

DEPARTMENT OF ZOOLOGY
UNIVERSITY OF ALLAHABAD

Choice Based Credit System Syllabus (M.Sc. Zoology)

Learning Outcomes Descriptors and Programme Outcomes for a Master's degree (e.g. M.A., M.Com., M.Sc., etc.) (Level 6.5)

Master's degree (1 year/2 semesters of study): The Master's degree qualifies students who can apply an advanced body of knowledge in a range of contexts for professional practice, research, and scholarship and as a pathway for further learning. Graduates at this level are expected to possess and demonstrate specialized knowledge and skills for research, and/or professional practice and/or for further learning.

Master's Degree (2 years /4 semesters of study): The Master's degree qualifies students who can apply an advanced body of knowledge in a range of contexts for professional practice, research, and scholarship and as a pathway for further learning. Graduates at this level are expected to possess and demonstrate specialized knowledge and skills for research, and/or professional practice and/or for further learning. Master's degree holders are expected to demonstrate the ability to apply the established principles and theories to a body of knowledge or an area of professional practice.

Descriptor	Knowledge and understanding: The graduates should be able to demonstrate the acquisition of:
P.O. 1.	advanced knowledge about a specialized field of enquiry with a critical understanding of the emerging developments and issues relating to one or more fields of learning,
P.O. 2.	advanced knowledge and understanding of the research principles, methods, and techniques applicable to the chosen field(s) of learning or professional practice,
P.O. 3.	procedural knowledge required for performing and accomplishing complex and specialized and professional tasks relating to teaching, and research and development.
Descriptor	General, technical and professional skills required to perform and accomplish tasks: The graduates should be able to demonstrate the acquisition of:
P.O. 4.	advanced cognitive and technical skills required for performing and accomplishing complex tasks related to the chosen fields of learning.
P.O. 5.	advanced cognitive and technical skills required for evaluating research findings and designing and conducting relevant research that contributes to the generation of new knowledge.
P.O. 6.	specialized cognitive and technical skills relating to a body of knowledge and practice to analyze and synthesize complex information and problems.
Descriptor	Application of knowledge and skills: The graduates should be able to demonstrate the ability to:
P.O. 7.	apply the acquired advanced theoretical and/or technical knowledge about a specialized field of enquiry or professional practice and a range of cognitive and practical skills to identify and analyze problems and issues, including real-life problems, associated with the chosen fields of learning.
P.O. 8.	apply advanced knowledge relating to research methods to carry out research and investigations to formulate evidence-based solutions to complex and unpredictable problems.
Descriptor	Generic learning outcomes: The graduates should be able to demonstrate the ability to:
P.O. 9.	listen carefully, read texts and research papers analytically and present complex information in a clear and concise manner to different groups/audiences,
P.O. 10.	communicate, in a well-structured manner, technical information and explanations, and the findings/results of the research studies undertaken in the chosen field of study,
P.O. 11.	present in a concise manner view on the relevance and applications of the findings of recent research and evaluation studies in the context of emerging developments and issues.

P.O. 12.	evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
P.O. 13.	meet one's own learning needs relating to the chosen fields of learning, work/vocation, and an area of professional practice,
P.O. 14.	pursue self-paced and self-directed learning to upgrade knowledge and skills, including research-related skills, required to pursue a higher level of education and research.
P.O. 15.	problematize, synthesize, and articulate issues and design research proposals,
P.O. 16.	define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships,
P.O. 17.	develop appropriate tools for data collection for research,
P.O. 18.	the ability to use appropriate statistical and other analytical tools and techniques for the analysis of data collected for research and evaluation studies,
P.O. 19.	plan, execute, and report the results of an investigation,
P.O. 20.	follow basic research ethics and skills in practicing/doing ethics in the field/ in one's own research work.
P.O. 21.	make judgements and take decisions regarding the adoption of approaches to solving problems, including real-life problems, based on the analysis and evaluation of information and empirical evidence collected.
P.O. 22.	make judgement across a range of functions requiring the exercise of full responsibility and accountability for personal and/or group actions to generate solutions to specific problems associated with the chosen fields/subfields of study, work, or professional practice.
Descriptor	Constitutional, humanistic, ethical, and moral values: The graduates should be able to demonstrate the willingness and ability to:
P.O. 23.	embrace and practice constitutional, humanistic, ethical, and moral values in one's life,
P.O. 24.	adopt objective and unbiased actions in all aspects of work related to the chosen fields/subfields of study and professional practice,
P.O. 25.	participate in actions to address environmental protection and sustainable development issues,
P.O. 26.	support relevant ethical and moral issues by formulating and presenting coherent arguments,
P.O. 27.	follow ethical principles and practices in all aspects of research and development, including inducements for enrolling participants, avoiding unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
Descriptor	Employability and job-ready skills, and entrepreneurship skills and capabilities/ qualities and mindset: The graduates should be able to demonstrate the acquisition of knowledge and skill sets required for:
P.O. 28.	adapting to the future of work and responding to the demands of the fast pace of technological developments and innovations that drive the shift in employers' demands for skills, particularly with respect to the transition towards more technology-assisted work involving the creation of new forms of work and rapidly changing work and production processes.
P.O. 29.	exercising full personal responsibility for the output of own work as well as for group/team outputs and for managing work that is complex and unpredictable requiring new strategic approaches.

Programme Specific Outcomes (PSOs)

PSO1. Comprehend and Recall Advanced Zoological Concepts

Students will acquire and demonstrate comprehensive knowledge of animal structure, function, and diversity at molecular, cellular, physiological, developmental, and ecological levels.

They will understand advanced taxonomic, evolutionary, and comparative anatomical principles, integrating these with molecular and environmental perspectives to explain animal organization and adaptation.

PSO2. Apply and Analyze Complex Physiological and Molecular Mechanisms

Learners will apply physiological, biochemical, genetic, and molecular biology principles to interpret regulatory mechanisms in animals.

They will analyze complex biological interactions, including homeostasis, neuroendocrine regulation, and stress physiology, linking experimental data to functional adaptations and health-related phenomena.

PSO3. Perform and Integrate Research, Laboratory, and Field Skills

Students will attain proficiency in modern laboratory and field techniques such as microscopy, electrophysiology, chromatography, spectroscopy, molecular cloning, and environmental monitoring.

They will integrate quantitative and qualitative data, adhere to biosafety and ethical standards, and design innovative experiments reflecting independent scientific reasoning and problem-solving ability.

PSO4. Evaluate Environmental, Ethical, and Applied Aspects of Zoology

Graduates will evaluate the ecological and toxicological impacts of anthropogenic activities, analyze issues like pollution, biodiversity loss, and climate change, and propose sustainable conservation strategies.

They will demonstrate ethical responsibility in animal experimentation, wildlife management, and applied zoological research in accordance with national and international guidelines.

PSO5. Develop Research Aptitude, Communication, and Lifelong Learning Skills

Students will develop a research-oriented mindset capable of hypothesis formulation, data analysis, and interpretation using biostatistics and bioinformatics.

They will communicate scientific knowledge effectively through research publications, presentations, and interdisciplinary collaboration, fostering leadership, innovation, and lifelong learning.

SEMESTER I

ZOO 501: Non-Chordata

Course Objectives (COBJ)

1. To comprehend the organization, diversity, and functional morphology of major non-chordate groups from Protozoa to Annelida.
2. To understand evolutionary trends and adaptive features of non-chordates with emphasis on their ecological and biological significance.
3. To analyze comparative anatomical, physiological, and developmental characteristics to understand relationships among non-chordate phyla.
4. To develop practical knowledge in the identification, dissection, and microscopic examination of representative non-chordate organisms.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the structural organization, nutrition, reproduction, and locomotion in protozoans.
CO2	Describe the canal system and skeletal framework in Porifera, understanding their evolutionary and functional relevance.
CO3	Analyze the polymorphism and metagenesis in coelenterates to interpret life

	cycle and adaptive morphology.
CO4	Evaluate parasitic adaptations and tegumental specializations in platyhelminths as evolutionary strategies.
CO5	Discuss metameric segmentation and trochophore larva in annelids, emphasizing evolutionary importance.

CO–PO Mapping Table

CO No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PO 16	PO 17
CO 1	✓	✓	✓	✓	✓	✓											
CO 2	✓	✓	✓	✓	✓	✓	✓	✓									
CO 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							
CO 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
CO 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Protozoa: Nutrition, Reproduction, Locomotory organs and locomotion

UNIT II

Porifera: Canal System, Skeletal system

UNIT III

Cnidaria: Metagenesis in Obelia, Polymorphism: Polypoid and medusoid form

UNIT IV

Platyhelminthes: Evolution of Parasitism, Tegument and tegumental organs

UNIT V

Annelida: Metameric segmentation, Trochophore larva- Structure and significance

ZOO 502: Non-Chordata

Course Objectives (COBJ)

1. To understand the morphological, physiological, and evolutionary characteristics of higher non-chordates including Arthropoda, Mollusca, and Echinodermata.
2. To analyze the structural adaptations, larval forms, and developmental patterns in diverse non-chordate taxa.
3. To evaluate the physiological mechanisms and nervous organization of cephalopods and arthropods.
4. To interpret evolutionary significance of larval forms and segmentation in molluscs and echinoderms.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Describe mouth parts, feeding modes, and larval forms in Arthropoda, emphasizing crustacean development.
CO2	Explain the process and hormonal control of insect metamorphosis.
CO3	Analyze the organization and evolutionary relationships of Archimollusca and their segmentation patterns.

CO4	Evaluate the nervous system and sensory adaptations of Cephalopoda as advanced molluscs.
CO5	Interpret symmetry and larval forms in Echinodermata, assessing their phylogenetic significance.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	✓	✓	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓					
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Arthropoda: Mouth parts and mode of feeding, Crustacean larvae-Structure and significance.

UNIT II

Insect Metamorphosis and its hormonal control

UNIT III

Mollusca: Archimollusca (Ancestral Mollusca), Segmentation and Molluscan ancestry

UNIT IV

Cephalopoda - Nervous system and sense organs

UNIT V

Echinodermata: Symmetry, Larval form and its significance

ZOO 503: Chordata

Course Objectives (COBJ)

1. To understand the origin and evolution of chordates and their ancestral forms.
2. To study the diversity, morphology, and evolutionary significance of representative vertebrate groups from Pisces to Reptilia.
3. To analyze adaptive and anatomical modifications leading to major evolutionary transitions in vertebrates.
4. To evaluate comparative anatomical features of chordates for phylogenetic and taxonomic understanding.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the origin of chordates and early vertebrate evolution including Ostracoderms and Devonian fishes.
CO2	Describe structural and functional peculiarities of lung fishes (Dipnoi) and their evolutionary position.
CO3	Analyze the transition from aquatic to terrestrial life through the origin and adaptations of Amphibia.
CO4	Evaluate the evolutionary development of reptiles and the adaptive significance of their skull structure.
CO5	Interpret fossil evidence and evolutionary patterns among major chordate groups to understand phylogenetic relationships.

CO–PO Mapping Table – ZOO 503: Chordata

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	✓	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓	✓	✓	✓					
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Chordata: Origin of Chordates, Origin of Gnathostomes Pisces: Ostracoderms and Devonian fishes

UNIT II

Lung fishes (Dipnoi) and their peculiar features:

Amphibia: Origin of Tetrapoda

UNIT III

Reptilia: Origin of Reptiles, Mesozoic Reptiles, Skull of reptiles and its significance in classification of Reptilia

UNIT IV

Aves: Origin of Birds, Palate of Birds

UNIT V

Mammalia: Origin and evolution of Mammalia, Characteristic features-Monotremes, Marsupials and Placentals

Suggested Readings:

1. Orr, R.T. Morphology and biology of Reptiles.
2. De Beer, G.R. Vertebrate Zoology.
3. Romer, A.S. Vertebrate Body.
4. Majumuria, T.S. Introduction to Chordates.

ZOO 504: Evolution**Course Objectives (COBJ)**

1. To understand the fundamental principles, evidence, and molecular basis of organic evolution.
2. To analyze the development of evolutionary thought from pre-Darwinian to modern synthetic theories.
3. To explain the genetic mechanisms underlying evolutionary processes such as mutation, selection, drift, and migration.
4. To evaluate the genetic and ecological factors influencing speciation, hybridization, and adaptation in natural populations.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the concept of organic evolution and molecular evolution of proteins and nucleic acids.
CO2	Describe the historical development of evolutionary theories and the modern synthetic theory of evolution.
CO3	Analyze mutation, selection, genetic drift, and migration as key forces driving evolution.
CO4	Interpret the principles of population genetics, Hardy-Weinberg equilibrium, and conditions for genetic stability.

CO5	Evaluate mechanisms of speciation, reproductive isolation, and the evolutionary role of hybridization and subspecies formation.
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CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	✓	✓	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓					
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Concept of organic evolution: Evolution of Protein and Nucleic Acid Facts and theories of evolution: during pre- and Darwin era.

UNIT II

Evolution: a new synthesis: Developments and concept of synthetic theory, Elemental forces of evolution, Mutation, Selection (types of selection, selection coefficient, selection in natural population), Genetic drift: Changes in gene frequency in small population; Migration

UNIT III

Population genetics: Gene frequencies in Mendelian population, Hardy-Weinberg equilibrium, Conditions for the maintenance of genetic equilibrium

UNIT IV

The nature of reproductive isolation, genetic basis of isolating mechanisms Concepts of species and models of speciation: allopatric and sympatric speciation

UNIT V

The polytypic species, subspecies and infraspecies categories

The role of hybridization in evolution: Definition and immediate effect of hybridization.

Suggested Readings:

1. Organic Evolution: R.S. Lull
2. Dobzhansky Th.: Genetics and the Origin of Species. Columbia.
3. Freeman S. and Jon C. Herron (1998): Evolutionary Analysis. Prentice Hall
4. Futuyma D. J. (1998): Evolutionary Biology. Sinauer
5. Hartl D. L. and A. G. Clark (1989 & 1997): Principles of Population Genetics. Sinauer
6. Ridley M. (1993): Evolution. Blackwell.
7. Strickberger M. W. (2000): Evolution. White M. J. D. (1978): Modes of Speciation. Freeman

ZOO 505: Biostatistics

Course Objectives (COBJ)

1. To understand the fundamental concepts and applications of biostatistics in biological data analysis.
2. To develop the ability to summarize, present, and interpret biological data using statistical measures.
3. To apply probability distributions and statistical tests for hypothesis testing in biological research.
4. To evaluate relationships among biological variables using correlation, regression, and analysis of variance (ANOVA).

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Describe basic concepts of sampling, data collection, and presentation using tables and graphs.
CO2	Compute and interpret mean, standard deviation, and other measures of central tendency and dispersion.
CO3	Apply probability theory and distributions (Binomial, Poisson, and Normal) to biological data.
CO4	Conduct statistical hypothesis tests including t-test, F-test, Chi-square, and ANOVA for biological inference.
CO5	Analyze and interpret correlations and linear regressions in biological datasets.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓	✓	✓					
CO2	✓	✓	✓	✓	✓	✓	✓	✓			
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Population sample, random sample, tabular and graphical representation of data

UNIT II

Mean and standard deviation of grouped and ungrouped data Probability, relative frequency, probability distribution

UNIT III

Binomial, Poisson and Normal distribution

UNIT IV

Tests of significance- t, F, Chi- square test, test for goodness of fit Analysis of Variance

UNIT V

Correlation Linear regression

Suggested Readings:

1. George W. Snedecor, William G. Cochran. 1992. Statistical Methods. Wiley-Blackwell. 503pp.
2. Frederick Emory *Croxtan*, Dudley J. Cowden. 1939. Applied General Statistics. Prentice-Hall, 944pp.
3. Karmel, P.H. & Polasek, M. 1970. Applied statistics for economists. Publisher, Pitman. 519pp.
4. Spiegel, M.R.: Theory & Problems of Statistics, Schaum's outline series, McGraw Hill Pub. Co., New York : Schaum's Outline Series (McGrawHill), 1961
5. Spiegel, M.R.: Probability and Statistics. 1982. Paperback. Wiley's Summer Savings Event. Amazon.com.
6. Marylees Miller, Irwin Miller, 2012. Freund, John, E's Mathematical Statistics with Applications. 624pp. Paperback. Pearson.

ZOO 531: Lab course/Practical

SEMESTER II

ZOO 506: Ecology

Course Objectives (COBJ)

1. To understand population dynamics, community interactions, and ecological principles governing natural systems.
2. To analyze models of population growth, interspecific competition, and niche concepts in ecological studies.
3. To evaluate biogeochemical cycles, energy flow, and ecosystem productivity in terrestrial and aquatic systems.
4. To apply ecological knowledge to biodiversity conservation, habitat management, and remote sensing applications.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain population growth models, intrinsic rate of increase, and factors influencing population regulation.
CO2	Analyze interspecific competition using Lotka–Volterra models and interpret niche parameters and biodiversity patterns.
CO3	Apply thermodynamic laws to ecological energetics and construct energy-flow and food-web models.
CO4	Evaluate biogeochemical cycles and community organization with respect to ecosystem stability and nutrient cycling.
CO5	Discuss ecological succession, habitat ecology, and the use of remote sensing in environmental monitoring.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Population growth: Exponential and logistic patterns of population growth, Intrinsic rate of natural increase $[r]$, its determination and importance in population ecology.

UNIT II

Lotka- Volterra Model of interspecific competition. Modern concepts of Niche. Niche parameters. Niche overlap.

Biodiversity: Measures of species diversity. Global diversity patterns and mechanisms.

UNIT III

Law of thermodynamics as they relate to ecological energetic. Food webs

UNIT IV

Biogeochemical cycles: Nitrogen, Phosphorous and Sulphur cycles in terrestrial and aquatic ecosystems. Community organization and its dynamics. Energy flow models.

UNIT V

Ecological succession, its types and concept of climax. Ecology of various habitats.

Remote sensing, Practical applications of ecology.

Suggested Readings:

1. Calver, M., Lymbery, A., McComb, J. and Bamford, M. Environmental Biology.
2. Clarke. Elements of Ecology.
3. Odum. E.P. 1965. Ecology. Amerind Publishing, New Delhi.
4. Kendeigh. S.C. Ecology with Special reference to Animal and Man
5. Allee, Emerton, Park and Schmidt. Principles of Animal Ecology.
6. Krebs, C.J. Ecology
7. Joseph. M. 1984. Ecology 2000. (Eds. Edmond Hillary. London).

ZOO 507: Methodology & Instrumentation

Course Objectives (COBJ)

1. To understand the principles, working, and applications of advanced microscopic and spectroscopic techniques.
2. To gain knowledge of common laboratory methods, autoradiography, and radioactive tracer techniques.
3. To learn the fundamental principles of chromatography, electrophoresis, and centrifugation for biochemical separation and analysis.
4. To apply analytical and hydrobiological techniques for estimation of inorganic ions using modern instruments.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the principles and working of fluorescence, scanning, and transmission electron microscopes.
CO2	Describe autoradiographic techniques and radioactive labeling with counting methods like liquid scintillation.
CO3	Apply principles of chromatography, electrophoresis, and centrifugation for separation and identification of biomolecules.
CO4	Evaluate spectrophotometric and spectrofluorometric techniques for quantitative biochemical analysis.
CO5	Demonstrate understanding of hydrobiological estimation of inorganic ions and the use of analytical instruments such as flame photometer and nephelometer.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓	✓	✓	✓					
CO2	✓	✓	✓	✓	✓	✓	✓	✓			
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Fluorescence and Electron Microscopy (SEM & TEM) with principles and working.

UNIT II

General laboratory methods, Autoradiography, radioactive labeling and counting i.e. liquid scintillation

UNIT III

Principles of chromatography and electrophoresis, centrifugation and ultracentrifugation

UNIT IV

UV- VIS Absorption Spectrophotometry, Spectroflurometry

UNIT V

Hydrobiological techniques for determination of inorganic ions in water (Na^+ , K^+ , Ca^{++} , Li^+ , SO_4^- , PO_4^- , and Cl^-)

Instruments: Flame Photometer, Nephelometer.

ZOO 508: Animal Physiology

Course Objectives (COBJ)

1. To understand the structural organization and physiological mechanisms in animals, with emphasis on muscular and neural functions.
2. To analyze the roles of major sense organs, osmoregulatory systems, and excretory mechanisms in maintaining homeostasis.
3. To evaluate hormonal regulation, reproductive physiology, and environmental adaptations in animals.
4. To comprehend molecular and cellular aspects of active transport, signal transduction, and stress physiology.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the ultrastructure of muscle, mechanism of contraction, and nerve conduction including neurotransmitter function.
CO2	Describe sensory physiology, electric organs, and mechanisms of osmoregulation and excretion in animals.
CO3	Analyze the physiological regulation of homeostasis through neural and endocrine coordination.
CO4	Evaluate reproductive physiology in males and females and interpret hormonal control mechanisms.
CO5	Discuss bioluminescence, active transport, signal transduction, and physiological adaptations to environmental stress.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Ultrastructure of Muscle and its contraction Nerve conduction and neurotransmitters

UNIT II

Major sense organs and receptors, electric organs Excretion and osmoregulation

UNIT III

Homeostasis- neural and hormonal

Reproduction- Male and female reproductive physiology

UNIT IV

Bioluminescence

Active transport across membranes

UNIT V

Endocrinology: Glands, hormonal secretions and functions Stress Physiology: High altitude and deep sea physiology Signal transduction

ZOO 509: Biochemistry

Course Objectives (COBJ)

1. To understand the fundamental principles of thermodynamics, bioenergetics, and the chemical basis of biomolecular reactions.
2. To study the chemistry, structure, and metabolism of carbohydrates, lipids, proteins, and nucleic acids.
3. To analyze enzyme kinetics, inhibition mechanisms, and the functional significance of cofactors, coenzymes, and vitamins.
4. To apply biochemical knowledge in understanding metabolic regulation, integration, and physiological relevance of biomolecules.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the concepts of thermodynamics, oxidation-reduction, electrolytes, and buffer systems including the Henderson–Hasselbalch equation.
CO2	Describe the structure, chemistry, and metabolism of carbohydrates through pathways like glycolysis, Kreb's cycle, and glycogen metabolism.
CO3	Analyze amino acid properties, protein structure, folding, and metabolism including the Ramachandran plot and protein targeting.
CO4	Evaluate lipid and nucleic acid metabolism emphasizing biosynthesis, oxidation, and regulation of biomolecules.
CO5	Discuss enzyme kinetics, inhibition, mechanisms of catalysis, and the biochemical roles of vitamins, cofactors, and coenzymes.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Thermodynamics: Elementary knowledge, oxidation-reduction, Electrolytes: Concepts of buffer, Handerson-Hasselbach equation

UNIT II

Carbohydrates: Chemistry, Glycolysis, Kreb's cycle, oxidative phosphorylation, gluconeogenesis, Hexose monophosphate pathway, glycogen metabolism, peptidoglycan

UNIT III

Amino acid: Chemistry, properties and metabolism

Proteins; Structure-Primary, secondary, tertiary and quaternary structure, Ramchandran plot, protein isolation, Solubilities and protein targeting

UNIT IV

Lipids: chemistry, metabolism of fatty acid and cholesterol Nucleic acids: Chemical nature, biosynthesis of nucleotides

UNIT V

Enzymes: Kinetics, inhibition, mechanism of action, Michaelis and Menton equation, isoenzymes allosteric enzymes, ribozymes, Abzymes

Vitamins (fat and water soluble) and coenzymes: Structure and functions

Elective (Any one of the following may be opted)

A. For Biology Student Biodiversity and Wild Life Nematology
Skill-development Communication Biology

B. For Non Biology Students Hormones and Health Basic Genetics
Elementary Biochemistry

ZOO 551: Biodiversity and Wild Life

Course Objectives (COBJ)

1. To understand the fundamental concepts of animal taxonomy, biodiversity, and conservation biology.
2. To apply molecular and quantitative tools for studying genetic diversity and conservation management.
3. To analyze factors leading to species extinction and evaluate wildlife health and population management techniques.
4. To promote understanding of conservation principles, forest management, and global biodiversity initiatives.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the principles of animal taxonomy, diversity, ecology, and their interrelationships in evolution and conservation.
CO2	Describe the role of molecular and genomic tools such as barcoding and RT-PCR in biodiversity studies and species identification.
CO3	Evaluate wildlife population management, capture, and handling techniques, emphasizing animal health and conservation ethics.
CO4	Assess sustainable forest management practices and the role of conservation biology in mitigating over-exploitation.
CO5	Discuss biodiversity values, conservation genetics, restoration ecology, and the role of national and international conservation organizations.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				

CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Animal Taxonomy and Diversity Ecology and Evolutionary Biology Conservation Biology
Quantitative Biology

UNIT II

Genomics and Biodiversity

Molecular Tools for diversity studies-Significance of Molecular Tools in Diversity and
Conservation Studies- Barcoding, RT-PCR.

UNIT III

Wildlife habitat and species populations Threat of species extinction

Wildlife Health and Population Management; Wildlife Health; Population Management-
Capture and Handling of Wild Animals

UNIT IV

Principles of forest management, forest and wildlife as natural resources. Conservation and
sustainable development.

Over-exploitation of wildlife natural resources

UNIT V

Concept of conservation with special reference to forest and wildlife management

- Conservation verses preservation
- Conservation Genetics-Genetic management of threatened species
- National Park tour, Wetland tour, High Altitude Techniques tour, and
- Management and Conservation Practice
- Values of biodiversity and conservation ethics
- Significance of ecological restoration in conservation
- Role of zoos, aquariums and botanic gardens in conservation, Concept of stakeholders.
International conservation bodies; IUCN, UNDP, FAO, WWF

Suggested Readings:

- Edward O. Wilson, 1996, Biodiversity, 521pp., National Academy Press.
- Alison J. Stattersfield, Michael J. Crosby, Adrian J. Long, and David C. Wege. 1998.
Endemic Bird Areas of the World: Priorities for Biodiversity Conservation. 846pp.
- Bibby, J., Collar, N.J., Crosby, M.J., Heath, M.F., Imboden, Ch., Johnson, T.H., Long, A.J.,
Stattersfield, A.J., and Thirgood, S.J. 1992. Putting biodiversity on the map: priority areas for
global conservation.

ZOO 552: Communication Biology

Course Objectives (COBJ)

- To understand the philosophical foundations, historical development, and key concepts governing enquiry-based study in biology.
- To explore scientific methodology, research design, data analysis, and ethical issues in biological research and communication.
- To develop competency in writing scientific proposals, reports, and research papers adhering to academic integrity.

4. To enhance skills in oral, visual, and legal communication of scientific knowledge through modern platforms and journalism.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the evolution of scientific enquiry in biology and its distinction from other natural sciences.
CO2	Describe the phases of scientific enquiry, including study design, data collection, and analysis in biological research.
CO3	Evaluate ethical considerations in research communication, including plagiarism, data manipulation, and animal/human experimentation ethics.
CO4	Develop proficiency in writing scientific proposals, reports, and research articles following structured academic conventions.
CO5	Demonstrate effective oral, poster, and media communication of scientific information, and understand intellectual property rights and patents.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Key concepts and their logic

Trends in Natural Sciences (Biology)

- Transition from Natural History to Enquiry based study in biology
- General introduction to Philosophy of Biology
- The differences in discipline specific philosophies (e.g. how philosophy of biology might differ from that of the physics etc.)

UNIT II

iv. Phases of Scientific Enquiry in Biology

- Problem identification/be of scientific approach.
- Choosing an appropriate system/s (Species, Ecosystem, Forest Type etc.)
- Design of a study
- Data Collection (Questionnaires, Surveys and Literature review)
- Data Analysis
- Ethics in Communication Biology.
- Social implications of Biological Communication
- Animal experimentation ethics, wild-life ethics and human experimentation ethics
- Data fudging and plagiarism

UNIT III

v. Importance of scientific communication

- Types of scientific communications- traditional and modern

vii. Different modes of scientific communication

- a. Proposal writing in Biology
 - i. Statement of Purpose (SOP) and Concept note
 - ii. Proposal for funding
 - iii. Report Writing

UNIT IV

- b. Research paper writing in Biology
 - i. Different types of research articles-Reviews, articles etc.
 - ii. Concept of peer reviewing
 - iii. Standard components of research communication

UNIT V

- c. Thesis writing in Biology
- d. Oral forms of scientific communication in Biology
 - i. Transformation of written content to oral form
 - ii. Poster presentation
 - iii. Oral presentations
- e. Scientific journalism (Print/media) in Biology
 - i. Science issues in public domain (explanation with case studies)
- f. Legal forms of communication of science IPR, patents submissions etc.

Suggested Readings:

1. Martha Davis 2005. Scientific Papers and Presentations
2. Strunk, Jr. W., white, E.B., 1979. The Elements of Style, 3rd Ed.
3. Grafen, A. and Ridley, M., 2006. Richard Dawkins: How a scientist changed the way we think. Oxford University Press.
4. Dawkins, R. 1998. Unweaving the Rainbow, Penguin Publication, London
5. Medawar, P.B. and Medawar, J.S. 1977. The Life Science: Current Ideas of Biology, Wildwood House, London
6. Barrow and Tipler 1988. The Anthropic Principle, Oxford University Press
7. Bowles, K.L. 1977. Problem Solving using Pascal, Berlin: Springer-Verlag.
8. Maynard Smith, J. 1986. The Problems of Biology, Oxford: Oxford University Press

ZOO 553: Nematology

Course Objectives (COBJ)

1. To understand the general characteristics, morphology, taxonomy, and life cycles of plant-parasitic nematodes.
2. To learn nematological techniques for sampling, extraction, identification, and processing of nematodes.
3. To analyze host–parasite relationships, nematode pathogenesis, and interaction with other microorganisms.
4. To evaluate and apply integrated management strategies for nematode-borne plant diseases.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the general characteristics, distribution, morphology, and classification of major plant-parasitic nematode groups.
CO2	Demonstrate proficiency in nematode sampling, extraction, and microscopic identification techniques.
CO3	Analyze the mechanisms of host–parasite interactions, histopathology, and

	the influence of abiotic factors on nematode infection.
CO4	Evaluate nematode interactions with fungi, bacteria, viruses, and other nematodes in the context of disease dynamics.
CO5	Apply integrated pest management principles, bio-control approaches, and chemical control methods for sustainable nematode disease management.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

General characters of plant parasitic nematodes: Distribution, morphology (Structural details of oesophagi, excretory, nervous and reproductive systems), life history, feeding habit, symptoms of plant nematode infection, Life history of root-knot nematode. Root knot disease of brinjal. Diagnostic features and classification of Tylenchoidea, Heteroderoidea, Criconematoidea, Aphelenchoidea, Dorylaimoidea and Trichodoroidea.

UNIT II

Techniques in Nematology: Methods of sampling (soil & plant samples), Methods of extracting nematodes from soil & plant samples, Methods of processing nematodes for observation. Identification of Anguina, Hoplolaimus, Helicotylenchus, Rotylenchulus, Tylenchulus, Meloidogyne. Heterodera and Xiphinema

UNIT III

Concept of plant disease, Host parasites relationship in nematode infection. Effect of abiotic factors in nematode multiplication. Mechanism involved in injury & histopathology of infected tissue.

UNIT IV

Interaction of Plant parasitic nematodes with fungi, bacteria and viruses. Nematode-Nematode interactions.

UNIT V

Broad principles of plant disease management: Disease forecasting, Integrated pest management (IPM), Regulatory and physical measures of disease management, Management of diseases by cultural practices, cropping sequences, organic amendments. Bio-control of nematode diseases. Epidemiology, Pathogenecity and Control of Root knot & Cyst Nematodes. Chemical measures of diseases management of nematicides.

Suggested Readings:

1. Perry, R.N., Perry, R. and Moens, M. 2013. Plant Nematology.
2. Stirling, G. 2014. Biological Control of Plant-parasitic Nematodes.
3. Kennedy, M. and Harnett, W. 2013. Parasitic Nematodes.

ZOO 554: Sericulture

Course Objectives (COBJ)

1. To understand the history, scope, and importance of sericulture and its role in rural and industrial development.
2. To study the biology, classification, and distribution of silkworm species and their food plants.
3. To analyze sericulture industry structure, seed production, reeling, weaving, and silk processing methods.
4. To evaluate mulberry cultivation practices, varietal selection, and economic aspects of sericulture.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the definition, history, and present scenario of sericulture, types of silkworms, and silk production processes.
CO2	Describe the prospects and economic importance of sericulture in India with emphasis on regional and employment potential.
CO3	Evaluate the role of research, training, and extension centers, including CSB and State Directorates in sericulture development.
CO4	Identify mulberry species, their morphology, distribution, and varieties used in Indian sericulture.
CO5	Apply knowledge of mulberry cultivation, harvesting, and management to analyze cost–benefit aspects of sericulture under different agro-climatic conditions.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Sericulture: Definition, history and present status. Silkworms: Types of silkworms, their food plants and distribution. Silk production: Mulberry and non-mulberry cocoon and yarn.

UNIT II

Prospects of Sericulture in India. Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture.

UNIT III

Sericulture Centres. Research Training and extension. Seed production, reeling, re-reeling, twisting, doubling, weaving, processing and trading centres. Central Silk Board (CSB): Role in Extension and development. Directorate of Sericulture: Extension and development in sericulture on state level.

UNIT IV

Mulberry plant morphology: Mulberry species: Classification, distribution and common varieties used in Sericulture in India.

UNIT V

Mulberry cultivation, harvesting & management. Economics: irrigated, non-irrigated & temperate region cultivation. Cost-benefit ratio.

Suggested Readings:

1. Ganga, G. and Sulochana Chett, J. 1997. Introduction to Sericulture. 302pp.
2. Anonymous. 1987. Manuals on Sericulture, CSB, Bangalore
3. Koshy, T.D. 1990 Silk Export and development, Ashish Publ. House, New Delhi
4. Yokoyama, T. 1959. Silkworm Genetics illustrated, Japanese Society for Promotion of Science, Japan.
5. Anonymous. 1993. Principles and techniques of silkworm Breeding, United Nations, USA (Oxford IBH, Calcutta)
6. Anonymous. 1997. Silkworm Egg production (Translated from Japanese) Oxford IBH, New Delhi
7. Anonymous. 1997. Silkworm rearing. (Translated from Japanese) Oxford IBH, New Delhi
8. Anonymous. 1972. Handbook of Silkworm rearing, Fuji Publ. Co., Tokyo, Japan
9. Jolly et al. 1974. Tasar Culture, CSTRI, Ranchi
10. Sathe, T.V. 1998. Sericultural crop Protection, Asawari Publ, Osmanabad.
11. Aruga, H. 1994 Principle of Sericulture, (Translated from Japanese) Oxford and IBH Publ., New Delhi
12. Sarkar, Dilip de 1998. The silkworm Biology, Genetic and breeding, UBS Publ. New Delhi
13. Jolly et al. 1987. Appropriate sericulture techniques, CSR & TI, Mysore

ZOO 555: Hormones and Health

Course Objectives (COBJ)

1. To understand the structure, organization, and functional role of the endocrine system in maintaining homeostasis.
2. To study the pathophysiology, etiology, and treatment of major endocrine and metabolic disorders.
3. To analyze the hormonal basis of reproduction, sexual health, and associated disorders.
4. To evaluate the role of endocrine disruptors in disease susceptibility and human health.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the anatomy and physiology of endocrine glands and describe hormonal regulation mechanisms.
CO2	Identify and classify major endocrine disorders including pituitary, thyroid, and adrenal dysfunctions.
CO3	Analyze the hormonal regulation of metabolism and the pathophysiology of diabetes and obesity.
CO4	Evaluate reproductive and sexual health disorders, including PCOD, osteoporosis, and their hormonal bases.
CO5	Discuss the mechanisms and health impacts of endocrine disruptors in modern environmental contexts.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				

CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Endocrine system: Brief description of the organization and function of endocrine glands

Endocrine disorders: Types, causes and treatment

Pituitary disorder

Panhypopituitarism, acromegaly and gigantism

UNIT II

Thyroid disorder Hypo/Hyper Thyroidism

Goitre, Hashimoto's Thyroiditis

UNIT III

Adrenal Disorder

Addison's disease; Cushing's syndrome; Grave's disease

UNIT IV

Hormones and metabolic disorders:

Diabetes (Type I and Type II) Obesity

UNIT V

Reproductive/sexual disorders:

Polycystic ovarian disease; Osteoporosis

Endocrine disruptors and disease susceptibility

Suggested Readings:

1. William's Text Book of Endocrinology: Shlomo Melmed, Kenneth S. Polonsky, P. Reed Larsen
2. Guyton's text book of Medical Physiology

ZOO 556: Basic Genetics

Course Objectives (COBJ)

1. To understand the basic organization, structure, and function of chromosomes, genes, and genomes.
2. To study chromosomal behavior, inheritance patterns, and the molecular mechanisms of genetic transmission.
3. To analyze Mendelian and non-Mendelian inheritance, genetic linkage, and chromosomal aberrations.
4. To explore genetic disorders and the cytogenetic basis of mutation and chromosomal variations.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the structural organization and packaging of chromosomes, nucleosome model, and genome components.
CO2	Differentiate between euchromatin and heterochromatin, and understand sex chromosome composition and dosage compensation mechanisms.
CO3	Describe mitotic and meiotic cell divisions and apply principles of inheritance to genetic analysis.
CO4	Interpret Mendel's laws, test and back crosses, and patterns of sex-linked inheritance.
CO5	Analyze genetic disorders, mutations, and chromosomal aberrations

underlying human syndromes.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Basic concept of chromosome, gene, allele and genome Structure and function of chromosomes
Chromosome packaging, Nucleosome model

UNIT II

Euchromatin and Heterochromatin

Autosomes and sex chromosomes; Barr body and Dosage compensation

UNIT III

Mitosis and Meiosis Principles of Inheritance

UNIT IV

Mendel's Laws: Back cross and Test cross Sex-linked inheritance

UNIT V

Genetic disease: Down syndrome; Klinefelter syndrome and Turner's syndrome Mutation,
Chromosomal aberration

ZOO 557: Elementary Biochemistry

Course Objectives (COBJ)

1. To understand the basic principles of biomolecular organization and the structural diversity of carbohydrates, proteins, lipids, and nucleic acids.
2. To study enzyme properties, mechanisms, and the biological significance of vitamins in metabolism.
3. To analyze the role of DNA as genetic material and the fundamental processes of replication, transcription, and translation.
4. To evaluate the biochemical pathways of energy production, including glycolysis, Krebs's cycle, and oxidative phosphorylation.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the organization, classification, and structure–function relationship of biomolecules such as carbohydrates, proteins, lipids, and nucleic acids.
CO2	Describe the biochemical significance of nucleotides, nucleosides, and DNA structural organization.
CO3	Analyze enzyme properties, catalytic mechanisms, and the classification and roles of vitamins in metabolism.
CO4	Interpret the molecular basis of genetic processes including DNA replication, transcription, and translation.
CO5	Evaluate key metabolic pathways such as glycolysis, Krebs's cycle, and

	oxidative phosphorylation in energy metabolism.
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CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Biomolecules: Organizational principle, scope and importance, Carbohydrate; Classification, Structure and conformation, Proteins; Amino acids. Structural organization and functions, Lipids

UNIT II

Biological significance and classification, Nucleic Acids; Bases, nucleosides and nucleotides, structure of DNA

UNIT III

Enzymes: General properties, major classes of enzymes, Elementary knowledge of mechanism of action Vitamins: Introduction, classification and significance

UNIT IV

DNA as genetic material; Elementary knowledge of Replication, transcription and translational processes.

UNIT V

Introduction of Glycolysis, Krebs's cycle, Oxidative phosphorylation, Oxidation of fatty acids.

ZOO 532-533: Lab course/Practical

SEMESTER III

ZOO 510: Formal and Experimental Embryology

Course Objectives (COBJ)

1. To understand the descriptive embryology of vertebrates with reference to frog and chick, emphasizing cleavage, gastrulation, and germ layer formation.
2. To study the organizer concept, induction mechanisms, and developmental patterning during embryogenesis.
3. To analyze processes such as metamorphosis, regeneration, and placentation in various animal groups.
4. To evaluate experimental embryological techniques and the influence of teratogenic agents on development.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the types of eggs, cleavage patterns, and morphogenetic movements during gastrulation in amphibians and birds.
CO2	Describe the concept of organizer, primary and secondary induction, and mechanisms of pattern formation during vertebrate development.
CO3	Analyze the physiological and hormonal control of metamorphosis and regeneration in amphibians and invertebrates.
CO4	Discuss foetal membranes, types and functions of placentation, and mechanisms of teratogenesis and congenital abnormalities.
CO5	Evaluate the experimental approaches used in embryology, including vital dyeing, extirpation, isolation, and transplantation techniques.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Descriptive embryology with particular reference to frog and chick

Egg types; Cleavage Patterns; Fate maps; Morphogenetic movement and formation of germ layers; Gastrulation in amphibian and birds

UNIT II

Organizer concept: Properties and physiology of organizer; Primary Organizer and Primary Induction, neurulation . Secondary Induction: Development and patterning of vertebrate limb, proximal- distal and dorso- ventral axis formation, Involvement of pattern forming genes

UNIT III

Metamorphosis in frogs, hormonal regulation Regeneration (Epimorphic/Morphallactic) Regeneration of the amphibian limb Regeneration in Hydra

UNIT IV

Teratogenesis: environmental assaults on development; teratogenic agents; teratological abnormalities

Experimental Embryology: Basic Concepts

Experiments on the analysis of early development and differentiation (Experiments of Spemann and Mangold) vital dyeing, extirpation, isolation, transplantation

Role of nucleus, cytoplasm and yolk

1. Balinsky, *B.I.* : An Introduction to *Embryology*, . Holt-Saunders, Philadelphia.
2. S. F. Gilbert. Developmental Biology

Course Objectives (COBJ)

1. To introduce students to the fundamental concepts, mechanisms, and evolution of animal behaviour.
2. To study classical and modern approaches to ethology, emphasizing neurophysiological and genetic mechanisms underlying behaviour.
3. To analyze the development of behaviour through innate and learned processes and understand fixed action patterns.
4. To explore neural and hormonal mechanisms of learning, memory, motivation, and social behaviour in animals.

Course Outcomes (COs)	
CO No.	Course Outcomes
CO1	Explain the basic principles, definitions, and mechanisms regulating animal behaviour.
CO2	Describe major contributions of classical ethologists and modern behavioural biologists in understanding animal behaviour.
CO3	Analyze methods for studying animal behaviour in wild and laboratory conditions using neuroanatomical, neurophysiological, and neurochemical approaches.
CO4	Differentiate between innate and learned behaviours, and understand neural and genetic mechanisms of instinct and learning.
CO5	Evaluate the evolutionary, hormonal, and motivational bases of behaviour and memory formation.

[illegible]

UNIT I

Definition and general mechanism of animal behaviour

Major contribution of scientists: In classical ethology and modern behavioural biology

UNIT II

Modern concepts of animal behaviour: Ethological, Psychological and Evolutionary

Methods of study of animal behaviour: In wild and laboratory environment, Neuroanatomical, Neurophysiological and Neurochemical approach

UNIT III

Development of behaviour: Innate and Learned; Comparative account on characteristics of instinct and learning; Types of fixed action patterns (FAPs); Neuro-genetic mechanism of instinct

UNIT IV

Learning and Memory: Classification or forms of learning and memory, Neural mechanisms of learning and memory

UNIT V

Evolution of behaviour, Hormones and behaviour, Motivation and behaviour

Suggested Readings:

1. Manning, A. An Introduction of Animal Behaviour.
2. Russell, E.S. The behaviour of Animals.
3. Mc Farland, D. Animal Behaviour: Psychology, Ethology & Evolution.
4. Alcock, J. Animal Behaviour: An evolutionary approach.
5. Dugatkin, L.A. Principles of Animal Behaviour.
6. Silverman, P. Animal Behaviour in the laboratory.

ZOO 512: Biotechnology

Course Objectives (COBJ)

1. To introduce students to the fundamental principles of recombinant DNA technology and gene cloning techniques.
2. To study the tools, enzymes, and vectors used in molecular cloning and their applications in biotechnology.
3. To understand cell, tissue, and organ culture techniques, hybridoma technology, and their biomedical applications.
4. To explore environmental and health care biotechnology, including pollution control, gene therapy, and bioinformatics tools.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the basic concepts of recombinant DNA technology, enzymes used, and steps in gene cloning.
CO2	Describe the structure and function of cloning vectors, gene probes, and production of recombinant biomolecules like insulin and growth hormone.
CO3	Analyze the principles and applications of tissue culture, hybridoma technology, stem cell transfer, and animal cloning.
CO4	Evaluate the applications of environmental biotechnology in

	bioconversion, pollution control, and sewage treatment.
CO5	Discuss health care biotechnology including gene therapy, biosensors, DNA fingerprinting, and immobilized enzyme technology.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Recombinant DNA technology: Introduction, Restriction endonucleases and applications, other useful enzymes for molecular cloning, steps in gene cloning, identification and isolation of desired gene.

UNIT II

Cloning vectors, screening and selection of recombinant DNA clones, gene probes as diagnostic. tools, biosynthesis of insulin, somatostatin and growth hormone

UNIT III

Tissue culture, hybridoma technology and monoclonal antibodies: Cell culture, organ, cultures, culture media, embryonic stem cell transfer, targeted gene transfer, in vitro fertilization in humans, embryo transfer in cattle, applications of embryo transfer technology, animal cloning

UNIT IV

Environmental biotechnology: Bioconversions, pollution control, microbial enhancement of oil recovery, microbial mining and metal recovery, sewage treatment

UNIT V

Health care biotechnology: gene replacement therapy

Miscellaneous: An introductory knowledge of biosensors, biochips, DNA fingerprinting, Immobilized enzymes, bioenergy, genomic DNA libraries

ZOO 513: Molecular Biology

Course Objectives (COBJ)

1. To understand the structural organization and kinetic behavior of eukaryotic DNA, and the mechanisms of DNA replication and repair.
2. To study the transcription and translation mechanisms, gene organization, and regulation in eukaryotes.
3. To analyze the molecular basis of protein synthesis, RNA processing, and organelle genome organization.
4. To explore viral genetics, replication mechanisms, and the molecular biology of cancer and genetic disorders.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the molecular structure, composition, and replication mechanisms of eukaryotic DNA including repair and mispair processes.

CO2	Describe the transcription machinery, promoter and enhancer elements, and the organization of eukaryotic genes such as globin and histone genes.
CO3	Analyze the mechanisms of translation, mRNA processing, genetic code, and the organization of organelle genomes.
CO4	Discuss the structure, life cycle, and genetic importance of bacteriophages, tumour viruses, and retroviruses.
CO5	Evaluate molecular mechanisms involved in oncogene activation, carcinogenesis, gene targeting, and gene silencing.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Molecular analysis of eukaryotic DNA- overall composition, reassociation kinetics, kinetic analysis of eukaryotic DNA,

Nucleotide polymerases, DNA replication, repair and mispair mechanisms UNIT II

The basic transcription apparatus, promoters, enhancers, termination and antitermination Organisation of eukaryotic genes-globin gene, IgG, r DNA, histone gene

UNIT III

Genetic code, protein synthesis, translation, m-RNA processing and organization of interrupted genes, Ribonucleoproteins, organelle genomes.

UNIT IV

Structure and life cycles of bacteriophage T2 or T4 virulent and temperate phages, phage mutants and their importance

RNA phages, tumour viruses and their life cycles, retroviruses, Topoisomerases, gyrases, methylases, nucleases

UNIT V

Molecular biology of cancer: Oncogenes, chemical carcinogenesis

Genetic and metabolic disorders, Principles and methods of gene targeting, gene silencing

Elective (Any one of following may be opted)

Entomology

Parasitology

Fish & Fisheries Environmental Biology Cell Biology

ZOO 558: Entomology – Morphology and Embryology

Course Objectives (COBJ)

1. To study the external morphology and structural organization of the insect body, including head, thorax, and abdomen.
2. To understand the structure and functions of the insect cuticle and fat body and their physiological

significance.

3. To analyze the embryonic development in insects including egg structure, germ band formation, and germ layer differentiation.

4. To examine different larval and pupal forms, their adaptive significance, and the process of metamorphosis and pheromonal regulation.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Describe the morphology and segmentation of the insect body including the head, thorax, and abdomen.
CO2	Explain the composition and functional aspects of the insect cuticle and fat body.
CO3	Analyze the structure of insect eggs, processes of blastoderm and germ band formation, and germ layer differentiation.
CO4	Identify and classify larval and pupal types, explaining their adaptive and developmental significance.
CO5	Discuss the physiological and biochemical aspects of metamorphosis and the role of pheromones in insect behavior.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

General structure of Head, Thorax and abdomen

UNIT II

Structure and functions of insect cuticle. Structure and functions of the fat body.

UNIT III

Structure of insect egg. Blastoderm formation, germ band, blastokinesis and three germ layers.

UNIT IV

Various types of larvae and pupae, significance of pupal instar in insects.

UNIT V

Metamorphosis. Pheromones

ZOO 559: Parasitology

Course Objectives (COBJ)

1. To understand the ecological and biological principles governing host-parasite relationships and parasite adaptations.

2. To study host specificity, pathophysiology, and immunological aspects of parasitic infections.

3. To analyze mechanisms of host-parasite interactions and the role of immunity in controlling vector and non-vector borne diseases.

4. To evaluate diagnostic and prophylactic techniques used in parasitology, along with population dynamics and invasive potential of helminths.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the bionomics, ecology, and environmental adaptations of parasitic helminths in their hosts.
CO2	Describe different types of host specificity, pathophysiological responses, and immunological mechanisms against parasites.
CO3	Analyze the physiology of host–parasite interactions and the immunological control of parasitic diseases.
CO4	Apply immunodiagnostic and immunoprophylactic techniques for identifying and preventing parasitic infections.
CO5	Evaluate population dynamics, bioinvasion, and epidemiological trends of helminth parasites.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Bionomics: Habitat; variety in host parasite relationship

Micro- and Macro- environment of parasites: Autecology and synecology of parasitic helminthes

UNIT II

Host specificity (definition and kinds of host specificity) Pathophysiology and Immunoparasitology

UNIT III

Physiology of host-parasite interactions.

Immunological control of vector borne and non-vector borne diseases

UNIT IV

Immunodiagnosis and immunoprophylaxis

Immunodiffusion: Fluorescent antibody technique: Serological diagnosis, diagnostic techniques (coprological urine and blood)

UNIT V

Population dynamics of helminthes Bioinvasion & helminthes

Suggested Readings:

1. Schimdt, G.D. and Roberts, L.S. Foundations of Parasitology
2. Maule, A.G. and Dr. N.J. Marks Parasitic Flatworms, Molecular Biology, Biochemistry, Immunology, Physiology
3. Hempel, P.S. Evolutionary Parasitology
4. Gunn, A. and Pitt, S.J. Parasitology: An Integrated Approach
5. Khalil, L.F. Jones, A. and Bray, R.A. Keys to the Cestode Parasites of Vertebrates
6. Rohde, K. Marine Parasitology

7. Duijn, V. 1973. Diseases of Fish
8. Dogiel, Perrushevski and Polyanski. 1958. Parasitology of fish.
9. Cheng 1964. The biology of animal parasites.
10. Smyth J.D. 1976 Introduction to Animal Parasitology.
11. Schell. 1970. How to know the trematodes.
12. Erasmus. 1972. The biology of trematodes.

ZOO 560: Fish & Fisheries

Course Objectives (COBJ)

1. To understand the taxonomy, classification, and evolutionary history of different fish groups.
2. To study the origin, adaptations, and ecological significance of various groups of fishes.
3. To analyze the anatomical and functional features of skin, scales, and fins in teleosts.
4. To explore the physiology and hormonal control of fish migration and their ecological importance.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the classification and evolutionary relationships of Elasmobranchs, Holocephalians, Dipnoans, and Actinopterygians.
CO2	Describe the origin and evolutionary adaptations of fishes to different aquatic environments.
CO3	Analyze morphological and physiological adaptations of hill-stream and deep-sea fishes.
CO4	Evaluate the structural diversity and functions of skin, scales, and fins in teleost fishes.
CO5	Discuss the mechanisms and hormonal regulation of fish migration with examples of Salmon and Eel.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Classification; Elasmobranchs, Holocephalians, Dipnoans and Actinopterygians (including the ancestral groups of Acanthodians. Placoderms and Crossopterygians)

UNIT II

Origin and evolution of major groups of fish

UNIT III

Adaptation of fishes; Hill-stream and deep sea

UNIT IV

UNIT V

Suggested Readings:

1. Datta Munshi, J.S. and M.P. Srivastava. Natural History of Fishes and Systematic of Fresh water Fishes of India. 2006 Narendra Publ. House, New delhi
2. Gupta S.K. and Gupta P.C. General and Applied Ichthyology.
3. Srivastava, C.B.L. A. textbook of Fishery Science and Indian Fisheries.
4. Lagler et. al. Ichthyology
5. Norman, J.R. A History of Fishes.
6. Kyle, H.M.A. Biology of Fishes
7. Khanna, S.S. An Introduction to Fishes.

Course Objectives (COBJ)

1. To introduce the scope, principles, and applications of environmental biology in understanding human–environment relationships.
2. To identify and analyze environmental problems at local, regional, and global scales.
3. To study resource exploitation, energy utilization, and their environmental implications in developing and developed nations.
4. To understand the biochemical and toxicological basis of environmental pollution and its ecological consequences.

CO No.	Course Outcomes
CO1	Explain the meaning, scope, and applications of environmental biology in ecosystem management.
CO2	Identify local, regional, and global environmental issues and suggest potential mitigation strategies.
CO3	Evaluate the environmental impacts of resource exploitation and energy consumption in different socioeconomic contexts.
CO4	Analyze environmental biochemistry and toxicological interactions between pollutants and living organisms.
CO5	Assess the sources and factors influencing environmental toxicity and develop awareness for pollution control.

[illegible]

UNIT I

Meaning and Scope of Environmental Biology. Practical application of Environmental Biology.

UNIT II

Environmental Problems: Local, regional and global.

UNIT III

Environmental problems associated with resource exploitation and energy utilization in developing and developed countries.

UNIT IV

Environmental Biochemistry. Environmental Toxicology.

UNIT V

Sources of toxic substances in the environment.

Factors affecting toxicity.

Suggested Readings:

1. Elements of Ecology. Clarke
2. Ecology, Eugene P. Odum. 1965. Amerind Publishing, New delhi
3. Ecology with Special reference to Animal and Man. S. Charles Kendeigh
4. Principles of Animal Ecology : Allee, Emerton, Park and Schmidt.
5. Ecology. C.J.Krebs.
6. Ecology 2000. Eds. Edmond Hillary. London Michael Joseph. 1984.

ZOO 562: Cell Biology

Course Objectives (COBJ)

1. To understand the fine structural organization and functional aspects of plasma membrane and transport mechanisms.
2. To study the structure, biogenesis, and functions of cellular organelles such as ER, Golgi apparatus, ribosomes, lysosomes, peroxisomes, and mitochondria.
3. To analyze the mechanisms of protein synthesis, intracellular trafficking, and cellular metabolism.
4. To evaluate nuclear organization, envelope structure, and nuclear pore complex dynamics in eukaryotic cells.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the structural models, composition, and transport mechanisms of the plasma membrane.
CO2	Describe the structure and function of endoplasmic reticulum and Golgi apparatus in protein synthesis and modification.
CO3	Analyze the role of ribosomes, lysosomes, and peroxisomes in cellular organization and macromolecular processing.
CO4	Evaluate the structure and function of mitochondria with reference to oxidative phosphorylation and electron transport chain.
CO5	Discuss the ultrastructure of the nucleus, organization of nuclear envelope, and function of nuclear pore complexes.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Plasma membrane: Fine structural details with reference to various models, functions of plasma membrane; Transport across cell membranes: active transport, phagocytosis, pinocytosis.

UNIT II

Endoplasmic reticulum: Structure and function (protein uptake and modification).

Golgi apparatus: Origin, development, fine structural details and functions; protein sorting in Golgi apparatus.

UNIT III

Ribosomes; prokaryotic and Eukaryotic ribosomes, mechanism of protein synthesis. Lysosomes: Structure, types (primary and secondary), formation and function, peroxisomes

UNIT IV
Mitochondria: Morphology, conformational states, fine structural detail and functions (Electron Transport Chain and Oxidative phosphorylation)

UNIT V

Nucleus: ultra structure, nuclear envelope, structure and function of nuclear pore complex, internal organization

Suggested Readings:

1. Lodish, Molecular Biology of the Cell.
2. Karp, G. (7th Edition), Cell and Molecular Biology: Concepts and Experiments.
3. Alberts ET Al., Essentials of Cell Biology

ZOO 534-535: Lab course/Practical

SEMESTER IV

ZOO 514: Bioinformatics

Course Objectives (COBJ)

1. To introduce the fundamental concepts of bioinformatics and its applications in genomics, proteomics, and computational biology.
2. To understand biological databases and algorithms used for sequence alignment and data analysis.
3. To study the principles of phylogenetic tree construction and interpretation in evolutionary biology.
4. To explore computational methods, statistical approaches, and bioinformatics tools used for evolutionary and molecular studies.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the scope and applications of bioinformatics in biological and medical sciences.
CO2	Describe the types and functions of biological databases such as GenBank, EMBL, and PDB.
CO3	Apply sequence alignment methods and algorithms (Needleman-Wunsch, Smith-Waterman, BLAST, FASTA) for biological data analysis.
CO4	Analyze phylogenetic relationships using different tree construction methods such as Maximum Likelihood, UPGMA, and Neighbor Joining.
CO5	Evaluate evolutionary and genetic relationships through bootstrapping, split decomposition, and pedigree analysis.

CO–PO Mapping Table

[illegible]

CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
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UNIT I

Biology & IT, Computers in Biology and medicine, Introduction to Genomics and Proteomics etc.

Definition and terminology: Cladogram, Dendrogram, Phylogram and Phenogram; Operational taxonomic unit (OTU), Informative sites.

UNIT II

Biological sequence data banks (GENBANK, EMBL, SWISSPORT, PDB)

Sequence alignment (Global & Local), Algorithms used (Dynamic & Heuristic) - Needleman Wunsch, Smith Waterman BLAST, FASTA

UNIT III

Trees: Rooted and unrooted trees

Species Tree and Gene Tree: Homology, Homoplasy, Orthology, Paralogy and Xenology

Trees Construction Methods: Maximum Parsimony, Maximum Likelihood, Branch and Bound

UNIT IV

Fitch- Margoliash method and distance based methods.

Distance based methods: Least squares, Neighbor joining, UPGMA

UNIT V

Bootstrapping and split decomposition; Concepts and its application in tree construction Application of Phylogeny; Evolutionary study, Pedigree analysis.

Suggested Readings:

1. Bioinformatics-Sequence and Genome Analysis-David W. Mount, CSHL Press
2. Molecular Systematics, 2nd ed. D.M. Hillis, C. Moritz and B.K. Mable, Sinauer Associates, Sunderland. Massachusetts.
3. Fundamental Concepts of Bioinformatics, Krane, D.E. and Raymer M.L. Pearson Education

Elective Entomology

ZOO 563: Insect Physiology

Course Objectives (COBJ)

1. To understand the structural and functional organization of the insect digestive system and associated physiological processes.
2. To study the excretory, respiratory, and circulatory systems of insects with special reference to physiological adaptations.
3. To explore the role of haemocytes and endocrine glands in insect metabolism and regulation.
4. To comprehend diapause mechanisms and hormonal regulation of insect physiology.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the structure and physiology of the alimentary canal and mechanisms of digestion in insects.

CO2	Describe the structure and excretory function of Malpighian tubules in relation to osmoregulation.
CO3	Analyze respiratory mechanisms and adaptations in aquatic and endoparasitic insects.
CO4	Evaluate the composition, types, and functions of haemocytes and the phenomenon of diapause.
CO5	Discuss the structure and functions of insect endocrine glands and hormones in regulating physiological activities.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Alimentary canal and digestion in insects.

UNIT II

Structure and function of Malpighian tubules.

UNIT III

Structure and function of insect spiracle. Respiration in aquatic and endoparasitic insects.

UNIT IV

Composition and function of haemocytes. Diapause.

UNIT V

Endocrine glands and insect hormones.

ZOO 564: Taxonomy and Economic Entomology

Course Objectives (COBJ)

1. To understand the principles of insect taxonomy and modern classification, emphasizing economically important orders.
2. To study the biology, nature, and control strategies of major agricultural and stored-product insect pests.
3. To explore the economic importance and management of beneficial insects like honeybees and silkworms.
4. To develop applied entomological knowledge for sustainable pest control and apiculture/sericulture industries.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the modern classification of insects with focus on economically important orders such as Lepidoptera, Diptera, and Coleoptera.
CO2	Analyze the life cycle, damage patterns, and management of major pests of paddy, sugarcane, and cotton.
CO3	Evaluate control measures and storage management practices for pests of stored products.
CO4	Describe the biology, behavior, and economic importance of honeybees and their role in apiculture.
CO5	Discuss the life cycle, management, and industrial significance of silkworms in sericulture.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Modern classification of insects with special reference to that of different economically important orders (Lepidoptera, Diptera, Coleoptera).

UNIT II

Biology, nature and extent of damage and control of pests of paddy, sugarcane and cotton

UNIT III

Pests of stored products.

UNIT IV

Beneficial insects- honeybee

UNIT V

Beneficial insects- silkworm.

ZOO 565: Toxicology

Course Objectives (COBJ)

1. To provide an understanding of the classification, chemistry, and mechanisms of action of different groups of insecticides.
2. To study the hazards, safe handling, and antidotes related to insecticide use, along with fumigation principles.
3. To understand the biological control principles and applications of parasites, predators, and pathogens in pest management.
4. To familiarize students with the principles, components, and applications of integrated pest management (IPM) systems.

5. To introduce the concept and application of autocides, chemosterilants, and advanced (3rd and 4th generation) pesticides in sustainable agriculture.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the chemical nature, mode of action, and application methods of organophosphates, carbamates, and botanical insecticides.
CO2	Describe the toxicological hazards, safety measures, and antidotes associated with insecticides and fumigants.
CO3	Analyze the roles of parasites, predators, and pathogens in biological control of insect pests.
CO4	Evaluate the components and effectiveness of integrated pest management (IPM) and the use of chemosterilants.
CO5	Discuss the characteristics and utility of autocides and next-generation pesticides in environmentally safe pest control.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Study of different types of insecticides- Organophosphates, carbamates, botanical insecticides. Methods of application of insecticides

UNIT II

Hazards of insecticides, precautions and antidotes, fumigants.

UNIT III

Principles of biological control-parasites, predators and pathogens affecting insect pests and the efficacy in controlling the insect pests.

UNIT IV

Principles and components of integrated pest management (IPM), Chemosterilants.

UNIT V

Autocides including 3rd and 4th generation pesticides.

Parasitology

ZOO 566: Parasitology

Course Objectives (COBJ)

1. To understand the diversity, morphology, and classification of parasitic protozoans and arthropods of medical and veterinary importance.

2. To study the epidemiology and zoonotic significance of major protozoan diseases affecting humans and animals.
3. To analyze the life cycles, transmission modes, and pathophysiological effects of significant parasitic species.
4. To explore the role of arthropod parasites in disease transmission and their impact on human and animal health.
5. To evaluate parasite-induced toxicosis and preventive strategies in veterinary and public health contexts.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the morphology, systematics, and general organization of medically and veterinary important parasites.
CO2	Describe the epidemiology, transmission, and zoonotic significance of protozoan diseases such as Trypanosomiasis and Giardiasis.
CO3	Analyze the life cycles and pathology of major protozoan parasites like Theileria and Coccidia.
CO4	Discuss the epidemiology and importance of parasitic arthropods including ticks and mites.
CO5	Evaluate arthropod-borne toxicosis and parasitic infestations caused by fleas, lice, and flies.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Protozoology, Medical and veterinary entomology.

UNIT II

Epidemiology and zoonotic significance of Ichthyophthiriasis, Trypanosomiasis Giardiasis, Theileriasis and Coccidiosis

UNIT III

General organization, morphology systematic and life cycles of aforementioned protozoans

UNIT IV

Epidemiology and zoonotic significance of parasitic arthropods, Ticks: Argas, Ixodes Mites: Sarcoptes, Demodex

UNIT V

Fleas: Hypoderma, Tabanus, Lice: Pulex, Cimex Parasite toxicosis in arthropods.

ZOO 567: Parasitology

Course Objectives (COBJ)

1. To study the epidemiology, life cycle, and pathogenic mechanisms of parasitic helminths affecting humans and animals.
2. To understand the taxonomy and systematics of Platyhelminthes and Aschelminthes with emphasis on parasitic forms.
3. To analyze host–parasite interactions and mechanisms of infection, growth, and adaptation in definitive hosts.
4. To explore the biology, metabolism, and control strategies of major helminth parasites causing zoonotic and veterinary diseases.
5. To evaluate the biochemical and physiological adaptations in parasitic helminths for survival within hosts.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the epidemiology, life cycle, and control measures of helminth parasites such as <i>Clonorchis sinensis</i> and <i>Polystoma integrimum</i> .
CO2	Describe the general systematics and classification of Platyhelminthes and Aschelminthes.
CO3	Analyze the epidemiology, pathogenicity, and control of cestode parasites like <i>Schistocephalus solidus</i> and <i>Hymenolepis</i> .
CO4	Discuss the infection process, penetration, and growth mechanisms of parasitic helminths within definitive hosts.
CO5	Evaluate metabolic adaptations and the biology of hydatid and other helminth organisms with medical significance.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Epidemiology, life cycle, pathogenicity and control of parasitic helminthes: *Clonorchis sinensis*, *Polystoma integrimum*

General systematics of Platyhelminthes and Aschelminthes

UNIT II

Epidemiology, life cycle, pathogenicity and control of parasitic helminthes: *Schistocephalus solidus*, *Duthlersia*, *Moneizia expansa*, *Hymenolepis*

UNIT III

Epidemiology, life cycle, pathogenicity and control of parasitic helminthes:

Ancylostoma duodenale, *Trichinella spiralis*

UNIT IV

Biology of eggs of parasitic helminthes Penetration and growth in definitive hosts

UNIT V

Metabolism in parasitic helminthes Biology of hydatid organisms

ZOO 568: Parasitology

Course Objectives (COBJ)

1. To study the morphology and functional importance of adhesive organs in different groups of parasitic helminths.
2. To understand the systematic significance of adhesive and excretory organs in the classification of parasitic helminths.
3. To analyze larval stages, development, and types of larvae among trematodes, cestodes, and nematodes.
4. To explore mechanisms of hyperparasitism, hypersensitivity, and zoonotic implications of helminthic infections.
5. To evaluate the biological basis and therapeutic applications of anthelmintic agents in controlling parasitic infections.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the structure, function, and systematic importance of adhesive organs in parasitic helminths like <i>Clonorchis</i> and <i>Polystoma</i> .
CO2	Describe adhesive organs in <i>Schistocephalus</i> , <i>Hymenolepis</i> , and <i>Moneizia</i> and their significance in helminth taxonomy.
CO3	Analyze the role of excretory organs in classification and physiology of trematode parasites.
CO4	Discuss the biology, developmental stages, and kinds of larvae in trematodes, cestodes, and nematodes.
CO5	Evaluate hyperparasitism, hypersensitivity reactions, zoonotic helminthic diseases, and the use of anthelmintics in control programs.

CO-PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Adhesive organs in parasitic helminthes with reference to *Clonorchis sinensis*, *Polystoma integrum*

and their importance in systematics

UNIT II

Adhesive organs in parasitic helminthes with reference to *Schistocephalus solidus*, *Duthlersia*, *Moneizia expansa*, *Hymenolepis*, and their importance in systematics

UNIT III

Adhesive organs in parasitic helminthes with reference to *Ancylostoma duodenale*, *Trichinella spiralis*
Significance of excretory organs in classification of parasitic helminthes with reference to trematoda.

UNIT IV

Larval stages of parasitic helminthes

Biology and kinds of larvae in trematoda, cestoda and nematoda Anthelmintics

UNIT V

Hyperparasitism and Hypersensitivity Helminth zoonoses and its causative agents.

Suggested Readings:

1. Schimdt, G.D. and Roberts, L.S. Foundations of Parasitology
2. Maule, A.G. and Marks, N.J. Parasitic Flatworms, Molecular Biology, Biochemistry, Immunology, Physiology
3. Hempel, P.S. Evolutionary Parasitology
4. Gunn, A. and Pitt, S.J. Parasitology: An Integrated Approach
5. Khalil, L.F. Jones, A. and Bray, R.A. Keys to the Cestode Parasites of Vertebrates
6. Rohde, K. Marine Parasitology
7. Duijn, V. 1973. Diseases of Fish
8. Dogiel, Perrushevski and Polyanski. 1958. Parasitology of fish.
9. Cheng 1964. The biology of animal parasites.
10. Smyth J.D. 1976 Introduction to Animal Parasitology.
11. Schell. 1970. How to know the trematodes.
12. Erasmus. 1972. The biology of trematodes.
13. Von Brand, T. 1973. Biochemistry of Parasites.

Fish & Fisheries

ZOO 569: Fish & Fisheries

Course Objectives (COBJ)

1. To understand the general anatomy, physiology, and functions of the internal organs of teleost fishes.
2. To study the mechanisms of digestion, respiration, osmoregulation, and reproduction in fishes.
3. To explore the structural and functional significance of endocrine and neurosecretory systems in fish physiology.
4. To analyze the sensory and electric organs in fishes and their ecological adaptations.
5. To evaluate physiological mechanisms underlying environmental adaptation and survival in aquatic ecosystems.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the anatomy and functional organization of internal organs and

	aortic arches in teleost fishes.
CO2	Describe the physiology of digestion, respiration, and the role of swim bladder and accessory respiratory organs.
CO3	Analyze the mechanisms of excretion, osmoregulation, and reproductive physiology in fishes.
CO4	Discuss the structure and functions of endocrine glands and the caudal neurosecretory system in fishes.
CO5	Evaluate sensory perception through lateral line, electric organs, and electroreception in fishes and their adaptive significance.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

General features of the anatomy, physiology and function of internal organs of teleosts; Aortic arches.
Alimentary canal & Digestion

UNIT II

Respiration, Swim bladder, Accessory respiratory organs

UNIT III

Excretion and Osmoregulation Reproduction and Reproductive organs

UNIT IV

Endocrine glands and Caudal neurosecretory system

UNIT V

Sense Organs, Lateral line organs.

Electric organs and Electroreception in Fishes

Suggested Readings:

1. Datta Munshi, J.S. and M.P. Srivastava Natural History of Fishes and Systematic of Fresh water Fishes of India. 2006 Narendra Publ. House, New Delhi
2. Gupta S.K. and Gupta P.C. General Applied Ichthyology.
3. Srivastava, C.B.L. A. textbook of Fishery Science and Indian Fisheries.
4. Lagler et. Al. Ichthyology
5. Norman, J.R. A History of Fishes.
6. Kyle, H.M.A. Biology of Fishes
7. Khanna, S.S. An Introduction to Fishes.

ZOO 570: Fish & Fisheries

Course Objectives (COBJ)

1. To study the diversity and productivity of marine and inland fishery resources across Indian coastal and riverine systems.
2. To understand the ecological, oceanographic, and economic factors influencing marine and inland fisheries in India.
3. To explore the technological and management aspects of inshore, offshore, and deep-sea fisheries with reference to sustainability.
4. To analyze estuarine and cold-water fisheries of India in relation to ecology and economic prospects.
5. To evaluate modern and traditional fishing crafts, gears, preservation techniques, and fish by-product development for enhanced fisheries management.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Describe the marine fishery resources, fish landings, and productivity differences between the east and west coasts of India.
CO2	Explain the ecological and oceanographic factors influencing Indian fisheries and the role of EEZ in marine fishery development.
CO3	Analyze inland capture fishery resources, major river systems, pollution effects, and future prospects of cold-water fisheries.
CO4	Discuss estuarine fishery ecology and evaluate its potential for sustainable utilization in India.
CO5	Assess modern fishing technologies, crafts, gears, fish preservation methods, and development of fish by-products.

CO–PO Mapping Table

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓						
CO2	✓	✓	✓	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Marine fishery: Important coastal fishery resources and fish landing in relation to different maritime states of India. Productivity of west coast and east coast, Problems of inshore fishery, off shore and deep sea fishery

UNIT II

Ecology of sea, Oceanography in relation to fishery, Exclusive Economic Zone (EEZ) Fishery of Sardine, Mackerel

Past, present and future prospects of marine fishery in India

UNIT III

Inland Fishery: Inland capture fishery resources of India, Important riverine systems and their fishery,

Riverine pollution and fish landing

Present and future prospects of cold water fishery of India

UNIT IV

Estuarine Fishery: Ecology of estuary, Present and future prospects of estuarine fishery of India

UNIT V

Crafts and Gears : Important traditional and modern crafts used for fish catch in inland and marine water, Conventional and unconventional fishing methods used in inland and marine sector

Age and growth determination

Methods and principles of fish preservations, development of fish bye - products

Suggested Readings:

1. Jhingran, V.G. Fish and Fisheries of India.
2. Bardach. Aquaculture.
3. Aggarwal, S.C. Fishery Management.
4. Govindan, T.K. Fish Processing Technology.
5. Beavan, C.R. Handbook of Freshwater fishes of India.
6. Bal and Rao, Marine Fisheries.

ZOO 571: Fish & Fisheries

Course Objectives (COBJ)

1. To understand the basic principles, scope, and types of aquaculture including cultivable fish and non-fish organisms in India.
2. To learn about various inland and marine aquaculture systems, including composite fish culture, integrated fish farming, and pearl culture.
3. To gain knowledge about pond management techniques involving water quality, fertilization, and control of weeds and predators.
4. To study methods of fish breeding including natural spawning, seed collection, and induced breeding using natural and synthetic hormones.
5. To analyze fish health, quality parameters, post-harvest handling, and control of common fish diseases.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Describe the fundamental concepts, importance, and types of aquaculture and mariculture in India.
CO2	Explain inland culture techniques such as composite fish culture, integrated fish farming, and pearl culture systems.
CO3	Demonstrate understanding of pond management including fertilization, aquatic vegetation control, and water quality maintenance.
CO4	Discuss techniques of fish seed raising, natural and induced breeding, and broodstock management.
CO5	Evaluate the freshness and health of fish, identify common diseases, and suggest preventive and control measures.

CO-PO Mapping Table

CO No.	PO2	PO4	PO7	PO9	PO13	PO18	PO21	PO23
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CO1	✓	✓	✓					
CO2	✓	✓	✓	✓	✓			
CO3	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Aquaculture: Definition, types, resources and cultivable fish and non-fish organisms, including seaweeds Current and future prospects of aquaculture in India

Basic principles of aquaculture

Mariculture: Important cultivable organisms

UNIT II

Inland culture: Principal methods used in fish culture: composite fish culture, air-breathing fish culture, Integrated fish farming, cage, pen, raceways and tank culture.

Trout prawn and pearl culture.

UNIT III

Pond preparation: Brooder, nursery, rearing and stocking ponds

Management of pond: Pond preparation, use of fertilizers, aquatic vegetation and their control, eradication of weed and predatory fishes as well as aquatic insects, supplementary feeding, physico-chemical and biological factors, control of algal blooms and swarms

UNIT IV

Carp seed raising: Natural spawning and seed collection of fish seeds, technique of induced breeding, natural and synthetic drugs for fish breeding

UNIT V

Freshness of fish: Features of raw fish, decomposition of fish, state of rigor mortis, Fish diseases and their control.

Suggested Readings:

1. Jhingran, V.G. Fish and Fisheries of India.
2. Bardach. Aquaculture.
3. Aggarwal, S.C. Fishery Management.
4. Govindan, T.K. Fish Processing Technology.
5. Beavan, C.R. Handbook of Freshwater fishes of India.
6. Bal and Rao, Marine Fisheries.

Environmental Biology

ZOO 572: Environmental Biology

Course Objectives (COBJ)

1. To understand the causes, effects, and control measures of major environmental pollutants including air, water, and soil pollution.

2. To learn about pollution indicators and monitoring techniques such as the Saprobian Index and water quality assessment methods.
3. To study waste water treatment, marine pollution, and the environmental impact of pesticides and heavy metals.
4. To analyze the processes of biodegradation, bioaccumulation, and biomagnification of pollutants in ecosystems.
5. To evaluate the importance of environmental legislation and sustainable approaches for pollution control and management in India.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the major types of pollution including air, water, and soil, their sources, effects, and control measures.
CO2	Describe pollution indicators, Saprobian Index, and monitoring techniques for assessing environmental quality.
CO3	Evaluate methods of wastewater treatment, marine and soil pollution control, and associated challenges.
CO4	Analyze the processes of biodegradation, biogeochemical cycling, and pesticide pollution impacts.
CO5	Assess heavy metal, radioactive, and noise pollution and understand Indian environmental legislation for pollution control.

CO-PO Mapping Table

CO No.	PO1	PO3	PO5	PO7	PO9	PO12	PO15	PO19	PO22
CO1	✓	✓	✓	✓					
CO2	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Air pollution, effect and control Pollution indicators, Saprobian Index

UNIT II

Water pollution sources, effect and control, Water quality criteria standards.

Physico-chemical and biological monitoring of water quality

UNIT III

Waste water treatment and associated problems Marine pollution; sources, effect and control Soil pollution source, effect and control

UNIT IV

Biodegradation of pesticides, Bio-geochemical cycle of pesticides Hazards of pesticide pollution Heavy metal and pesticide pollution

UNIT V

Noise pollution sources, effect and control Radioactive pollution: Sources, effect and control Bio-concentration & Bio-magnification

Indian legislation for pollution control.

Suggested Readings:

1. Elements of Ecology, Clarke.
2. Ecology, Eugene P. Odum, 1965. Amerind Publishin, New Delhi
3. Ecology with Special reference to Animal and Man. S. Charles Kendeigh.
4. Principles of Animal Ecology: Allee, Emeroon, Park and Schmidt
5. Ecology. C.J. Krebs.
6. Ecology 2000. Eds. Edmond Hillary. London Michael Joseph. 1984

ZOO 573: Environmental Biology

Course Objectives (COBJ)

1. To understand the diversity of environmental habitats and principles of animal resource management.
2. To study the principles and applications of vermiculture, forest, wetland, and wasteland management.
3. To explore methods of integrated pest management, biological control, and treatment of municipal and industrial wastes.
4. To learn about soil monitoring, soil erosion control, and sustainable management practices.
5. To evaluate the role of NGOs and modern technological tools, including computers, in environmental management and conservation.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the diversity of environmental habitats and the importance of animal resource management in sustainable ecosystems.
CO2	Describe vermiculture practices, forest management policies, and wetland and wasteland conservation strategies.
CO3	Analyze the principles of integrated pest management, biological control, and waste treatment methods.
CO4	Discuss soil monitoring and erosion management techniques for environmental protection.
CO5	Evaluate the role of NGOs and use of modern tools such as computers in environmental management and conservation efforts.

CO-PO Mapping Table

CO No.	PO2	PO4	PO6	PO8	PO10	PO13	PO17	PO20	PO22
CO1	✓	✓	✓						
CO2	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Diversity of environmental habitats Animal resource management

UNIT II

Vermiculture

Forest management (policies and problems) Wetland and Wasteland management

UNIT III

Integrated pest management

Biological control with the help of natural enemies Management and Treatment of municipal and industrial wastes

UNIT IV

Soil monitoring and management Management of soil erosion

UNIT V

Recycling of non- degradable substances

Role of NGO's in Environmental Management and Conservation Basic knowledge of use of computer in Environmental Management.

Suggested Readings:

1. Clarke, Elements of Ecology.
2. Odum, E.P. 1965 Ecology, Amerind Publishing, New Delhi
3. Kendeigh, S.C. Ecology with Special reference to Animal and Man
4. Allee, Emeroon, Park and Schmidt, Principles of Animal Ecology.
5. Krebs. C.J. Ecology
6. Joseph, M. 1984. Ecology 2000 (Edmond Hillary. London)

ZOO 574: Environmental Biology

Course Objectives (COBJ)

1. To study environmental management practices for agricultural, urban, rural, and forest ecosystems.
2. To understand land use classification, planning, and management strategies for sustainable development.
3. To analyze the purpose and methodologies of Environmental Impact Assessment (EIA) and its applications.
4. To learn environmental monitoring techniques including ambient, trend, and source-linked monitoring systems.
5. To explore modern technologies such as sensors and remote sensing in environmental management and planning.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Describe the environmental management approaches for agricultural, urban, rural, and forest ecosystems.
CO2	Explain land use classification systems and strategies for planning and sustainable land management.
CO3	Analyze the objectives and methodologies of Environmental Impact Assessment and its importance in project evaluation.
CO4	Discuss the purpose, design, and applications of various environmental monitoring methods.
CO5	Evaluate the use of sensors and remote sensing technologies in environmental management and decision-making.

CO–PO Mapping Table

CO No.	PO1	PO3	PO5	PO8	PO11	PO14	PO18	PO21	PO23
CO1	✓	✓	✓						
CO2	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Environmental management of agricultural land, urban land, rural land and forest land

UNIT II

Land use classification and practices Land use planning and management

UNIT III

Environmental impact assessment

Purposes of environmental assessment methods

UNIT IV

Environmental monitoring: purpose of monitoring, trend monitoring, ambient source-linked monitoring, Monitoring activities and directions, design and applications

UNIT V

Sensors and methods

Role of remote sensing in environmental management.

Suggested Readings:

1. Elements of Ecology, Clarke.
2. Ecology, Eugene P. Odum, 1965. Amerind Publishin, New Delhi
3. Ecology with Special reference to Animal and Man. S. Charles Kendeigh.
4. Principles of Animal Ecology: Allee, Emeroon, Park and Schmidt
5. Ecology. C.J. Krebs.
6. Ecology 2000. Eds. Edmond Hillary. London Michael Joseph. 1984

ZOO 575: Cell Biology**Course Objectives (COBJ)**

1. To study the molecular organization and compaction of eukaryotic chromosomes including specialized types like polytene and lampbrush chromosomes.
2. To understand cell signaling mechanisms involving membrane-bound and intracellular receptors.
3. To explore the molecular basis of cell communication, including interactions between cells and the extracellular matrix.
4. To analyze the structure and functions of cytoskeletal components such as microfilaments, intermediate filaments, and microtubules.
5. To examine the regulation of the cell cycle, mechanisms of cellular aging, and their implications in growth and disease.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the molecular structure and organization of eukaryotic chromosomes and their specialized forms.
CO2	Describe the mechanisms of signal transduction via membrane and intracellular receptors.
CO3	Analyze the interactions between cells and their environment, focusing on integrins, selectins, and cadherins.
CO4	Discuss the organization and dynamic roles of cytoskeletal elements in maintaining cell structure and motility.
CO5	Evaluate the regulation of the cell cycle, cellular senescence, and their roles in development and aging.

CO–PO Mapping Table

CO No.	PO1	PO3	PO6	PO8	PO11	PO15	PO19	PO22
CO1	✓	✓	✓					
CO2	✓	✓	✓	✓	✓			
CO3	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Molecular organization of eukaryotic chromosomes; Chromosome compaction (Nucleosome, solenoid); Organisation and significance of heterochromatin; Specialized chromosomes: Structural organization and functional significance of polytene chromosomes in cells of dipterans, lampbrush chromosomes of vertebrate oocytes.

UNIT II

Cell signaling:

Signaling through membranes receptors (G protein coupled receptors, Receptor Tyrosine kinase); intracellular receptors (signaling of steroid molecules)

UNIT III

Communication between cells and their environment: Interaction of cells with extracellular matrix and other cells; Integrin, selectins and cadherins

UNIT IV

Cytoskeleton: structure and dynamics of microfilaments, intermediate filaments and microtubules

UNIT V

Cell cycle and its regulation;

Cell aging

RECOMMENDED BOOKS

1. Molecular Biology of the Cell: By Lodish
2. Cell and Molecular Biology: Concepts and Experiments : Gerald Karp (7th Edition)
3. Essentials of Cell Biology: Alberts et al
4. Lehninger Principles of Biochemistry: Nelson and Cox

ZOO 576: Cell Biology

Course Objectives (COBJ)

1. To understand the fundamental laws of bioenergetics, energy transformations, and redox reactions in cellular metabolism.
2. To study the structure, differentiation, and functions of immune-competent cells including B and T lymphocytes.
3. To learn about antibody structure, diversity, and mechanisms of antigen processing and presentation via MHC molecules.
4. To explore monoclonal antibody production, hybridoma technology, and their biological and therapeutic applications.
5. To examine the molecular basis of cancer, focusing on oncogenes, tumor suppressor genes, and characteristics of transformed cells.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the principles of bioenergetics, thermodynamic laws, and redox reactions in biological systems.
CO2	Describe the differentiation and immune functions of B and T lymphocytes in humoral and cellular responses.
CO3	Analyze the processes of antigen recognition, processing, presentation, and the role of MHC molecules in immunity.
CO4	Discuss the generation of monoclonal and polyclonal antibodies and their significance in diagnostics and therapeutics.
CO5	Evaluate the molecular mechanisms of cancer development involving oncogenes and tumor suppressor genes.

CO-PO Mapping Table

CO No.	PO2	PO4	PO6	PO9	PO11	PO14	PO17	PO21	PO23
CO1	✓	✓	✓						
CO2	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Bioenergetics: Laws of energy changes (concept of entropy, free energy), Redox couples, coupled reactions.

UNIT II

Special cell function:

Immunocompetent cells; Differentiation of B lymphocytes and humoral immune response, Differentiation of T lymphocytes and cellular immune response; Antigen Processing and Presentation, Antigen presenting cells, Major Histocompatibility Complex (MHC), MHC Restriction of Lymphocytes.

UNIT III

Polyclonal antibody, Types, structure and function; antibody diversity

UNIT IV

Monoclonal antibody, hybridomas; Function of monoclonal antibody

UNIT V

Cancer: Cytological characteristics of transformed cells, cancer causing agents. Molecular Biology of cancer: tumor suppressor genes and oncogenes

RECOMMENDED BOOKS

1. Kuby Immunology: JA Owen, SA, Stranford, PP Uones.
2. Cell and Molecular Biology: Concepts and Experiments : Gerald Karp (7th Edition)
3. Essentials of Cell Biology: Alberts et al
4. Lehninger Principles of Biochemistry: Nelson and Cox

ZOO 577: Cell Biology

Course Objectives (COBJ)

1. To study the principles and applications of light and electron microscopy and their role in cellular visualization.
2. To understand tissue preparation, fixation, embedding, and sectioning techniques for histological and cytological analysis.
3. To learn histochemical and immunocytochemical methods for identifying cellular components and specific cell types.
4. To explore autoradiography and immunoelectron microscopy techniques for cellular localization and disease diagnosis.
5. To analyze cell culture techniques and detection methods for apoptotic and necrotic cells using fluorescence and enzymatic assays.

Course Outcomes (COs)

CO No.	Course Outcomes
CO1	Explain the principles of light and electron microscopy and their applications in cellular and subcellular studies.
CO2	Describe tissue preparation, fixation, embedding, and sectioning techniques for histological investigations.
CO3	Apply histochemical and immunocytochemical techniques for detecting cellular macromolecules and specialized cells.
CO4	Analyze autoradiography and immunoelectron microscopy for studying cellular structures and histopathological conditions.
CO5	Evaluate cell culture methodologies and techniques for detecting apoptosis

	and necrosis using fluorescence-based assays.
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CO–PO Mapping Table

CO No.	PO2	PO4	PO6	PO8	PO11	PO14	PO18	PO21	PO23
CO1	✓	✓	✓						
CO2	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓

UNIT I

Tools and Techniques of cell Biology Microscopy

Principles of light and electron microscopy Tissue preparation:

Fixation of tissue for paraffin and cryocut sectioning and electron microscopy:

Tissue embedding (Paraffin and epoxy resin) Tissue sectioning (Rotary and ultra microtome)

UNIT II

Histochemical techniques for detection of carbohydrates, lipids, proteins,

Techniques for detection of special cells: Neuronal staining: Cresyl violet and Silver Impregnation staining (Golgi Cox)

UNIT III

Autoradiography: Uses of radioisotopes as tracers in cell Immunocytochemistry/ Immunohistochemistry

Light microscopic immunocytochemistry

UNIT IV

Immunoelectron microscopy: Nano-gold immunoprobe and Protein A-gold immunocytochemistry

Applications of Immunocytochemistry/Immunohistochemistry: Detection of histopathology of diseases.

Study of histogenesis and cytogenesis.

UNIT V

Cell culture: Detection of apoptotic and necrotic cells (AO/EB staining) Direct and Indirect Method

Fluorescence and Enzymatic Method Antigen Retrieval

Suggested Readings:

1. Owen, J.A. Stranford, S.A. and Uones, P.P. Kuby Immunology
2. Cell and Molecular Biology:
3. Karp, G. (7th Ed.) Concepts and Experiments
4. Alberts et al. Essentials of cell Biology
5. Lehninger Principles of Biochemistry: Nelson and Cox

ZOO 578: Project/Seminar Presentation ZOO 536-542: Lab course/Practical