

Punyashlok Ahilyadevi Holkar Solapur University, Solapur



Name of the Faculty: Science & Technology

(As per New Education Policy 2020)

Syllabus: Zoology

Name of the Course: M.Sc. I (Sem. I & II)

(Syllabus to be implemented from June 2026)



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
NEP- 2020 Compliant Curriculum

M.Sc. (Zoology)
Program
Preamble

The Master of Science (M.Sc.) in Zoology is a comprehensive and dynamic program designed to provide students with a deep understanding of the fundamental principles of Zoology, along with the practical skills required to apply this knowledge in various scientific and technological contexts. Aligned with the vision of the National Education Policy (NEP) 2020, the program offers a flexible, multidisciplinary, and learner-centric curriculum that encourages critical thinking, innovation, and holistic development. The M.Sc. Zoology program spans four years, with each year offering a progressively advanced curriculum designed to build a strong foundation in Zoology while allowing for specialization and interdisciplinary learning. The curriculum is structured around several key components:

- 1. Major Courses:** These core courses form the backbone of the program, providing in-depth knowledge and understanding of essential Zoology concepts, theories, and methodologies. Students will engage with topics ranging from classical mechanics, electromagnetism, and thermodynamics to quantum Zoology, relativity, and modern Zoology, ensuring a robust and comprehensive education in the discipline.
- 2. Minor Courses:** Students have the opportunity to choose minor courses from related or distinct disciplines, promoting an interdisciplinary approach to learning. This flexibility allows students to complement their Zoology education with insights from fields such as mathematics, computer science, or engineering, enhancing their versatility and broadening their career prospects.
- 3. Open Electives/General Electives:** The program encourages intellectual exploration beyond the core discipline by offering a wide range of elective courses. These electives enable students to pursue their interests in diverse subjects, fostering creativity, critical thinking, and a well-rounded educational experience.
- 4. Vocational and Skill Enhancement Courses:** Practical skills and technical proficiency are integral to the program, with vocational and skill enhancement courses providing hands-on experience in areas such as computational Zoology, electronics, and instrumentation. These courses are designed to prepare students for immediate employment and equip them with the tools necessary for career advancement in various scientific and technological fields.
- 5. Ability Enhancement Courses (AEC), Indian Knowledge System (IKS), and Value Education Courses (VEC):** In alignment with NEP 2020, the program integrates courses that emphasize the Indian Knowledge System, ethical values, and life skills. These courses foster a deep appreciation for India's rich cultural heritage, while also developing essential communication and ethical decision-making skills that are vital for personal and professional growth.
- 6. Field Projects/Internships/Apprenticeships/Community Engagement Projects/On-Job Training:** To bridge the gap between theoretical knowledge and real-world applications, the program includes opportunities for field projects, internships, apprenticeships, and community engagement. These experiences provide students with practical insights, problem-solving abilities, and exposure to professional environments, enhancing their readiness for careers in Zoology and related fields.
- 7. Research Methodology and Research Projects:** Research is a critical component of the M.Sc. Zoology program, with students acquiring skills in research methodology, data collection, analysis, and scientific inquiry. By engaging in independent research projects, students are encouraged to develop innovative solutions to complex scientific problems, preparing them for advanced studies and research-oriented careers.

Multiple Entry and Multiple Exit Options

In accordance with the NEP 2020, the M.Sc. Zoology program incorporates a Multiple Entry and Multiple Exit framework, offering students the flexibility to enter or exit the program at various stages. This approach ensures that students can tailor their educational journey according to their personal and professional goals, with options to earn certificates, diplomas, or degrees based on the duration of study completed.

- **Year1:**
Upon completion of the first year, students may exit with a **Certificate in Zoology**.
- **Year2:**
After two years, students may choose to exit with a **Diploma in Zoology**.
- **Year3:**
Completion of the third year qualifies students for a **M.Sc. Degree in Zoology**.
- **Year4:**
The fourth year offers an advanced curriculum with a focus on research, allowing students to graduate with an **Honors Degree in Zoology**.

Eligibility For M.Sc. Zoology: A candidate should have Bachelor degree in Zoology/Life Sciences/Equivalent subjects (three years course after 10+2) from the recognized university.

Year	Sem	Major		Minor	SEC/ VSC	AEC/ IKS/ CEC	RP/CC/CEP/ Apprenticeship/ Internship	Credits
		Mandatory	Elective					
I	I	DSC-1 (2309101) Animal Taxonomy (4 Cr) & Practical- 1 Based on DSC-1 (2309104) (2Cr)	DSE-1 (2309106) Biological Techniques and Instrumentation (4 Cr) & Practical -3 Based on DSE-1 (2309107) (2Cr) OR DSE-1 (2309108) Applied Entomology (4 Cr) & Practical- 3 Based on DSE-1 (2309109) (2Cr)	Research Methodology (2309103) (4 Cr)	-	-	-	22
		DSC-2 (2309102) Molecular Cell Biology (4 Cr) & Practical- 2 Based on DSC-2 (2309105) (2Cr)			-	-	-	
	II	DSC-3 (2309201) Ontogeny and Developmental Biology (4 Cr) & Practical- 4 Based on DSC-3 (2309204) (2Cr)	DSE-2 (2309206) Fishery Science and Aquaculture (4 Cr) & Practical-6 Based on DSE-2 (2309207) (2Cr) OR DSE-2 (2309208) Applied Parasitology (4 Cr) & Practical-6 Based on DSE-2 (2309209) (2Cr)	-	-	-	(2309203) OJT/In-House Project/Internship/ Apprenticeship (4 Cr)	22
		DSC-4 (2309202) Mammalian Physiology: System & Regulation (4 Cr) & Practical- 5 Based on DSC-4 (2309205) (2Cr)		-	-	-	-	
Total Credits								44
Exit Option: Award of PG Diploma in Discipline with 44 Credits or Continue with Discipline								

SEMESTER-I



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-I

Major (Mandatory)

Paper code: 2309101

Course Code DSC-1: Animal Taxonomy (Theory)

***Teaching Scheme**

Lectures:04 Hours/week, 04 Credits

OR

Practical:02Hours/week, 01Credit

***Examination Scheme**

UA:60 Marks

CA: 40 Marks

Program specific outcome (PSOs):

- PSO1. Acquire comprehensive knowledge of invertebrate diversity and classification systems.
- PSO2. Identify major invertebrate phyla based on morphological and anatomical features.
- PSO3. Understand evolutionary trends in invertebrate groups.
- PSO4. Apply taxonomic keys and systematic principles for species identification.
- PSO5. Develop practical skills in specimen collection, preservation, and labeling.
- PSO6. Recognize economic, ecological, and medical importance of invertebrates.
- PSO7. Utilize modern taxonomic approaches including molecular tools (introductory level).

Program Outcomes (POs)

- PO1. Understand fundamental concepts of animal diversity, classification, and evolution.
- PO2. Apply scientific methods for identification and systematic study of organisms.
- PO3. Develop skills in observation, specimen handling, and taxonomic techniques.
- PO4. Analyze biological data related to morphology, anatomy, and taxonomy.
- PO5. Interpret ecological and evolutionary relationships among organisms.
- PO6. Use modern tools and references in biological research and documentation.
- PO7. Communicate scientific knowledge effectively through reports and presentations.
- PO8. Promote environmental awareness and biodiversity conservation.
- PO9. Develop ethical responsibility in scientific research.
- PO10. Prepare for higher studies, research, and careers in biological sciences.

Course Objectives:

During this course, the student is expected to:

Course Objectives:

- a) To introduce students to the principles and importance of biological classification.
- b) To provide detailed knowledge of major invertebrate phyla and their diagnostic characters

Course Outcomes:

After completing the course, the student should be able to:

- CO1. Explain principles and objectives of biological classification.
- CO2. Describe major invertebrate phyla with their diagnostic characters.
- CO3. Classify invertebrates up to appropriate taxonomic levels using standard systems.
- CO4. Identify invertebrate specimens based on morphology and taxonomy.
- CO5. Compare structural adaptations among different invertebrate groups.
- CO6. Understand evolutionary relationships among invertebrate taxa.
- CO7. Appreciate biodiversity and its conservation importance.
- CO8. Apply taxonomic knowledge in research, environmental studies, and applied fields.

Section –I

Unit-I:	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Classical vs Modern taxonomy, Species concepts, Binomial nomenclature, ICZN, Species typification, Taxonomic keys • Phylum Protozoa, Porifera, Coelenterate, Ctenophora: Important taxonomic characteristics and classification up to classes with suitable examples • Phylum: Platyhelminthes, Nematelminthes, Annelida: Important taxonomic characteristics and classification up to classes with suitable examples • Phylum Arthropoda, Mollusca, Echinodermata, Hemichordata: Important taxonomic characteristics and classification up to classes with suitable examples 		
Unit- II:	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Polymorphism in coelenterates, Corals and coral reefs, Ctenophora: Evolutionary significance • Parasitic adaptations in helminths, Life cycle and pathogenicity of <i>Ascaris lumbricoides</i>, Evolution of Coelom and Coelomic ducts • Metamorphosis in Insects, Peripatus - Structure and affinities • Larval forms of Echinodermata and their evolutionary significance, <i>Balanoglossus</i> - Structure and affinities 		

Section –II

Unit-III:	No. of lectures-15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Origin of Vertebrates: Connecting links, Colonization of vertebrates on land • Higher classification of Vertebrates, Recent advances in taxonomy: Molecular Taxonomy, Cytotaxonomy, Chemotaxonomy • Class: Urochordata, Protochordate, Pisces: Important taxonomic characteristics and classification up to orders <p>Class Amphibia, Reptilia, Aves and Mammalia: Important taxonomic characteristics and classification up to order with examples from each order</p>		
Unit-IV:	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Evolutionary Significance of Urochordata and Protochordates, Adaptive characteristics in fresh water and marine fishes • Evolutionary adaptations in Amphibians, Scalation and morphometry as key in lizards and snakes' taxonomy • Evolutionary adaptations in Aves, Adaptations in marine mammals, Leg and beak modification in different bird families, Bioacoustics in birds <p>Molecular taxonomy of three major mammal group: Afrotheria, Xenathra & Boreotheria for three lineages of placental mammals</p>		
<p>Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unit wise weightage distribution.</p>		
<p>College Level Assessment (CA) Activities: List of Experiments/Assignments/Field visit, etc.</p>		

**Practical-1 Based on
DSC-1: Animal Taxonomy Code: 2309104
(UA - 30 MARKS & CA-20MARKS)**

1	Classification of Invertebrates (Evolutionary and Ecological significance): 20 specimens (Protozoa to Nematodes)
2	Collection and Identification (with keys of few species) of zoo planktons using appropriate sampling technique
3	Collection of various invertebrate groups using different sampling techniques: Sweep netting, Pitfall, Bush tapping, active searching
4	Study of dichotomous taxonomic keys from documented insect specimens in the field
5	Study of dichotomous taxonomic keys form Molluscan specimens
6	Classification of Vertebrates (Evolutionary and Ecological significance): 20 specimens (Pisces to Mammals)
7	Study of scalation and morphometry of snake, lizard and amphibian using lab specimens
8	Study morphometry of fish using different fish specimens
9	Preparation of dichotomous taxonomic keys using Reptile/ Amphibian lab specimens.
10	Study of dentition in mammals using different mammalian groups

Suggested Reading Materials:

- Keto, M: The Biology of Diversity.
- Avise, J. C.: Molecular markers. Natural History and Evolution, Chapman and Hall, New York.
- Wilson, E. O.: Biodiversity, Academic Press, Washington.
- Simpson, G. G.: Principles of Animal Taxonomy, Oxford IBH Publishing Company.
- Mayer, E.: Elements of Taxonomy.
- Wilson, E.O.: The Diversity of Life. W. W. Northern and Company.
- Tikedar, B. K.: Threatened Animals of India, ZSI Publication, Calcutta.
- Mayer, E.: Principles of Systematic Zoology, M. Hill Publication.



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-I

Major (Mandatory)
Paper code: 2309102

Course Code DSC-2: Molecular Cell Biology (Theory)

***Teaching Scheme**

Lectures:04 Hours/week, 04 Credits

OR

Practical:02Hours/week, 01Credit

***Examination Scheme**

UA:60 Marks

CA: 40 Marks

Program specific outcome (PSOs):

PSO 1: Understand the structure and function of key biological molecules and their roles in cellular processes.

PSO 2: Analyze the mechanisms of gene expression, regulation, and inheritance at the molecular level.

PSO 3: Apply techniques in molecular biology, such as PCR, gel electrophoresis, and DNA sequencing, to experimental research.

PSO 4: Evaluate cellular signaling pathways and their impact on cell function and behavior.

PSO 5: Investigate the molecular basis of diseases and the development of therapeutic strategies.

PSO 6: Integrate knowledge of cell and molecular biology with other disciplines such as biochemistry, genetics, and physiology.

PSO 7: Develop skills in critical thinking, data analysis, and scientific communication.

PSO 8: Conduct independent research projects, demonstrating proficiency in experimental design and data interpretation.

Program Outcomes (POs)

PO – 1 Apply the Biotechnological concepts for basic and applied research.

PO – 2 Explore new areas of research in all the branches of Biotechnology in addition to interdisciplinary fields such as Chemistry and Physics.

PO – 3 Create an awareness of the impact of Biotechnology on the environment, society, and development outside the scientific community

PO -4The students' exposure throughout the program would help them become aware of career opportunities in the biological sciences. .

PO -5 Students will gain the capacity to work effectively in multidisciplinary teams to achieve specific objectives.

PO – 6 Students will be able to expand their learning horizons by utilizing multidimensional knowledge qualities to keep up with the global pace of scientific advancement.

Course Objectives:

During this course, the student is expected to:

Course Objectives:

a) To study the cell and its components

b) To study molecular interactions within the cell

Course Outcomes:

After completing the course, the student should be able to:

CO1. Explain the structure and function of cellular organelles at molecular level.

CO2. Describe the chemical nature and biological roles of biomolecules such as proteins, lipids, carbohydrates, and nucleic acids.

CO3. Understand molecular mechanisms of DNA replication, transcription, translation, and gene regulation.

CO4. Analyze cell cycle regulation and processes like mitosis, meiosis, and apoptosis.

CO5. Interpret cellular signaling pathways and their role in cell communication.

CO6. Apply basic molecular biology techniques in laboratory practices.

CO7. Correlate molecular processes with physiological functions and diseases.
 CO8. Evaluate experimental data related to molecular and cellular biology.
 CO9. Use modern tools such as microscopy, biochemical assays, and bioinformatics resources.
 CO10. Develop scientific reasoning and problem-solving skills in molecular cell biology.

Section –I

Unit-I: Cellular Membranes	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Molecular composition, arrangement and function. • Dynamic nature of plasma membrane: Transport across the cell membrane- Passive and active transport, pumps, imports, symports and antiport. Transport across epithelia. • Membrane potential and nerve impulse. • Integrins and collagens. • Cell matrix and cell matrix adhesion. 		
Unit- II: Structural organization and function of intracellular organelles	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Nucleus, Mitochondria, Endomembrane system and Lysosomes (Origin, ultrastructure and functions) • Microfilaments and microtubules- structure and dynamics • Cilia, Flagella- structure and dynamics • Microtubular organizing centres: centriole, kinetochore, basal bodies • Intermediate filaments: structure and function. Actin- binding proteins 		

Section –II

Unit-III: Cellular Organelles and Membrane Trafficking	No. of lectures-15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Endoplasmic reticulum, Golgi bodies: structure and function • Protein synthesis on free and bound polysomes • Membrane proteins and other proteins in ER with suitable examples • Post-translational modifications and protein sorting in Golgi apparatus. • Lysosomes types and functions • Biogenesis of mitochondria 		
Unit-IV: The Cell cycle and cell signaling	No. of lectures- 15	Weightage:9-16 Marks

- Cell cycle
- Control of cell cycle
- Mitosis and biology of cancer cells: Cancer cell morphology and properties; types of cancer- causes and treatment
- Cell signalling systems: G-protein coupled receptor
- Tyrosine Kinase receptor: Ras-MAP Kinase pathway, Hedgehog pathway, WNT signaling pathway

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unit wise weightage distribution.

**College Level Assessment (CA) Activities:
List of Experiments/Assignments/Field visit, etc.**

**Practical-2 Based on
DSC-2: Molecular Cell Biology Code: 2309105
(UA - 30 MARKS & CA-20MARKS)**

1.	Preparation of Metaphasic chromosomes using colchicine drug
2.	Preparation/Demonstration of meiotic stages in the onion bud
3.	Preparation of <i>Drosophila</i> culture to study of its life cycle and observation of morphological characters of male and female <i>Drosophila</i>
4.	Demonstration of Polytene Chromosomes from salivary glands of <i>Chironomous/ Drosophila</i> larva using photograph or permanent slide
5.	To perform cell fractionation for the isolation of nucleus from given sample/material
6.	Demonstration of electrophoresis for the separation of serum proteins
7.	Virtual Lab. For Cell Biology: using c-BioPortal
8.	To study Cell Homeostasis using virtual lab.
9.	To perform retrieval and analysis of protein sequence from protein database
10.	To perform multiple sequence alignment and phylogenetic analysis based on DNA and protein sequences

Suggested Reading Materials:

- Bruce Alberts et al., Garland Publishing Inc., New York & London.
- Cell and Molecular Biology – De Robertis & De Robertis Jr., Saunders College Publishing, Philadelphia.
- Biochemistry and Molecular Biology – W. H. Elliott & D. C. Elliott, Oxford University Press, Oxford & New York..
- Cell Biology, Genetics, Molecular Biology, Evolution and Ecology – P. C. Verma & V. K. Agrawal, S. Chand & Company, New Delhi.
- Genetic Engineering – Sandhya Mitra, Macmillan Publishers.
- A Textbook of Biotechnology – R. C. Dubey, S. Chand & Company, New Delhi.
- Genetic Engineering – Mohan Arora, Himalaya Publishing House.
- The World of the Cell – Becker & Kleinsmith, Pearson Education.
- The Cell: A Molecular Approach



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-I

Elective

Paper code: 2309106

Course Code DSE-1: Biological Techniques and Instrumentation (Theory)

***Teaching Scheme**

Lectures:04 Hours/week, 04 Credits

OR

Practical:02Hours/week, 01Credit

***Examination Scheme**

UA:60 Marks

CA: 40 Marks

Program specific outcome (PSOs):

PSO1: Acquire advanced knowledge of biological techniques and instrumentation used in zoological research.

PSO2: Operate and interpret data from modern analytical and imaging instruments.

PSO3: Apply laboratory techniques in molecular biology, cell biology, and applied zoology.

PSO4: Perform biological experiments following standard protocols and safety guidelines.

PSO5: Analyze experimental results using scientific and statistical approaches.

PSO6: Prepare for careers in research laboratories, diagnostics, industries, and academia.

Program Outcomes (POs)

Course Objectives:

During this course, the student is expected to:

Course Objectives:

PO1: Demonstrate comprehensive knowledge of biological sciences and applied zoology.

PO2: Apply scientific reasoning, experimental design, and analytical skills in research.

PO3: Use modern laboratory techniques and instruments for biological investigations.

PO4: Integrate biological knowledge with applications in health, agriculture, environment, and industry.

PO5: Practice ethical standards, biosafety, and sustainability in scientific work.

PO6: Communicate scientific information effectively in professional formats.

PO7: Develop critical thinking and problem-solving abilities.

PO8: Prepare for higher education, research, and professional careers.

Course Outcomes:

After completing the course, the student should be able to:

a) Learn laboratory safety and bioethics.

b) Understand advanced laboratory, field, and analytical biological techniques.

CO1: Explain the principles, working mechanisms, and applications of major biological instruments.

CO2: Demonstrate proficiency in basic and advanced laboratory techniques used in biological sciences.

CO3: Operate analytical instruments such as spectrophotometers, microscopes, and centrifuges.

CO4: Analyze and interpret experimental data obtained through biological techniques.

CO5: Apply appropriate methodologies in research, diagnostics, and applied biological fields.

CO6: Follow biosafety, ethical, and quality standards in laboratory practices.

CO7: Utilize instrumentation knowledge for solving biological research problems.

Section –I

Unit-I: Advanced Laboratory and Analytical Techniques	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Advanced microscopy: Confocal, fluorescence, phase-contrast, electron microscopy (SEM, TEM) • Cryo-techniques and sample preservation. • Advanced staining and labeling techniques: Immuno-histochemistry and immunofluorescence. • Flow cytometry: Principles, working and applications flow cytometry. • Spectroscopic techniques: Principles, working and applications of UV-Vis, IR, fluorescence and Mass spectroscopy. • e) Chromatographic techniques: Principles, working and applications of HPLC, GC, Affinity chromatography. 		
Unit- II: Molecular and Systems Biology Techniques	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Isolation of Nucleic Acid: Introduction and protocol for the isolation of DNA • DNA sequencing technologies: Introduction to Sanger's Dideoxymethod and Maxam-Gilbert Method, c) DNA Amplification: PCR, qPCR, RT-PCR techniques • Next-Generation Sequencing (NGS). • Genomics, Transcriptomics and proteomics: Basic concepts and tools for exploring genome, proteome and transcriptome and its applications • e) Introductory Concepts on: Basics of stem cell techniques, CRISPR-Cas systems & Metabolomics 		

Section –II

Unit-III: Cellular and Biochemical Techniques	No. of lectures-15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • The Cell Culture Techniques: Cell culture laboratory and equipments, Primary cell culture, continuous cell culture and cell line, Applications of cell culture (vaccine production, toxicity testing, cancer research & genetic engineering). • Centrifugation Techniques: Principle, working and applications of differential, density-gradient (Rate-zonal and isopycnic/equilibrium centrifugation), preparative and analytical centrifugation. • Electrophoretic Techniques: Principle, working and applications of polyacrylamide gel electrophoresis and agarose gel electrophoresis. <ul style="list-style-type: none"> • d) Tools for the Study of Cancers: Liquid biopsy, Digital PCR, CRISPR/Cas9 gene editing, Microfluidic 'Lab-on-a-chip' devices, western blotting, Fluorescence In-situ Hybridization (FISH), PET-CT and PET-MRI. 		
Unit-IV: Techniques for the study of Wildlife and Biodiversity	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Visual Monitoring Tools: Introduction and applications of binoculars and spotting scopes, camera traps, thermal imaging cameras, infra-red night vision devices, drone based visual monitoring and aerial photography. • Field Monitoring Tools: Introduction and applications of GPS Collars, Radiotelemetry systems, satellite telemetry, RFID tagging. • Non-invasive Biological Monitoring Tools: Fecal DNA analysis, hair and feather analysis, scat analysis, hormonal analysis. • d) Community and Participatory Tools: Mobile biodiversity Apps (iNaturalist, Map of Life, Project Noah, e-Bird, Merlin Bird ID, India Biodiversity Portal, Indian Butterflies), Biodiversity informatics (mobilization and digitization of biodiversity data, Darwin Core-DwC and Access to Biological Collection Data-ABCD, GBIF), Catalogue of Life and ZooBank. 		

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unit wise weightage distribution.

**College Level Assessment (CA) Activities:
List of Experiments/Assignments/Field visit, etc.**

**Practical-3 Based on
DSE-1: Biological Techniques and Instrumentation Code: 2309107
(UA - 30 MARKS & CA-20MARKS)**

1	Conceptual understanding of confocal, fluorescence, SEM, TEM microscopy in comparison with light microscope.
2	Colorimetric estimation of Proteins using simple colorimeter and concept mapping with IR/fluorescence/MS concept mapping to HPLC, GC, affinity chromatography.
3	Isolation and estimation of DNA using suitable material.
4	Demonstration of sample genome/ transcriptome/ proteome datasets using bioinformatics tools/databases.
5	To perform cell fractionation for isolation of nucleus using centrifugation.
6	Demonstration of Polymerase Chain Reaction (PCR).
7	Demonstration of gel electrophoresis (PAGE or Agarose).
8	Visit to local cancer hospital to study instruments used for cytological (biopsy tissue) and imaging of cancers.
9	Demonstration of camera-trap as a tool for monitoring of wildlife.
10	Conceptual understanding of GPS Collars, Radio-telemetry systems, satellite telemetry, RFID tagging in monitoring of wildlife (eg.: Case study of Great Indian Bustard from Wildlife Institute of India).
11	Demonstration and use of use of iNaturalist /eBird/ IBP.
12	To perform biodiversity data mining from GBIF & other Biodiversity Databases.

Suggested Reading Materials:

- Wilson, K. & Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
- Plummer, D.T. An Introduction to Practical Biochemistry. Tata McGraw-Hill.
- Boyer, R.F. Modern Experimental Biochemistry, The Benjamin/Cummings
- Wilson and Walker, Principles and Techniques of Biochemistry and Molecular Biology, Cambridge.
- Sutherland, W.J. (Ed.). Ecological Census Techniques: A Handbook. Cambridge University Press.
- Krebs, C.J. Ecological Methodology. Pearson Education.
- Southwood, T.R.E. & Henderson, P.A. Ecological Methods. Wiley-Blackwell.



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-I

Elective

Paper code: 2309108

Course Code DSE-1: Applied Entomology (Theory)

***Teaching Scheme**

Lectures:04 Hours/week, 04 Credits

OR

Practical:02Hours/week, 01Credit

***Examination Scheme**

UA:60 Marks

CA: 40 Marks

Program specific outcome (PSOs):

PSO 1: Understand the taxonomy, morphology, biology, and life cycles of economically important insect pests and beneficial insects relevant to agriculture, forestry, public health, and stored products.

PSO 2: Analyze insect–plant interactions, pest population dynamics, and the ecological principles underlying pest outbreaks and natural regulation.

PSO 3: Apply entomological techniques such as insect collection, preservation, identification, rearing, and monitoring for field and laboratory investigations.

PSO 4: Evaluate different pest management strategies, including cultural, mechanical, biological, chemical, and Integrated Pest Management (IPM) approaches.

PSO 5: Investigate the mode of action, resistance development, and environmental impact of insecticides, emphasizing safe and sustainable pest control practices.

PSO 6: Assess the role of beneficial insects such as pollinators, predators, parasitoids, silkworms, honey bees, and lac insects in agriculture and rural economy.

PSO 7: Develop problem-solving, data analysis, and decision-making skills for addressing real-world pest problems in crop protection and public health entomology.

PSO 8: Demonstrate research aptitude and professional skills through field surveys, experimental studies, report writing, and scientific communication related to applied entomology.

Program Outcomes (POs)

PO 1: Apply fundamental and advanced biotechnological concepts and techniques to address problems in basic and applied biological research.

PO 2: Explore and integrate knowledge across all branches of Biotechnology, including interdisciplinary fields such as Chemistry, Physics, Bioinformatics, and Environmental Science, for innovative research and applications.

PO 3: Develop awareness and understanding of the ethical, environmental, social, and economic impacts of Biotechnology, and communicate scientific knowledge responsibly to society.

PO 4: Identify and pursue career opportunities in biological and biotechnological sciences, including research, industry, healthcare, agriculture, education, and entrepreneurship.

PO 5: Demonstrate the ability to work effectively in multidisciplinary teams, exhibiting leadership, collaboration, and professional responsibility to achieve common scientific goals.

PO 6: Engage in lifelong learning by utilizing multidimensional knowledge and modern scientific tools to adapt to rapid global advancements in biotechnology and allied sciences.

Course Objectives:

During this course, the student is expected to:

Course Objectives:

a) To develop practical skills in insect collection, identification, and control techniques

b) To study the biology, identification, and life cycles of major insect pests and beneficial insects

Course Outcomes:

After completing the course, the student should be able to:

CO 1: Understand the synthesis, turnover, and regulation of biomolecules within the cell.

CO 2: Explain the interactions among biomolecules and their role in maintaining cellular structure and

function.

CO 3: Describe the mechanisms and dynamics of intracellular cargo transport across different cellular compartments.

CO 4: Analyze the properties and behavior of transformed cells, including alterations in growth and regulation.

CO 5: Explain the current molecular and cellular approaches used in cancer diagnosis and treatment.

CO 6: Interpret signal transduction pathways and evaluate their role in regulating gene expression and cellular responses.

Section –I

Unit-1: Fundamentals of Economic Entomology	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Scope and importance of Economic Entomology • Classification of insects of economic importance • Beneficial and harmful insects • Types of insect pests: <ul style="list-style-type: none"> – Major pests, minor pests, potential pests • Concept of economic injury level (EIL) and economic threshold level (ETL) 		
Unit- II: Insect Pests of Crops and Stored Products	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Pests of cereals (rice, wheat, maize) • Pests of pulses and oilseed crops • Pests of cotton, sugarcane, fruits, and vegetables • Stored grain pests: primary and secondary pests • Biology, life cycle, nature of damage, and control measures of major pests • Insect pests of household and public health importance 		

Section –II

Unit-III: Beneficial Insects and Insect Products	No. of lectures-15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Apiculture: <ul style="list-style-type: none"> – Species of honey bees – Structure of beehive and bee colony organization – Bee products and their economic importance • Sericulture: <ul style="list-style-type: none"> – Types of silkworms – Life cycle of <i>Bombyx mori</i> – Silk production and processing • Lac culture: <ul style="list-style-type: none"> – Lac insect and lac production • Insects as food, feed, and industrial resources 		
Unit-IV: Pest Management and Modern Control Strategies	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Principles of pest management • Mechanical and cultural methods of pest control • Biological control: <ul style="list-style-type: none"> – Predators, parasitoids, and pathogens 		

- Chemical control:
 - Types of insecticides
 - Insecticide resistance and resurgence
- Integrated Pest Management (IPM):
 - Components and advantages
- Recent advances in pest control:
 - Pheromones, insect growth regulators (IGRs), genetic control methods

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unit wise weightage distribution.

**College Level Assessment (CA) Activities:
List of Experiments/Assignments/Field visit, etc.**

**Practical-3 Based on
DSE-1: Applied Entomology Code: 2309109
(UA - 30 MARKS & CA-20MARKS)**

1	Study of external morphology of insect pests (mouthparts, wings, legs) related to feeding habits
2	Identification and classification of insects of economic importance (orders & families)
3	Study of insect pest categories – major, minor, and potential pests
4	Identification of major crop pests with nature of damage (using specimens / charts) Rice, wheat, cotton, sugarcane, pulses
5	Study of honey bee species and caste system
6	Examination bee hive structure and equipment used in apiculture
7	Study of bee products – honey, wax, royal jelly, propolis
8	Study of life cycle of <i>Bombyx mori</i> / Lac Insect/ Honey Bee
9	Identification of biological control agents – predators & parasitoids
10	Insect collection, preservation, and labeling techniques
11	Visit / report on sericulture unit / apiculture unit

Suggested Reading Materials:

- B.V. David & T. Kumar
- General and Applied Entomology – Vasantharaj David & T. Kumar
- Applied Entomology – K.P. Srivastava
- Principles of Insect Pest Management – G.S. Dhaliwal & R. Arora
- Insect Pests of Crops – P. Prasada Rao, Metcalf & Luckmann
- Insecticides: Action and Metabolism – R.K. Odak & S.S. Shinde
- Biological Control of Insect Pests – P. DeBach



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-I

Minor

Paper code: 2309103

Course Code Research Methodology (Theory)

***Teaching Scheme**

Lectures:04 Hours/week, 04 Credits

OR

Practical:02Hours/week, 01Credit

***Examination Scheme**

UA:60 Marks

CA: 40 Marks

Program specific outcome (PSOs):

PSO1: Acquire in-depth knowledge of developmental processes from fertilization to organogenesis.

PSO2: Understand cellular, molecular, and genetic mechanisms regulating development.

PSO3: Analyze normal and abnormal developmental patterns in animals.

PSO4: Apply developmental biology concepts in research and biomedical sciences.

PSO5: Utilize experimental techniques in embryology and developmental studies.

PSO6: Prepare for careers in research, education, healthcare, and biotechnology sectors..

Program Outcomes (POs):

PO1: Demonstrate advanced knowledge in zoological sciences and related disciplines.

PO2: Apply scientific methods and experimental techniques in biological research.

PO3: Use modern tools and methodologies for biological investigations.

PO4: Integrate developmental biology concepts with health, environment, and applied sciences.

PO5: Practice ethical standards and biosafety in scientific research.

PO6: Communicate scientific findings effectively in academic and professional contexts.

PO7: Develop critical thinking and analytical problem-solving skills.

PO8: Prepare for higher education, research careers, and competitive examinations.

Course Objectives:

During this course, the student is expected to:

Course Objectives:

Course Outcomes:

After completing the course, the student should be able to:

- Provide fundamental and advanced knowledge of animal development processes.
- Explain cellular and molecular mechanisms controlling growth and differentiation.

CO1: Describe stages of animal development including fertilization, cleavage, gastrulation, and organogenesis.

CO2: Explain cellular and molecular mechanisms involved in differentiation and morphogenesis.

CO3: Analyze genetic control of development and pattern formation.

CO4: Interpret experimental evidence related to developmental processes.

CO5: Identify developmental abnormalities and understand their biological causes.

CO6: Apply developmental biology principles in research and biomedical fields.

CO7: Demonstrate understanding of ethical considerations in developmental research..

Section –I

Unit-I: Introduction to Research	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Definition, Objectives and types of Research: • Scientific methods • Process of Research. Identification & Formulation of research problem, Research Question, Investigation Question • Hypothesis – Qualities of good Hypothesis, Null Hypothesis and alternative hypothesis, Hypothesis testing • Importance of research 		
Unit- II: Research Design	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Concept and importance of Research Design • Types of Research Design: Exploratory, Descriptive and Causal • Experimental Design • Measurement: Concept of measurement, Problems in measurement in research, Validity and reliability • Levels of measurement: Nominal, Ordinal, Interval, Ratio 		

Section –II

Unit-III: Sampling of Research Data	No. of lectures-15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Sampling methods • Concepts of statistical population and Sample • Steps in development of sample plan w.r.t. Sampling frame, Sampling methods (Probability sample: Simple random sample, Systematic Sample, Stratified random sample & multi stage sampling) • Sampling error, Sampling size, non response, Characteristics of a good sample., Determining size of the sample, Practical consideration in sampling and sample size 		
Unit-IV: Analysis of Research Data	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Data Analysis: Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis: Cross tabulations and Chi-square test including testing hypothesis of associations • Interpretation of data and paper writing- Layout of research paper, Ethical issues related to publication, • Use of tools/techniques for Research: Important tools to search required information effectively, Software for Reference management (Zotero/Mendeley), Software for detection of plagiarism. 		

Suggested Reading Materials:

- Chaitali Ghosh and Mamtesh Singh (2020) Research Methodology, Rastogi Publications
- Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
- Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientist – a training reference manual. West Africa Rice Development Association, Hong Kong.
- Kothari and Garg (2024) Research Methodology: Methods and Techniques

SEMESTER-II



Punyashlok Ahilyadevi Holkar Solapur University, Solapur

First Year M.Sc. (Zoology) Semester-II

Major (Mandatory)

Paper code: 2309201

Course Code DSC-3: Ontogeny and Developmental Biology (Theory)

***Teaching Scheme**

Lectures:04 Hours/week, 04 Credits

OR

Practical:02Hours/week, 01Credit

***Examination Scheme**

UA:60 Marks

CA: 40 Marks

Program specific outcome (PSOs):

PSO1: Acquire in-depth knowledge of developmental processes from fertilization to organogenesis.

PSO2: Understand cellular, molecular, and genetic mechanisms regulating development.

PSO3: Analyze normal and abnormal developmental patterns in animals.

PSO4: Apply developmental biology concepts in research and biomedical sciences.

PSO5: Utilize experimental techniques in embryology and developmental studies.

PSO6: Prepare for careers in research, education, healthcare, and biotechnology sectors..

Program Outcomes (POs):

PO1: Demonstrate advanced knowledge in zoological sciences and related disciplines.

PO2: Apply scientific methods and experimental techniques in biological research.

PO3: Use modern tools and methodologies for biological investigations.

PO4: Integrate developmental biology concepts with health, environment, and applied sciences.

PO5: Practice ethical standards and biosafety in scientific research.

PO6: Communicate scientific findings effectively in academic and professional contexts.

PO7: Develop critical thinking and analytical problem-solving skills.

PO8: Prepare for higher education, research careers, and competitive examinations.

Course Objectives:

During this course, the student is expected to:

Course Objectives:

Course Outcomes:

After completing the course, the student should be able to:

- c) Provide fundamental and advanced knowledge of animal development processes.
- d) Explain cellular and molecular mechanisms controlling growth and differentiation.

CO1: Describe stages of animal development including fertilization, cleavage, gastrulation, and organogenesis.

CO2: Explain cellular and molecular mechanisms involved in differentiation and morphogenesis.

CO3: Analyze genetic control of development and pattern formation.

CO4: Interpret experimental evidence related to developmental processes.

CO5: Identify developmental abnormalities and understand their biological causes.

CO6: Apply developmental biology principles in research and biomedical fields.

CO7: Demonstrate understanding of ethical considerations in developmental research.

Section –I

Unit-I: Fundamentals of Development and Gametogenesis

No. of lectures- 15

Weightage:9-16 Marks

<ul style="list-style-type: none"> • Basic concepts in development: Potency, commitment, specification, induction, competence, Cell determination and differentiation. • Gametogenesis: Oogenesis and Spermatogenesis • Evolution of sexual reproduction in eukaryotes. 		
Unit- II: Fertilization and Early Embryonic Development in Chordates	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Capacitation and general mechanism of fertilization • Study of eggs, blastula, gastrula and three germ layers in Amphioxus, Frog, Chick and Mammals. • Neural tube formation in mammals. 		

Section –II

Unit-III: Limb Development and Molecular Regulation of Development	No. of lectures-15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Development of limbs in fishes, amphibians, reptiles, birds and mammals. • Genetic regulation of limb development in chordates. • Stem Cells, Cell fate and cell lineage, mutant and transgenic analysis of developmental embryo 		
Unit-IV: Developmental Regulation in Model Organisms	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Regulation of development in <i>Drosophila</i>. • Cell aggregation and differentiation in <i>Dictyostelium</i>. • Vulva formation in <i>Caenorhabditis elegans</i>. 		
Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unit wise weightage distribution.		
College Level Assessment (CA) Activities: List of Experiments/Assignments/Field visit, etc.		

Practical-4 Based on DSC-3: Ontogeny and Developmental Biology Code: 2309204 (UA - 30 MARKS & CA-20MARKS)

1	Study blastula, Gastrula in Amphioxus, Frog, Chick and Mammals
2	Analysis of sperm motility
3	Procedure to understand embryological stages of chick up to 72 hours by non-invasive method
4	To observe and interpret metamorphic stages of insect eggs (with help of model or field survey observation data)
5	To demonstrate acrosomal development in rat testis by PAS method
6	To study of different phases of oestrous cycle in Rat
7	Observation of homeotic mutants of <i>Drosophila</i>
8	Submission of report based on visit to IVF centre/ Medical college / or Review papers related to recent trends in embryogenic work

Suggested Reading Materials:

- Turner, C. D. and Bangara, J. T.: General Endocrinology.
- Edwards, R. G.: Human Reproduction.
- Austen, C. R. and Short, R. V.: Reproduction in Animals.
- Longo, F. T.: Fertilization, Chapman & Hall.
- Mathur, Ramesh: Embryology, Anmol Publications.
- Morgan, T. H.: Embryology and Genetics. Agrobios India.
- Balinski: Introduction to Embryology.
- Scott, F. Gilbert: Developmental Biology –Sixth Edition, Sinaur Publications.



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-II
Major (Mandatory)
Paper code: 2309202
Course Code DSC-4: Mammalian Physiology-System & Regulation
(Theory)

***Teaching Scheme**

Lectures:04 Hours/week, 04 Credits

OR

Practical:02Hours/week, 01Credit

***Examination Scheme**

UA:60 Marks

CA: 40 Marks

Program specific outcome (PSOs):

PSO 1: Understand the structural and functional organization of mammalian organ systems and their physiological roles.

PSO 2: Analyze the mechanisms of regulation and coordination involving nervous and endocrine systems in mammals.

PSO 3: Explain homeostatic processes related to metabolism, circulation, respiration, excretion, and reproduction.

PSO 4: Apply physiological knowledge to understand health, disease, and adaptive responses in mammals.

PSO 5: Develop experimental, analytical, and interpretative skills in mammalian physiological studies.

Program Outcomes (POs)

PO 1: Apply fundamental concepts of mammalian physiology to understand normal functioning of organ systems.

PO 2: Integrate physiological knowledge with biochemistry, cell biology, genetics, and endocrinology.

PO 3: Analyze regulatory mechanisms and feedback systems maintaining internal body balance.

PO 4: Develop problem-solving and critical thinking skills to interpret physiological data.

PO 5: Recognize the clinical relevance of physiology in understanding diseases and therapeutic approaches.

PO 6: Demonstrate scientific communication, teamwork, and ethical awareness in biological sciences.

Course Objectives:

During this course, the student is expected to:

Course Objectives:

a) To describe fish breeding, seed production, nutrition, and culture techniques

b) To identify common fish diseases and apply basic health management and preventive measures

Course Outcomes:

After completing the course, the student should be able to:

CO 1: Describe the physiology of major mammalian systems such as digestive, respiratory, circulatory, and excretory systems.

CO 2: Explain the mechanisms of nerve impulse transmission and muscle contraction.

CO 3: Understand the endocrine regulation of growth, metabolism, reproduction, and stress.

CO 4: Analyze homeostatic mechanisms, including thermoregulation, osmoregulation, and acid–base balance.

CO 5: Explain the physiology of reproduction and lactation in mammals.

CO 6: Correlate physiological processes with common disorders and disease conditions.

CO 7: Apply basic physiological experimental techniques and data interpretation skills.

CO 8: Develop analytical, entrepreneurial, and problem-solving skills relevant to fisheries and aquaculture sectors.

Section –I

Unit-1: Physiological Principles and Muscle & Nerve Physiology	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Scope and importance of Animal Physiology • Bioelectric potentials and action potential • Nerve impulse transmission • Synaptic transmission and neurotransmitters • Muscle physiology: <ul style="list-style-type: none"> – Types of muscles – Sliding filament theory – Muscle contraction and relaxation • Neuromuscular junction 		
Unit- II: Digestive and Respiratory Physiology	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Digestion, absorption, and assimilation of carbohydrates, proteins, and lipids • Role of digestive enzymes and hormones • Physiology of respiration • Structure and functions of respiratory organs • Mechanism of breathing • Transport of respiratory gases • Regulation of respiration • Respiratory pigments 		

Section –II

Unit-III: Circulatory, Excretory and Osmoregulatory Physiology	No. of lectures-15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Composition and functions of blood • Hemostasis and blood coagulation • Heart: structure and cardiac cycle • Regulation of heart rate and blood pressure • Lymphatic system • Excretory physiology • Structure and function of nephron • Urine formation • Osmoregulation in aquatic and terrestrial animals 		
Unit-IV: Endocrine, Reproductive and Environmental Physiology	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Endocrine glands and hormones • Mechanism of hormone action • Physiology of reproduction in males and females • Menstrual and estrous cycles • Physiology of pregnancy and lactation • Stress physiology • Thermoregulation 		
<p>Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unit wise weightage distribution.</p>		
<p>College Level Assessment (CA) Activities: List of Experiments/Assignments/Field visit, etc.</p>		

Practical-5 Based on
DSC-4: Mammalian Physiology-System & Regulation Code: 2309205
(UA - 30 MARKS & CA-20MARKS)

1	Study of compound microscope and physiological instruments
2	Study of Simple Muscle twitch
3	Measurement of reaction time
4	Action of salivary amylase on starch
5	Estimation of blood glucose
6	Analysis of urine – physical and chemical examination
7	Study of endocrine glands using charts/models
8	Identification of hormones and their physiological effects
9	Effect of stress on physiological parameters (case-based)
10	Mini-project / assignment on physiological disorders
11	Visit to Blood Bank

Suggested Reading Materials:

- Arthur C. Guyton & John E. Hall
- Review of Medical Physiology – William F. Ganong
- Animal Physiology – R.W. Hill, G.A. Wyse & M. Anderson
- Principles of Animal Physiology – Christopher Moyes & Patricia Schulte
- Comparative Animal Physiology – C.L. Prosser & F.A. Brown
- C.C. Chatterjee
- Physiology of Mammals – Knut Schmidt-Nielsen
- Endocrinology – Mac E. Hadley & Jon E. Levine
- Neurophysiology – Ganong (Selected chapters)



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-II

Elective

Paper code: 2309206

Course Code DSE-2: Fishery Science and Aquaculture (Theory)

***Teaching Scheme**

Lectures:04 Hours/week, 04 Credits

OR

Practical:02Hours/week, 01Credit

***Examination Scheme**

UA:60 Marks

CA: 40 Marks

Program specific outcome (PSOs):

PSO 1: Understand the diversity, taxonomy, morphology, and biology of finfish and shellfish, with emphasis on commercially important species.

PSO 2: Analyze aquatic ecosystems, water quality parameters, and their influence on fish health, growth, and productivity.

PSO 3: Apply fishery and aquaculture techniques such as seed collection, breeding, hatchery management, feeding, and culture practices.

PSO 4: Evaluate fish nutrition, fish diseases, and health management strategies for sustainable aquaculture production.

PSO 5: Assess fisheries management practices, including capture fisheries, stock assessment, conservation, and regulatory frameworks.

PSO 6: Understand the principles of post-harvest technology, fish processing, preservation, and value addition.

PSO 7: Develop analytical, entrepreneurial, and problem-solving skills applicable to fisheries, aquaculture industries, and allied sectors.

PSO 8: Demonstrate research competence and professional skills through field surveys, laboratory experiments, data analysis, and scientific reporting in fisheries science.

Program Outcomes (POs)

PO 1: Apply fundamental concepts of fishery science and aquaculture to understand fish biology, aquatic ecosystems, and production systems.

PO 2: Analyze water quality, nutrition, breeding, and health management to improve fish growth and sustainable aquaculture practices.

PO 3: Use field and laboratory techniques for fish identification, culture practices, disease diagnosis, and fisheries assessment.

PO 4: Evaluate fisheries management, conservation strategies, and regulatory frameworks, ensuring responsible utilization of aquatic resources.

PO 5: Recognize the environmental, social, and economic impacts of fisheries and aquaculture on livelihoods and food security.

PO 6: Demonstrate teamwork, communication, and professional ethics while working in multidisciplinary fisheries and aquaculture settings.

PO 7: Develop entrepreneurial and employability skills related to aquaculture, hatchery operations, ornamental fisheries, and value-added products.

PO 8: Engage in lifelong learning and research-oriented thinking to adapt to advancements in fisheries science and global aquaculture technologies.

Course Objectives:

During this course, the student is expected to:

Course Objectives:

a) To describe fish breeding, seed production, nutrition, and culture techniques

b) To identify common fish diseases and apply basic health management and preventive measures

Course Outcomes:

After completing the course, the student should be able to:

- CO 1: Explain the diversity, classification, and biology of economically important finfish and shellfish.
 CO 2: Understand aquatic ecosystems and water quality parameters influencing fish growth and survival.
 CO 3: Describe fish breeding, seed production, nutrition, and culture techniques used in aquaculture.
 CO 4: Identify common fish diseases and apply basic health management and preventive measures.
 CO 5: Explain principles of capture fisheries, fisheries management, and conservation of aquatic resources.
 CO 6: Understand post-harvest technology, fish processing, preservation, and value addition.
 CO 7: Apply field and laboratory techniques related to fisheries and aquaculture practices.
 CO 8: Develop analytical, entrepreneurial, and problem-solving skills relevant to fisheries and aquaculture sectors.

Section –I

Unit-1: Fundamentals of Fishery Science	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Scope and importance of Fishery Science • Classification of fisheries: capture and culture fisheries • Inland fisheries: rivers, lakes, reservoirs, ponds • Marine fisheries: coastal and deep-sea fisheries • Fishery resources of India 		
Unit- II: Fish Biology and Fishery Resources	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Systematic position and distinguishing characters of major edible fishes • Biology of important freshwater fishes (Indian major carps) • Biology of important marine fishes • Reproductive biology of fishes • Fish breeding – natural and induced breeding • Fecundity and spawning behavior • Fish migration – anadromous and catadromous fishes 		

Section –II

Unit-III: Aquaculture and Fish Culture Practices	No. of lectures-15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Principles and scope of aquaculture • Types of aquacultures – freshwater, brackish water, marine • Composite fish culture • Monoculture and polyculture practices • Integrated fish farming (fish–poultry, fish–duck, fish–pig) • Fish seed production and hatchery management • Fish nutrition and artificial feeds 		
Unit-IV: Fishery Management, Processing and Conservation	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none"> • Fishery management concepts and strategies • Fishing gears and crafts • Fish diseases – bacterial, viral, fungal, parasitic • Fish health management • Fish preservation methods – chilling, freezing, drying, curing 		

- Fish processing and value-added products
- Conservation of fishery resources

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unit wise weightage distribution.

**College Level Assessment (CA) Activities:
List of Experiments/Assignments/Field visit, etc.**

**Practical-6 Based on
DSE-2: Fishery Science and Aquaculture Code: 2309207
(UA - 30 MARKS & CA-20MARKS)**

1	Study of external morphology of fishes (scales, fins, lateral line)
2	Identification of freshwater and marine fishes up to family level
3	Study of fishing crafts and gears (charts/models)
4	Study of fish larvae and fry stages
5	Study of migratory fishes with examples
6	Demonstration of induced breeding techniques (hypophysation – chart/video)
7	Identification of plankton used as fish feed
8	Water quality parameters for aquaculture (pH, DO, temperature)
9	Study of fish diseases and symptoms
10	Study of fish preservation methods
11	Visit to fish farm / fish market / hatchery and report submission

Suggested Reading Materials:

- S.S. Khanna & H.R. Singh
- Fish and Fisheries of India – V.G. Jhingran
- Aquaculture Principles and Practices – T.V.R. Pillay & M.N. Kutty
- Handbook of Fisheries and Aquaculture – ICAR
- Fish Nutrition and Feeding – J.E. Halver & R.W. Hardy
- W.S. Hoar & D.J. Randall
- Introduction to Fisheries Science – K.F. Lagler
- Principles of Aquaculture – R.R. Stickney
- Fish Pathology – R.J. Roberts



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
First Year M.Sc. (Zoology) Semester-II

Elective

Paper code: 2309208

Course Code DSE-2: Applied Parasitology (Theory)

***Teaching Scheme**

Lectures:04 Hours/week, 04 Credits

OR

Practical:02Hours/week, 01Credit

***Examination Scheme**

UA:60 Marks

CA: 40 Marks

Program specific outcome (PSOs):

PSO1: Acquire advanced knowledge of parasitic organisms, host–parasite relationships, and disease transmission.

PSO2: Identify medically, veterinary, agricultural, and fishery important parasites using standard taxonomic and diagnostic tools.

PSO3: Apply parasitological concepts in disease diagnosis, control strategies, and public health management.

PSO4: Develop laboratory skills in parasitological techniques, microscopy, sample processing, and data interpretation.

PSO5: Understand epidemiology, zoonoses, and emerging parasitic diseases with societal relevance.

PSO6: Prepare for careers in research, diagnostics, healthcare, veterinary services, agriculture, and academia.

Program Outcomes (POs).

After successful completion of the programme, students will be able to:

PO1: Demonstrate comprehensive understanding of core and applied areas of zoological sciences.

PO2: Apply scientific reasoning, experimental design, and analytical skills in biological investigations.

PO3: Identify organisms and biological problems using appropriate tools and techniques.

PO4: Integrate zoological knowledge with applications in health, agriculture, environment, and industry.

PO5: Practice ethical standards, biosafety, and environmental sustainability.

PO6: Communicate scientific information effectively through written, oral, and visual formats.

PO7: Develop problem-solving abilities and critical thinking in biological sciences.

PO8: Prepare for higher education, research, competitive examinations, and professional careers.

Course Objectives:

During this course, the student is expected to:

Course Objectives:

a) To develop Provide fundamental and applied knowledge of parasitology

b) To Introduce students to host–parasite relationships

Course Outcomes:

After completing the course, the student should be able to:

CO1: Explain the scope, principles, and significance of parasitology in medical, veterinary, and environmental contexts.

CO2: Classify parasites and describe host–parasite relationships, life cycles, and adaptations to parasitism.

CO3: Describe the biology, pathogenicity, epidemiology, and control of protozoan and helminth parasites of medical importance.

CO4: Identify parasites affecting livestock, poultry, fishes, and crops and assess their economic impact.

CO5: Understand diagnostic methods including microscopy, serology, and molecular approaches used in parasitology.

CO6: Analyze parasite control strategies including chemotherapy, vector control, and integrated parasite management.

CO7: Apply parasitological knowledge to public health, disease prevention, and sustainable management

practices.

Section –I

Unit-1: Introduction and General Parasitology	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none">• Scope and importance of parasitology• Types of parasites: ectoparasites, endoparasites, temporary and permanent parasites• Host–parasite relationships• Types of hosts and vectors• Adaptations of parasites to parasitic mode of life• Life cycles of parasites• Pathogenicity and virulence• Zoonotic parasites• Epidemiology and transmission of parasitic diseases		
Unit- II: Protozoan and Helminth Parasites of Medical Importance	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none">• • General characters and classification of protozoan parasites• Life cycle, pathogenicity, symptoms, diagnosis, and control of:<ul style="list-style-type: none">– <i>Entamoeba histolytica</i>– <i>Plasmodium</i> spp.– <i>Leishmania</i> spp.• General characters of helminths• Life cycle, pathogenicity, and control of:<ul style="list-style-type: none">– <i>Ascaris lumbricoides</i>– <i>Taenia</i> spp.– <i>Wuchereria bancrofti</i>• Host immune response to parasitic infections		

Section –II

Unit-III: Veterinary, Agricultural and Fish Parasitology	No. of lectures-15	Weightage:9-16 Marks
<ul style="list-style-type: none">• Parasites of domestic animals – nematodes, trematodes, cestodes• Economic losses due to veterinary parasites• Parasites of fishes and aquaculture importance• Parasites affecting poultry• Arthropod parasites of animals – ticks, mites, lice, fleas• Parasitic infections in livestock and their management• Agricultural nematodes and crop damage• Control measures in veterinary and agricultural parasitology		
Unit-IV: Diagnosis, Treatment and Control of Parasitic Diseases	No. of lectures- 15	Weightage:9-16 Marks
<ul style="list-style-type: none">• Diagnostic methods in parasitology:<ul style="list-style-type: none">– Microscopy– Serological methods– Molecular methods (PCR – overview)• Chemotherapy of parasitic diseases• Antiparasitic drugs and drug resistance• Vector control strategies		

- Preventive and control measures
- Integrated parasite management
- Public health aspects of parasitic diseases
- Recent advances in parasitology

Above Unit Weightage is given for 60% marks of UA assessment only. There could be variation of 10-15% in the Unit wise weightage distribution.

**College Level Assessment (CA) Activities:
List of Experiments/Assignments/Field visit, etc.**

**Practical-6 Based on
DSE-2: Applied Parasitology Code: 2309209
(UA - 30 MARKS & CA-20MARKS)**

1	Study of types of parasites and hosts (charts/models)
2	Identification of vectors (mosquito, sand fly, housefly, tick – charts/specimens)
3	Identification of protozoan parasites (<i>Entamoeba</i> , <i>Plasmodium</i> , <i>Leishmania</i>)
4	Study of helminth parasites (<i>Ascaris</i> , <i>Taenia</i> , <i>Wuchereria</i>)
5	Identification of ectoparasites of livestock (ticks, lice, mites)
6	Study of vector control methods
7	Preparation of parasite life cycle charts
8	Economic importance of veterinary parasites (case studies)
9	Preparation of parasite life cycle charts
10	Mini-project on a parasitic disease of local importance

Suggested Reading Materials:

- Cheng, T. C. – *General Parasitology*, Academic Press
- Soulsby, E. J. L. – *Helminths, Arthropods and Protozoa of Domesticated Animals*, Baillière Tindall
- Cox, F. E. G. – *Modern Parasitology*, Blackwell Science
- Paniker, C. K. J. – *Textbook of Medical Parasitology*, Jaypee Brothers
- Arora & Arora – *Medical Parasitology*, CBS Publishers
- Bogitsh, Carter & Oeltmann – *Human Parasitology*, Elsevier
- Markell, Voge & John – *Medical Parasitology*, Saunders
- Roberts & Janovy – *Foundations of Parasitology*, McGraw-Hill
- Yamaguti, S. – *Systema Helminthum*, Interscience



Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-II
Paper Code: 2309203
OJT/In-house Project/ Internship/ Apprenticeship

Credits: 4

Marks: 100

Program specific outcome: (PSOs)

- **Laboratory Skills:** Learn to use lab equipment and conduct experiments.
- **Data Analysis:** Develop skills in analyzing scientific data.
- **Research Methods:** Understand how to design and conduct scientific research.

Program outcome: (Pos)

- **Real-World Experience:** Apply classroom knowledge in a professional setting.
- **Career Exploration:** Explore different career paths and industries.
- **Professional Networking:** Build a network of professional contacts.
- **Skill Enhancement:** Improve both technical and soft skills.
- **Workplace Adaptability:** Learn to adapt to different work environments.
- **Feedback and Improvement:** Receive feedback to improve performance and skills.

OJT/In-house Project/ Internship/Apprenticeship

- Evaluation of **OJT/In-house Project/ Internship/ Apprenticeship** shall be as per the procedure evolved by the University from time to time.
- The student shall opt for lab/ field projects / internship / apprenticeship. Lab work will be assessed for **30 hours per credit (Total=4 x 30 = 120 contact hours)**, and field projects / internship / apprenticeship will be internally assessed for 45 hours per credit under the supervision of faculty member.
- The concerned department has to maintain the details of OJT/In-house project/Internship/Apprenticeship for appropriate evaluation of students for grading and certification.

Important Note Concerning Dissection and Field Studies

As per the guidelines of 'UGC Resolution- D.O.No.F.14-6/2014 (CPP-II) dated 5th August, 2014' it is mandatory to promote the students towards knowledge component for skill development, ICT based virtual dissections be promoted. As per the notification it is necessary to encourage field trips and observations without disturbing the biodiversity. For laboratory observations existing preserved specimens and permanent slides are shown for the knowledge component. Zoology Department should be empowered with ICT based tools, infrastructure, software components and enrich with high-quality internet facilities.

Students must follow instructions as instructed from respective institutes during various kinds of study tours, field trips, project work etc. Students are entirely responsible for any sort of personal injury, harm or unfortunate incident in case of students misconduct during the course of study.