – Making groups for assignments – Rapport building						
II	Finding Peace, and me Diversity – Harmony – Original State of All Creation – Connectivity – Value – Role – Duty – Interpersonal relationship – Greed – Love – Order						
III	Peace Values Gratitude – Consideration – Sacrifice – Understanding – Forgiveness – Respect for Parents, Teachers and Peace – Scripture – Cultural sphere						
IV	Peace Citizen Heritage – World Peace – Great legacy; a case of Peace – Law – Law-abiding Spirit						

	– Treaty – DPCW – NGO; HWPL – Peace Citizen – Courage – Peace-loving Heart – Messenger of Peace									
V	Peace Messenger Peace Messenger – Peace experience – Will for Peace									
Tasks and Assignments: 1. Writing an Essay on World Peace and Gratitude 2. Engaging in debates on topic related to peace 3. Group Project for practicing peace values 4. Group Project to promote the importance of peace										
References: 1. https://www.un.org/en/ 2. https://www.youtube.com/watch?v=18LhBZc6Sn4 3. https://www.hwpl.kr/language/en/home-hwpl-en/ 4. Heavenly Culture World Peace Restoration of Light (2022), Road to Peace Oh Ik-soo (1996), Youth Group counseling										
Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	-	-	-	-	L	-	S	-	L	M
CO2	-	-	-	-	L	-	S	-	M	M
CO3	-	-	-	-	M	-	S	-	M	S
CO4	-	-	-	-	M	L	S	L	M	S
CO5	-	-	-	-	L	-	S	M	S	S

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

M.Sc. Zoology Course – SEMESTER - III

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

CANCER THERAPEUTICS

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1N02	Cancer Therapeutics	Non-Major Elective [NME] – II	2	3	25	75	100
Course Objectives: The main objectives of this course are: 1. Understand the molecular and cellular basis of cancer, including carcinogenesis, metastasis, oncogenes, tumor suppressor genes, apoptosis, and modern diagnostic techniques. 2. Explain the principles and mechanisms of conventional cancer therapies, drug resistance, multidrug resistance, and combination treatment strategies for major human cancers. 3. Acquire knowledge of cancer immunology and advanced immunotherapeutic approaches, including monoclonal antibodies, CAR-T cell therapy, antibody-drug conjugates, and innate immune-based therapies. 4. Evaluate emerging therapeutic strategies such as targeted therapy, hormone therapy, oncolytic virotherapy, and their applications, limitations, and recent developments in cancer treatment. 5. Develop an understanding of nanotechnology-based drug delivery systems, novel therapeutic approaches, and recent advances including ferroptosis, siRNA therapy, cancer stem cells, and bacteria-mediated cancer therapy for translational cancer research.							
Pre-requisite: Basic knowledge of cell biology, molecular biology, genetics, and biochemistry is essential for understanding the principles of cancer therapeutics.							
Course Outcome:							
CO1	Analyze the molecular basis of carcinogenesis, apoptosis, oncogenes, tumor suppressor genes, and the principles of cancer diagnosis using biochemical, microscopic, and molecular techniques.					LO1, LO4, LO8	
CO2	Evaluate the mechanisms of cancer chemotherapy, drug resistance, multidrug resistance, combinatorial therapies, and therapeutic strategies for major cancers.					LO3, LO6, LO8	
CO3	Assess the principles and applications of cancer immunotherapy, including monoclonal antibodies, CAR-T cells, and innate and adaptive immune-based therapeutic approaches.					LO4, LO5, LO6, LO9	
CO4	Explain the mechanisms, applications, and limitations of targeted therapy, hormone therapy, and oncolytic virus therapy in cancer treatment.					LO5, LO6, LO8	
CO5	Evaluate emerging cancer therapeutics, including nanomedicine, siRNA therapy, photodynamic therapy, ferroptosis, bacteria-mediated therapy, and cancer stem cell-targeted approaches.					LO1	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I	Cancer cells: Basic Properties of a Cancer Cell, Comparison of normal and cancer cells. Types of Carcinogens and mechanism of Carcinogenesis. Mechanism of						

	Metastasis and malignancy. Oncogenes: Growth factors, Signal Transducers and Transcription factors. Tumor suppressor genes: p53, PTEN, BRCA1 and their action Pathways, Apoptosis – Types and mechanisms. Diagnosis of Cancer-Biochemical: MTT Assay and BrUd Assay, Microscopic staining techniques: DAPI, AO/EtBr, Hoechst and Molecular Detection: DNA Fragmentation Assay, Western Blotting and Flow Cytometry.
II	Chemotherapy- Principle and mode of action of drugs against Breast, Cervical, Lung and colorectal Cancers. Mechanism of Drug Resistant Development against Doxorubicin, Cispatin and Temaxifan. Combinatorial Therapy for cancer: Radio therapy combined Chemotherapy, Sugical combined Chemotherapy, Chemo combined Chemotherapy. Development of Multi-drug Resistance (MDR). Mechanism of Development of triple negative cancers and their treatment options
III	Cancer immunotherapy- Cancer immunology, Interaction of immune cells with cancer cells, Exploitation of acquired immune response; Monoclonal antibody therapy; Antibody drug conjugation, T-cell engager, Pi-specific antibodies, CART (Chimeric Antigenic Receptor T-cells). Harnessing innate immunity; lymphokine activated killer cells, Interferon. Current scenario of Cancer Immunology and treatment modalities.
IV	Targeted therapy for Cancer: Principle, mode of action and draw backs of Targeted Therapy. Hormone Therapy: Principle, mode of action and draw backs of hormone therapy. Oncolytic Virus Therapy: HSV-based oncolytic viruses and Adenovirus-based oncolytic viruses for hepato-carcinoma and pancreatic cancer. Hormesis and cancer therapy.
V	Nanotherapeutics- Principles of drug delivery systems, Nano-drugs for diagnosis and treatment of cancer; concept of Nano-drug encapsulation, self-assembly, controlled release (targeted, triggered Release and Cellular uptake mechanisms). Nanoparticles for Photodynamic Therapy of cancer; siRNA therapy. Peptide assemblies as supramolecular medicine for cancer therapy. Single Molecule Therapy for cancer. Recent advances in Cancer medicine: Ferroptosis and bacteria mediated cancer therapy. Significance of cancer stem cell for cancer.

Text books:

1. Robert A Weinberg. 2023. The Biology of Cancer, 3rd Edition, International student Edition, MIT Press, USA.
2. Lauren Pecorino. Molecular Biology of Cancer (Mechanisms, Targets and Therapeutics), 5th Edition, 2021, Oxford Press, UK.
3. Atul Batra, Bartosz Chmielowski, Mary Territo 2022. Manual of Clinical Oncology, 1st South Asian Edition, Wolters Kluwer India.

Reference books:

1. Ashutosh Muherji and Satyajit Pradhan, Daniel Morgensztern, Armin Ghobadi, Ramaswamy Govindan 2022. The Washington Manual of Oncology, First South Asian Edition, Wolters Kluwer India.
2. Imran Saleem, Ahmed AH Abdellatif, 2025. Nanomedicine and Applications in Cancer, CRC Press.
3. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher. 2021. Molecular Cell Biology, 9th edition, W H Freeman & Co. New York.
4. Lanza, R. 2005. Essentials of Stem Cell Biology. Academic Press.

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - III

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

BAT ECOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1N03	Bat ecology	Non-Major Elective for Swayam Repeaters	2	-	-	-	-
Course Objectives: The main objectives of this course are: 1. To gain knowledge about bats 2. To understand the habitat ecology of bats 3. To know about feeding and ecosystem services of bats 4. To get insight about the reproductive ecology of bats 5. To know about the bat survey and conservation methods							
Pre-requisite: Basic understanding of general zoology, genetics, cell biology, and ecological principles.							
Course Outcome:							
CO1	Students will be able to taxonomically identify the bats					LO1, LO2, LO3	
CO2	Students will be able to identify different types of roosts used by bats					LO2, LO3, LO4	
CO3	Students will be able to explain about the feeding behaviour and ecosystem services of bats					LO5, LO6, LO7, LO8	
CO4	Students will be able to classify bats based on reproductive behaviour					LO3, LO4, LO5, LO6	
CO5	Students will be involved in the bat survey and conservation activities					LO8, LO9, LO10, LO11	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness/reasoning, LO14: Leadership readiness/qualities & LO15: Lifelong learning							
Units		Content					
I	Introduction to Bat Ecology: Classification and taxonomy of Chiroptera; Morphological and physiological adaptations; Echolocation and flight mechanisms; Global distribution and diversity of bats; Diversity of bats in India with special reference to the Western Ghats and South India.						
II	Habitat Ecology and Behaviour: Habitat selection and roosting ecology; Cave, crevices, tree, Tree holes, foliage, and human-made roosts; Roost fidelity and roost marking. Social organization- All male group, all female group and mixed groups; Environmental factors influencing bat distribution						
III	Feeding Ecology and Ecosystem Services: Feeding guilds of bats (insectivorous, frugivorous, nectarivorous, carnivorous, piscivorous, and sanguivorous); Diet analysis using conventional and molecular methods; Bats as biological pest controllers; Pollination and seed dispersal; Role of bats in nutrient cycling and ecosystem functioning.						
IV	Reproductive ecology of bats: Monogamy, Polygamy- Resource defense polygyny- Harem and satellite males, Female defense polygyny, Polyandry, Promiscuity, Lek mating system						

V

Bat survey methods and Conservation; Mist netting and harp trapping; Acoustic monitoring using bat detectors; Radio telemetry and GPS tracking; Microscopic and molecular techniques for dietary analysis Conservation status of bats (IUCN Red List and Wildlife Protection Act, 1972); Threats to bat populations including habitat loss, climate change, urbanization, mining, and wind energy development; Bat-borne zoonotic pathogens and disease ecology.

Reference books:

1. Kunz, T. H., & Fenton, M. B. (2003). Bat Ecology. University of Chicago Press, Chicago.

2. Srinivasulu, C., Srinivasulu, B., & Kaur, H. (2010). Bats of the Indian Subcontinent. Universities Press (India) Pvt. Ltd., Hyderabad.

3. Voigt, C. C., & Kingston, T. (Eds.). (2016). Bats in the Anthropocene: Conservation of Bats in a Changing World. Springer International Publishing, Cham, Switzerland.

4. Neuweiler, G. (2000). The Biology of Bats. Oxford University Press, Oxford.

5. Freeland, J. R., Kirk, H., & Petersen, S. D. (2011). Molecular Ecology (2nd ed.). Wiley-Blackwell, Chichester, UK.

Web Sources:

1. <https://iuis.org/immunopaedia-advancing-global-immunology-education/>

2. <https://www.immunology.org/public-information/bitesized-immunology>

3. <https://www.bio-rad-antibodies.com/immunology-resources.html>

4. <https://www.cell.com/immunity/home>

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - IV

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

ENVIRONMENTAL BIOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1C13	Environmental Biology	Core Course-13	4	5	25	75	100
Course Objectives: The main objectives of this course are: 1. To learn key ecological terms, concepts, and levels of organization (organisms, populations, communities, ecosystems). 2. To study energy flow and chemical cycling through the environment. 3. Understanding the contributing factors for pollution in the environment and the ways in controlling and restoring to natural conditions. 4. To understand how interactions between organisms and their physical environment drive the dynamics of individuals, populations, communities, and ecosystems. 5. To learn about the significance of endemic biodiversity and the need for its conservation.							
Pre-requisite: A strong grasp of general biology, basic ecological terms, and earth systems/soil science.							
Course Outcome:							
CO1	Students can explain how living organisms adapt to physical and biological surroundings.					L01, L03, L04, L06	
CO2	Students can differentiate between fundamental and realized niche and relate it to the competitive exclusion principle.					L03, L04, L05, L06	
CO3	Students will analyze population growth patterns and community dynamics using basic math or models.					L03, L06, L08, L09, L011	
CO4	Student can evaluate environmental issues and propose science-based conservation solutions.					L03, L06, L08, L09 L011	
CO5	Students will design and conduct basic ecological experiments or field studies.					L01, L05, L06, L09	
LO1: Disciplinary Knowledge - LO2: Communication Skills - LO3: Critical thinking - LO4: Problem Solving - LO5: Analytical Reasoning - LO6: Research- related Skills - LO7: Cooperation/ Team Work - LO8: Scientific Reasoning - LO9: Reflective Thinking - LO10: Digital Literacy - LO11: Self-directed Learning - LO12: Multicultural Competence - LO13: Moral and Ethical awareness/ reasoning - LO14: Leadership qualities - LO15: Lifelong Learning.							
Units		Content					
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. Ecological complexity and stability in food webs, Food chain and their significance, Ecological pyramids.					
II		Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); Survivorship curves; Diversity Indices: Calculating Shannon-Wiener and Simpson's indices. Concept of metapopulation- demes and dispersal, interdemec extinctions, age structured populations - action taken to control population explosion.					

III	Species interactions: Types of interactions, intra and interspecific competition, predation, mutualism, commensalism, and parasitism. 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 pioneer, intermediate (seral) and climax community.
IV	Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
V	Applied ecology: Environmental pollution; global environmental change; Microplastics pollution and remediation; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches - Waste management. Conservation biology: Principles of conservation, major approaches to management, Biodiversity hotspots – endemic, endangered and keystone species. Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Text books:

1. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
2. Edward, I.N. 1996. Applied Ecology and Environmental Management. Wiley-Blackwell Publishers.
3. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
4. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.
5. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.

Reference books:

1. Copsey, J.A. and Black, S.A. 2018. Species Conservation: Lessons from Islands (Ecology, Biodiversity and Conservation). Cambridge University Press.
2. Odum, E.P. and Barrett, G.W. 2005. Fundamentals of Ecology. 5th Edition, Cengage Publishers.
3. Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.
4. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.
5. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.

Web Resources:

1. <https://esajournals.onlinelibrary.wiley.com/journal/19399170>
2. <https://www.iucnredlist.org/>
3. <https://libguides.brighton.ac.uk/ecology/webresearch>
4. <https://www.nature.com/natecolevol/>
5. <https://ecampusontario.pressbooks.pub/trentenvironmental/chapter/chapter-9-ecology-from-individuals-to-the-biosphere/>

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - IV

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

STEM CELL BIOLOGY

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1E07	Stem Cell Biology	Elective Course-7	3	3	25	75	100
Course Objectives: The main objectives of this course are: 1. Recall the concepts, types, properties, and hierarchy of stem cells. 2. Explain the characteristics, differentiation, and therapeutic potential of embryonic and adult stem cells. 3. Apply knowledge of stem cell biology, iPSC generation, and tissue regeneration in biomedical research. 4. Analyze stem cell aging, regeneration, and clinical applications in disease treatment. 5. Evaluate stem cell therapies, clinical outcomes, and ethical issues in regenerative medicine.							
Pre-requisite: Basic knowledge of Stem Cell Biology, Genetics, and Molecular Biology.							
Course Outcome:							
CO1	Describe the types, properties, potency, and differentiation of stem cells.					K1, K2,	
CO2	Explain the biology of embryonic, adult, and induced pluripotent stem cells					K1, K2, K3, K4	
CO3	Apply stem cell concepts to tissue repair, regeneration, and disease management					K2, K4, K5	
CO4	Analyze stem cell aging, regeneration, and therapeutic applications.					K1, K2, K4, K5	
CO5	Evaluate stem cell therapies, clinical trials, and ethical considerations in regenerative medicine.					K2, K4, K5, K6	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I		Introduction to stem cell biology: Stem cell definition, origin and hierarchy, stem cell properties, Identification and Characterization, potency and differentiation, niche of stem cell, overview of different stem cell types (embryonic stem cells, adult stem cells and induced pluripotent stem cells).					
II		Embryonic stem (ES) cell: Characterization and properties of ES cells, pluripotency and self-renewal of ES cells; molecular mechanisms regulating pluripotency and maintenance of the stem state, progressive differentiation of ES cells into ectoderm lineage organs (skin, brain and nerve), mesoderm lineage organs (heart, kidney, muscle, bone and blood), and endoderm lineage organs (lung, liver, stomach, pancreas and intestine).					
III		Adult stem cells: Mesenchymal stem cells (MSCs) - sources, properties (plasticity, homing and engraftment), potency and characterization; Haematopoietic stem cells (HSCs) - sources, properties, potency and characterization; steps involved in production of induced pluripotent stem cells (iPSCs); role of Yamanaka factor in iPSCs.					

IV	Stem cell and aging: aging theory; cell cycle; telomere and telomerase; senescence of stem cell; role of stem cell in aging; tissue repair and regeneration of adult stem cell.
V	Current stem cell therapies: Advantages and disadvantages of ES cells and adult stem cells (MSCs and HSCs) therapy; Ethical concern on stem cell therapy; current stem cell therapy for various diseases; clinical outcome of stem cell therapy; state of clinical trials in adult stem cells for various diseases.

Text books:

1. Essentials of Stem Cell Biology, 2023.
2. Stem Cells: Scientific Facts and Fiction, 2022.
3. Principles of Regenerative Medicine, 2022.
4. Stem Cell Biology and Regenerative Medicine, 2021.
5. Molecular Biology of the Cell, 2022. 4.
6. Essentials of Stem Cell Biology, Third Edition – Edited by Robert Lanza and Anthony Atala. Academic Press, CA, USA (2013).
7. Stem Cell Biology - Edited by Daniel R Marshak, Richard L. Gardner and David Gottlieb. Cold Spring Harbor Press, NY, USA (2001).
8. Hand book of Stem Cells, Edited by RoberLanza, Elsevier, Academic Press, 2011.
9. Stem Cells Handbook, Edited by Stewart Sell, Human Press, 2010.

Reference books:

1. Lanza R. (2014). Handbook of Stem Cells. Elsevier Publication, USA.
2. Mary Clarke, Jonathan Frampton (2020). Stem Cells Biology and Application, Taylor and Francis, USA.
3. Robert Lanza and Robert Lanza, Anthony Atala (2013). Essentials of Stem Cell Biology. Academic Press, US.
4. Alain A. Vertès, Nasib Qureshi, Arnold I. Caplan, Lee E. Babiss (2015). Stem Cells in Regenerative Medicine: Science, regulation and business strategies, John Wiley & Sons, Ltd, US.

Web Sources:

1. <https://www.isscr.org>
2. <https://stemcells.nih.gov>
3. <https://www.ncbi.nlm.nih.gov>
4. <https://www.clinicaltrials.gov>
5. <https://www.who.int>

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER -IV

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

POULTRY FARMING

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1E08	Poultry Farming	Elective Course-8	3	3	25	75	100
Course Objectives: The main objectives of this course are: 1. Understand the scope, significance, housing systems, and current status of the poultry industry. 2. Acquire knowledge of hatching, brooding, and scientific management practices for different classes of poultry. 3. Understand poultry nutrition, feed formulation, and feeding management for layers and broilers. 4. Identify major poultry diseases and apply appropriate preventive, control, and vaccination measures. 5. Develop skills in poultry farm planning, waste management, and economic analysis for commercial poultry farming.							
Pre-requisite: Students should have a basic understanding of biology, particularly animal biology, including the fundamental concepts of animal structure, physiology, nutrition, and reproduction. Prior knowledge of livestock or agricultural sciences is desirable but not mandatory.							
Course Outcome:							
CO1	Explain the fundamentals of poultry farming, housing systems, and the status of the poultry industry in India.					LO1, LO2, LO15	
CO2	Perform scientific procedures related to egg selection, incubation, brooding, and the management of chicks, growers, and layers.					LO1, LO8, LO11	
CO3	Apply principles of poultry nutrition and feeding for efficient layer and broiler production.					LO4, LO5, LO8	
CO4	Analyze major poultry diseases and recommend appropriate prevention, vaccination, and health management practices.					LO3, LO5, LO8, LO13	
CO5	Evaluate the economic viability of poultry farming and prepare project reports for commercial poultry enterprises.					LO5, LO6, LO10, LO14	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
I	Introduction to Poultry Farming Definition and scope of poultry farming; history and present status of the poultry industry in India; importance of poultry production in food security and rural livelihood; principles of poultry housing; characteristics of an ideal poultry house; different types of poultry houses; systems of poultry farming including intensive, semi-intensive, and free-range systems.						
II	Breeding, Hatching and Poultry Management Selection and care of hatching eggs; egg testing (candling); methods of hatching including natural and artificial incubation; brooding and rearing of chicks; sexing of chicks; management practices for chicks, growers, and layers, including feeding.						

	housing, lighting, and environmental management.
III	Poultry Nutrition and Broiler Management Principles of poultry nutrition; nutrient requirements of chicks, growers, layers, and broilers; feed ingredients and feed formulation; methods of feeding; feeding schedules; scientific management of broiler production, including housing, feeding, environmental control, and marketing age.
IV	Poultry Health Management Major poultry diseases including viral diseases (Newcastle disease and Infectious Bursal Disease), bacterial diseases (Fowl Cholera and Salmonellosis), fungal diseases (Aspergillosis and Candidiasis), and parasitic diseases (Coccidiosis and Ascariasis); symptoms, diagnosis, prevention, control, and management of poultry diseases; vaccination programmes; farm hygiene, water sanitation, and biosecurity measures.
V	Poultry Farm Management and Economics Recycling and utilization of poultry waste; preparation of project reports for banking and insurance; economics of poultry farming, including fixed and variable costs, cost-benefit analysis, profitability, and break-even analysis; marketing of poultry meat and eggs; entrepreneurship opportunities in poultry farming.

Text books:

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

Reference books:

1. Banerjee, G. C. (2018). *Poultry* (4th ed.). CBS Publishers & Distributors Pvt. Ltd., New Delhi.
2. Sastry, N. S. R., Thomas, C. K., & Singh, R. A. (2021) *Livestock Production Management*. Kalyani Publishers, New Delhi.
3. Panda, B., & Mohapatra, S. C. (1989) *Poultry Production*. ICAR, New Delhi.
4. Leeson, S., & Summers, J. D. (2005) *Commercial Poultry Nutrition* (3rd ed.). Nottingham University Press, Nottingham, UK.

Mapping with Programme Outcomes*

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

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

M.Sc. Zoology Course – SEMESTER - IV

(This syllabus is applicable to the students who are admitted on or after 2026-2027 academic year onwards)

MEDICAL LABORATORY TECHNIQUES

Subject Code	Name of the Subject	Category	Credits	Hours/ Week	Marks		
					CIA	External	Total
26UPZOO1I01	Medical Laboratory Techniques	Industry Entrepreneurship Course-1	2	2	25	75	100
Course Objectives: The main objectives of this course are: 1. Students should understand the different protocols and procedures to collect clinical samples.							
Pre-requisite: Students should have a basic knowledge about medical laboratories and the works carried out by them.							
Course Outcome:							
CO1	Remember and apply the safety measures in clinical labs					LO1, LO3, LO8	
CO2	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.					LO1, LO5, LO6, LO8	
CO3	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.					LO1, LO3, LO5, LO8	
CO4	Evaluate the hematological and histological parameters of biological samples.					LO1, LO3, LO5, LO8	
CO5	Remember and apply the safety measures in clinical labs					LO1, LO5, LO8, LO13	
LO1: Disciplinary knowledge, LO2: Communication Skills, LO3: Critical thinking, LO4: Problem solving, LO5: Analytical reasoning, LO6: Research-related skills, LO7: Cooperation/Team work, LO8: Scientific reasoning, LO9: Reflective thinking, LO10: Information/digital literacy, LO11: Self-directed learning, LO12: Multicultural competence, LO13: Moral and ethical awareness /reasoning, LO14: Leadership readiness/qualities, LO15: Lifelong learning							
Units		Content					
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.					
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. Urine analysis.					
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.					
IV		Cardiovascular system- Blood pressure - Pulse - regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) - significance - ultra sonography- Electroencephalography (EEG).					
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.									
Text books:										
1. Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.										
2. Guyton and Hall, 2000. Text Book of medical Physiology, 10 th edition, Elseiner, New Delhi.										
3. Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.										
4. Sood, R, 2009. Medical Laboratory technology, Methods and interpretation.										
Reference books:										
1. Manoharan, A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi.										
2. Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia. Published by Tata McGraw-Hill Education Pvt. Ltd.,										
3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.										
Web Sources:										
1. https://nios.ac.in/online-course-material/vocational-courses/dmlt.aspx										
2. https://gppanchkula.ac.in/e-notes-medical-lab-technology/										
Mapping with Programme Outcomes*										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	L	L	M	M	L	M
CO2	S	S	M	S	S	S	L	M	S	S
CO3	M	S	S	S	S	S	S	S	S	L
CO4	S	S	M	M	L	M	L	M	M	S
CO5	M	M	S	S	M	S	L	L	S	S

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