Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI, DIST – PUNE. AUTONOMOUS

POST GRADUATE DEPARTMENT OF ZOOLOGY

SYLLABUS
M.Sc. Zoology Part-I, SEMESTER-I

ACADEMIC YEAR 2019-20

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI.
AUTONOMOUS

Scheme of Course Structure (CBCS)
Faculty of Science
Post Graduate Department of Zoology
SEMESTER I

Class: M.Sc. I **Pattern: 40 (IA) + 60 (EA)**

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	ZOO: 4101	Theory	Biochemistry and Bioenergetics	4	I / E	40 + 60
2	ZOO: 4102	Theory	Cell Biology and Genetics	4	I / E	40 + 60
3	ZOO: 4103	Theory	Fresh Water Zoology and Ichthyology	4	I / E	40 + 60
4	ZOO: 4104	Theory	Skills in Scientific Communication & Writing and Biostatistics	4	I / E	40 + 60
5	ZOO: 4105	Zoology Practical-5	Practicals Corresponding to: ZOO:4101 and ZOO:4102	4	I / E	40 + 60
6	ZOO: 4106	Zoology Practical-6	Practicals Corresponding to: ZOO:4103 and ZOO:4104	4	I / E	40 + 60
7	CC-23		Certificate Course	2	-	-
	SD-24		Skill Development II	2	-	-

IA* - Internal Assessment

EA*- External Assessment

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)

Academic Year 2019 – 2020

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: I**

Course Name: Biochemistry and Bioenergetics **Course Code: ZOO: 4101**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- Explain the fundamental building blocks of life (biomolecules) and their diverse functions through understanding different classes like carbohydrates, lipids, proteins, vitamins, and coenzymes.
- Analyze the stabilizing interactions and key properties of biomolecules with focus on water's role, pH and buffers, protein structure, and denaturation processes.
- Apply the principles of bioenergetics to metabolic pathways by interpreting concepts like free energy, redox potential, and high-energy compounds like ATP.
- Dissect the intricate pathways of carbohydrate metabolism including glycolysis, citric acid cycle, and HMP pathway, understanding their regulation and energetic significance.
- Delve into the breakdown and synthesis of amino acids by exploring transamination, urea cycle, and their connection to ammonia excretion.
- Unravel the intricacies of nucleic acid metabolism by tracing the pathways for both purine and pyrimidine degradation and biosynthesis.
- Master the science of enzyme action through classification, understanding enzyme kinetics (Michelis-Menten equation), specific activity, and factors influencing their activity and inhibition.

Course Outcomes:-

After completion of this course students will be able to -

CO1: identify and characterize the fundamental biomolecules (carbohydrates, lipids, proteins, vitamins, and coenzymes) and their diverse roles in living organisms. (Focuses on knowledge and understanding)

CO2: explain the stabilizing interactions (e.g., hydrogen bonding) and key properties of biomolecules, with emphasis on the influence of water, pH & buffers, protein structure, and denaturation processes. (Analyses relationships and factors affecting stability)

CO3: apply the principles of bioenergetics (free energy, redox potential, ATP) to analyze and interpret metabolic pathways, including their energetic significance. (Develops problem-solving skills using bioenergetics concepts)

CO4: master the details and regulatory mechanisms of key carbohydrate metabolism pathways (glycolysis, citric acid cycle, HMP pathway) and their contribution to cellular energy production. (Requires in-depth analysis and comprehension of specific pathways)

CO5: evaluate the processes of amino acid breakdown (transamination) and synthesis (urea cycle) and their connection to ammonia excretion in various organisms. (Focuses on understanding interconnected metabolic processes)

CO6: demystify the intricacies of nucleic acid metabolism by tracing the pathways for both purine and pyrimidine degradation and biosynthesis, considering their regulation and significance. (Develops a comprehensive understanding of nucleotide metabolism)

CO7: become proficient in enzyme knowledge, including classification, reaction kinetics (Michaelis-Menten equation), specific activity, and factors influencing enzyme activity and inhibition. (Requires mastery of enzyme concepts and their practical applications)

Course Articulation Matrix of ZOO: 4101 Biochemistry and Bioenergetics
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	1	3	2	2	1	3
CO2	3	3	2	2	2	3	2	2	3
CO3	2	3	2	2	2	2	3	2	3
CO4	3	3	2	3	2	3	2	2	3
CO5	3	2	2	3	1	2	2	1	2
CO6	3	3	2	3	3	3	2	2	3
CO7	2	3	2	2	2	2	3	2	3

PO1: Disciplinary Knowledge

All Course Outcomes (COs) contribute to building a strong foundation in the discipline of biochemistry.
CO1-6 delve into different biomolecules and their metabolic pathways, providing in-depth knowledge of this field.
CO7 focuses on enzymes, key players in biochemical reactions, solidifying understanding of the mechanisms powering various processes.

PO2: Critical Thinking and Problem Solving

CO3 requires applying bioenergetic principles to analyze metabolic pathways, demonstrating problem-solving skills within the context of biochemistry.
CO4 demands in-depth analysis of specific pathways, such as glycolysis, to understand their energetic significance and troubleshoot potential disruptions.
CO5 and CO6 involve evaluating interconnected metabolic processes like amino acid metabolism and nucleic acid metabolism, showcasing the ability to think critically about complex systems.

PO3: Social Competence

CO1 and CO3 require explaining biomolecular properties and applying bioenergetic concepts, both of which can involve effective communication in group discussions or explaining these concepts to others.
CO7 emphasizes enzyme classification and factors influencing activity, which could be presented in group projects or discussions, further developing social and communication skills.

PO4: Research-related skills and Scientific temper

CO2 analyses factors affecting biomolecule stability, encouraging an investigative approach and critical evaluation of scientific data.
CO5 and CO6 delve into interconnected metabolic processes and complex pathways, respectively, fostering a research-oriented mindset and the ability to interpret intricate results.

PO5: Trans-disciplinary knowledge

CO4's focus on the energetic significance of specific pathways allows for connections to other disciplines like biophysics or evolutionary biology.
CO6's exploration of nucleic acid metabolism has connections to genetics and molecular biology, promoting trans-disciplinary understanding.

PO6: Personal and professional competence

CO7's emphasis on enzyme kinetics, specific activity, and factors influencing enzyme activity equips students with professional skills relevant to biopharmaceutical research or clinical studies.

PO7: Effective Citizenship and Ethics

CO2's exploration of water's role in biomolecule stability raises awareness of environmental factors influencing biochemical processes.

CO5's focus on ammonia excretion connects biochemistry to ecological considerations and potential environmental implications.

PO8: Environment and Sustainability

CO2's analysis of factors affecting biomolecule stability can be linked to environmental concerns like pollution and its impact on biochemical processes.

CO5's exploration of ammonia excretion has connections to agricultural practices and their potential environmental impact.

PO9: Self-directed and Life-long learning

All COs require independent learning, critical thinking, and the ability to analyze and interpret complex information, laying the foundation for lifelong learning in biochemistry and related fields.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: I**

Course Name: Cell Biology and Genetics **Course Code: ZOO: 4102**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- Gain a fundamental understanding of the chemical building blocks of life.
- Master the structure and function of the plasma membrane..
- Unravel the secrets of the endomembrane system and peroxisomes.
- Appreciate the critical role of the nucleus in cellular control.
- Decipher the mechanisms of cell signaling and transduction.
- Gain insights into the intricate regulation of the cell cycle.
- Develop a holistic understanding of cancer biology.

Learning Outcomes:-

After completion of this course students will be able to -

CO1: build molecular models of biomolecules and explain their functions in living systems.
CO2: explain the structure and function of the plasma membrane using various models.
CO3: describe the roles of the endomembrane system and peroxisomes in cellular processes.
CO4: analyze the structure and function of the nucleus and its role in cell division.
CO5: design a signal transduction pathway based on a specific stimulus and receptor.
CO6: create a cell cycle checkpoint simulation to illustrate the regulation of cell division.
CO7: develop a research proposal to investigate a specific aspect of cancer biology.

Course Articulation Matrix of ZOO: 4102 Cell Biology and Genetics
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	2	3	2	2	3
CO2	2	3	2	3	2	3	2	2	3
CO3	2	3	2	3	2	3	2	2	3
CO4	2	3	2	3	2	3	2	2	3
CO5	3	3	2	3	2	3	2	2	3
CO6	2	3	2	3	2	3	2	2	3
CO7	3	3	2	3	3	3	3	3	3

PO1: Disciplinary Knowledge:

CO1, CO2, CO3, CO4: These COs require understanding the key biomolecules, structures, and functions within a cell, demonstrating disciplinary knowledge of cell biology.

CO5, CO6, CO7: Analyzing signal transduction pathways, designing cell cycle simulations, and proposing research illustrate deeper application of cell biology concepts.

PO2: Critical Thinking and Problem Solving:

CO1, CO2, CO3: Building molecular models and explaining functions involves analyzing complex structures and their interactions, demonstrating critical thinking.

CO4, CO5, CO6: Analyzing cell division, designing signal transduction pathways, and simulating cell cycle checkpoints require complex problem-solving skills.

CO7: Developing a research proposal necessitates critical questioning, hypothesis formulation, and problem-solving skills in a real-world context.

PO3: Social Competence:

CO5, CO6, CO7: Presenting research findings, collaborating on the cell cycle simulation, and discussing research proposals in a group setting develop effective communication and teamwork skills.

PO4: Research-related skills and Scientific temper:

CO5, CO6, CO7: Designing a signal transduction pathway, simulating cell cycle checkpoints, and developing a research proposal all involve research skills like data analysis, interpretation, and hypothesis testing.

CO4: Analyzing the role of the nucleus in cell division requires a critical and skeptical approach to scientific findings.

PO5: Trans-disciplinary knowledge:

CO5, CO6, CO7: Understanding signal transduction pathways, designing cell cycle simulations, and proposing cancer research require integrating knowledge from related fields like biochemistry, genetics, and medicine.

PO6: Personal and professional competence:

CO1, CO2, CO3, CO4: Building molecular models, explaining functions, and analyzing structures hone independent research and learning skills.

CO5, CO6, CO7: Designing experiments, simulating processes, and proposing research demonstrate project management, time management, and communication skills needed for professional settings.

PO7: Effective Citizenship and Ethics:

CO7: Investigating cancer biology emphasizes the ethical implications of research and its potential benefit to society.

PO8: Environment and Sustainability:

CO7: Exploring cancer research could potentially lead to solutions for reducing environmental pollutants linked to cancer incidence

PO9: Self-directed and Life-long learning:

CO1, CO2, CO3, CO4: Building models, explaining functions, and analyzing structures encourage further exploration and lifelong learning in cell biology.

CO5, CO6, CO7: Designing experiments, simulating processes, and proposing research foster independent learning and critical thinking skills for continual knowledge acquisition

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: I**

Course Name: Fresh Water Zoology and Ichthyology **Course Code: ZOO: 4103**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- Understand the different types of aquatic environments and their characteristics: This includes learning about lotic (flowing) and lentic (still) habitats, as well as ephemeral water bodies.
- Analyze the physical and chemical conditions of water and their impact on aquatic life: This involves studying factors like water movement, depth, temperature, light, dissolved oxygen, pH, and nutrient levels.
- Examine the physiological and protective adaptations of various aquatic organisms: This section focuses on how different groups like protozoa, rotifers, crustaceans, and fishes have adapted to their specific environments.
- Study the diagnostic features and life cycles of temporary rainwater pool animals: This objective delves into the unique characteristics and lifecycle stages of creatures like fairy shrimps, tadpole shrimps, and clam shrimps.
- Investigate respiratory and locomotor adaptations, particularly in freshwater insects and their larvae: This section explores how insects and their larvae have adjusted their breathing and movement mechanisms to thrive in aquatic environments.
- Explore the relationship between amphibians and water, with a focus on the frog's life cycle and the tadpole's ecological role: This objective focuses on how amphibians like frogs rely on water and the important role tadpoles play as herbivores.
- Analyze the adaptations of freshwater reptiles and their economic importance: This section examines how reptiles like turtles and crocodiles have adapted to freshwater environments and explores their economic value.

Learning Outcomes:-

After completion of this course students will be able to -

CO1: explain the diversity and complexity of aquatic environments.
CO2: analyze and interpret environmental data.
CO3: enhanced problem-solving skills related to aquatic conservation challenges.
CO4: think and develop new research ideas.
CO5: explore the relationship between amphibians and water.
CO6: explain the diagnostic features and life cycles of temporary rainwater pool animals.
CO7: analyze the adaptations of freshwater reptiles and their economic importance.

Course Articulation Matrix of ZOO: 4103 Fresh Water Zoology and Ichthyology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	1	3	2	2	3	2
CO2	2	3	2	3	1	2	2	2	3
CO3	2	3	3	2	2	3	2	1	2
CO4	3	2	2	3	2	3	1	2	2
CO5	1	2	3	1	3	2	2	2	2
CO6	2	3	2	3	2	3	2	1	2
CO7	1	2	3	1	3	2	3	2	2

PO1: Disciplinary Knowledge
CO1 & CO2 directly contribute to deepening disciplinary knowledge of aquatic environments.
CO3 & CO4 demonstrate comprehension of specific and advanced concepts in aquatic conservation challenges and research avenues.

PO2: Critical Thinking and Problem Solving
CO2 & CO3 require analyzing and interpreting complex data, forming hypotheses, and designing solutions.
CO4 demands critical evaluation of existing knowledge and generating innovative research questions.

PO3: Social Competence
CO5 encourages creative expression and communication, potentially involving collaboration with others.
CO7 emphasizes effective communication and advocacy towards stakeholders and the public.

PO4: Research-related skills and Scientific temper
CO2 & CO4 directly involve data analysis, research question formulation, and hypothesis testing.
CO7 showcases responsible citizenship within scientific exploration and environmental advocacy.

PO5: Trans-disciplinary knowledge
CO3 & CO4 may involve integrating knowledge from various disciplines like ecology, chemistry, sociology, etc., when addressing conservation challenges.
CO7 promotes informed advocacy that considers the broader economic, social, and political context of environmental issues.

PO6: Personal and professional competence
CO1 & CO2 require independent study and engagement with complex material.
CO3 & CO4 demonstrate initiative and proactive engagement in research and problem-solving.
CO6 indicates potential for career development and professional skills acquisition in aquatic science or conservation.

PO7: Effective Citizenship and Ethics
CO5 encourages responsible and creative expression that can raise awareness and influence positive change.
CO7 emphasizes responsible citizenship through informed advocacy for healthy aquatic ecosystems.

PO8: Environment and Sustainability
CO1 & CO7 cultivate understanding and appreciation for the environment, specifically aquatic ecosystems.
CO3 & CO4 foster skills and knowledge relevant to addressing environmental challenges and promoting sustainable practices.

PO9: Self-directed and Life-long learning
CO1 & CO2 stimulate intellectual curiosity and motivation to acquire new knowledge.
CO3 & CO4 require independent investigation, critical evaluation, and formulation of new research questions, fostering the spirit of lifelong learning.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: I**

Course Name: Skills in Scientific Communication Writing and Biostatistics

Course Code: ZOO: 4104

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives: -

- **Develop strong communication skills:** Emphasis on reading, writing, listening, and speaking, along with understanding synonyms and antonyms, aims to build clear and effective communication.
- **Master the fundamentals of English grammar and syntax:** Focus on sentence structure, basic grammar rules, paragraph writing, paraphrasing, and précis writing hones in on accurate and precise written and spoken English.
- **Eliminate common errors in written and spoken language:** Learning to identify and avoid tautology, double negatives, superfluous words, incorrect sequence of tenses, and other common errors leads to polished and professional communication.
- **Become a confident and effective oral presenter:** Gaining knowledge on preparation, using presentation tools, communication techniques, voice control, and addressing obstacles equips one for delivering impactful presentations.
- **Differentiate between hypotheses, theories, and concepts:** Understanding these key scientific terms fosters critical thinking and accurate representation of knowledge.
- **Grasp the concept of intellectual property rights (IPR) and patents:** Introduction to IPR and its international conventions provides awareness of protecting innovative ideas and inventions.
- **Gain skills in research project preparation and funding:** Learning about project planning, funding avenues and effective proposal writing prepares one for successful research endeavours.

Learning Outcomes:-

After completion of this course students will be able to -

CO1: communicate with clarity and confidence: Participants will be able to: Express themselves clearly and concisely in writing and speech.
CO2: grammatically correct sentences and paragraphs. Paraphrase and write concise summaries.
CO3: identify and avoid common errors like tautology, double negatives, and incorrect tenses. Produce polished and professional communication materials.
CO4: utilize presentation tools effectively and confidently. Employ impactful communication techniques, including body language and voice control.
CO5: differentiate between hypotheses, theories, and concepts.
CO6: explain the concept of intellectual property rights (IPR) and protect their own innovative ideas and inventions through appropriate legal means.
CO7: develop research projects addressing well-defined research questions and write effective research proposals that secure funding.

Course Articulation Matrix of ZOO: 4104 Skills in Scientific Communication & Writing and Biostatistics
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	2	2	3	3	3	3	3	3
CO4	2	3	3	2	2	3	2	2	3
CO5	3	3	3	3	3	3	3	3	3
CO6	3	2	2	3	3	3	3	3	3
CO7	2	3	3	3	2	3	2	2	3

PO1: Disciplinary Knowledge
Mapped to CO1, CO2, CO3, CO5: These COs focus on mastering the use of English language, both written and spoken, with accuracy and clarity. This is foundational to understanding and communicating disciplinary knowledge effectively.
Mapped to CO6: Understanding and protecting intellectual property relates to knowledge within specific disciplines and the importance of its ownership and dissemination.

PO2: Critical Thinking and Problem Solving
Mapped to CO1, CO2, CO5: Effective communication skills are essential for analyzing information, developing arguments, and presenting solutions. These COs emphasize the ability to express complex ideas clearly and concisely.
Mapped to CO7: Conducting successful research projects requires critical thinking for defining research questions, data analysis and draw conclusions.

PO3: Social Competence
Mapped to CO1, CO2, CO4: These COs focus on effective communication and engagement in conversations and presentations. This includes skills like active listening, understanding audience needs, and delivering impactful messages.

PO4: Research-related skills and Scientific temper
Mapped to CO5, CO7: The ability to think critically and present knowledge accurately is crucial for research. CO5 emphasizes differentiating between concepts and avoiding oversimplification, while CO7 focuses on conducting research projects with defined questions and effective methodologies.

PO5: Trans-disciplinary knowledge
Mapped to CO1, CO2, CO5: Mastering language enables communication and understanding across different disciplines. These COs emphasize clear and concise expression, which facilitates the transfer of knowledge between fields.

PO6: Personal and professional competence
Mapped to all COs: All of the COs contribute to personal and professional competence by equipping individuals with effective communication skills, critical thinking abilities, and research expertise. These skills are valuable in various professional settings and enhance personal development.

PO7: Effective Citizenship and Ethics
Mapped to CO1, CO2, CO5: Clear and ethical communication is essential for responsible citizenship. These COs focus on using language accurately and avoiding misrepresentation of information, which are crucial for effective and ethical social engagement.

PO8: Environment and Sustainability

Mapped to CO5, CO7: Research and communication play a vital role in addressing environmental issues and promoting sustainability. CO5 emphasizes accurate knowledge representation, while CO7 focuses on conducting research that supports sustainable practices.

PO9: Self-directed and Life-long learning

Mapped to all COs: The skills developed through these COs, such as critical thinking, research, and communication, empower individuals to be self-directed learners and continue acquiring knowledge throughout their lives.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: I**

Course Name: Title of paper: Zoology Practical-I
(Practicals Corresponding to ZOO: 4101, ZOO: 4102)

Course Code: ZOO: 4105

Number of Credits: 04 **Number of Practicals: 10**

Learning Objectives:-

- Understand and perform basic laboratory techniques: This includes preparing standard solutions, buffers, and conducting titrations. You'll also learn how to measure pH and estimate the concentration of various biochemicals.
- Isolate and characterize enzymes: You'll gain hands-on experience in isolating enzymes like amylase or invertase, determining their specific activity, and studying their activity under different conditions (pH, temperature, substrate concentration, inhibitors, activators).
- Analyze cellular components: You'll learn how to use light microscopy to measure cell size, study cell division (meiosis) in detail, and observe organelles like nuclei and mitochondria.
- Investigate chromosome structure and *behaviour*: You'll prepare chromosome spreads, analyze their morphology, and study the effects of treatments like colchicine on mitosis. Additionally, you'll explore banding techniques like G-banding and C-banding to visualize specific chromosome regions.
- Apply genetic principles: You'll delve into sex-linked inheritance in *Drosophila*, calculate gene distances and order, and analyze human population genetics. This involves understanding concepts like allelic frequencies and heterozygosity.
- Explore the impact of environmental factors: You'll investigate the effects of toxicants on the regeneration ability of *Hydra*, providing insights into environmental stress responses.
- Develop quantitative skills: Throughout the course, you'll hone your skills in data analysis, interpretation, and drawing conclusions from experimental results.

Learning Outcomes:-

After completion of this course students will be able to -

CO1: independently prepare standard solutions, buffers, conduct titrations, measure pH, and estimate the concentration of various chemicals using established protocols.

CO2: isolate and purify enzymes, determine their specific activity under varied conditions (pH, temperature, substrate concentration, etc.), and analyze the effects of inhibitors and activators.

CO3: gain proficiency in using light microscopy to measure cell size, study cell division processes (meiosis), and identify and characterize organelles such as nuclei and mitochondria.

CO4: prepare and analyze chromosome spreads, interpret their morphology, study the effects of treatments like colchicine on mitosis, and apply banding techniques like G-banding and C-banding to visualize specific chromosome regions.

CO5: analyze sex-linked inheritance patterns in *Drosophila*, calculate gene distances and order, and apply concepts like allelic frequencies and heterozygosity to analyze human population genetics.

CO6: investigate and interpret the effects of environmental stressors (e.g., toxicants) on organisms (e.g., *Hydra*) and gain insights into environmental stress responses.

CO7: effectively analyze and interpret experimental data, draw sound conclusions from results, and communicate findings in a clear and concise manner.

Course Articulation Matrix of ZOO: 4105 Zoology Practical-I
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	1	2	3	1	3
CO2	3	3	2	3	2	3	3	2	3
CO3	2	2	2	2	1	2	2	2	2
CO4	2	3	2	3	2	2	3	2	3
CO5	3	3	2	3	3	3	3	2	3
CO6	2	3	3	2	3	2	2	3	3
CO7	2	3	3	3	2	3	3	2	3

PO1: Disciplinary Knowledge

CO1, CO2, CO3, CO4, CO5: These COs directly involve acquiring and applying knowledge in core biological concepts like laboratory techniques, enzymes, cellular components, chromosomes, and genetics.

CO6, CO7: Understanding the impact of environmental factors and analyzing experimental data requires strong disciplinary knowledge in ecology and biostatistics.

PO2: Critical Thinking and Problem Solving

CO1, CO2, CO3, CO4, CO5: Isolating enzymes, analyzing chromosome spreads, calculating gene distances, and interpreting inheritance patterns all require critical thinking and problem-solving skills.

CO6, CO7: Investigating environmental effects and drawing conclusions from data involve analyzing complex information and formulating solutions.

PO3: Social Competence

CO1, CO2, CO3, CO4, CO5: Collaborating with peers in laboratory experiments, discussing results, and presenting findings in reports and presentations foster social competence.

CO6, CO7: Interpreting environmental issues and communicating scientific findings effectively to a broader audience require strong communication and collaboration skills.

PO4: Research-related skills and Scientific temper

CO1, CO2, CO3, CO4, CO5: Designing experiments, following protocols, collecting data, and drawing conclusions based on evidence all contribute to developing research-related skills and a scientific temper.

CO6, CO7: Analyzing environmental data, interpreting results critically, and forming hypotheses based on observations further enhance research skills and scientific thinking.

PO5: Trans-disciplinary knowledge

CO2, CO3, CO4, CO5: Understanding enzymes in cellular processes, analyzing chromosome *behaviour* during cell division, and studying genetic principles in human populations involve applying biological knowledge to other disciplines like medicine and agriculture.

CO6, CO7: Analyzing the impact of environmental factors on organisms bridges biology with environmental science and ecology.

PO6: Personal and professional competence

CO1, CO2, CO3, CO4, CO5: Planning and executing experiments, managing time effectively, and working independently in the laboratory contribute to personal and professional development.

CO6, CO7: Analyzing data, drawing conclusions, and presenting findings confidently enhance communication and critical thinking skills, valuable for personal and professional growth.

PO7: Effective Citizenship and Ethics

CO6: Understanding the impact of environmental factors and responsible conduct of scientific research foster awareness of ethical considerations in environmental issues.
CO7: Communicating scientific findings accurately and objectively to the public promotes responsible citizenship and ethical scientific practices.

PO8: Environment and Sustainability

CO6: Investigating the effects of environmental stressors on organisms directly relates to understanding environmental issues and promoting sustainable practices.
CO7: Analyzing environmental data and advocating for responsible environmental actions contribute to environmental awareness and sustainability.

PO9: Self-directed and Life-long learning

CO1, CO2, CO3, CO4, CO5: Designing experiments, interpreting data, and seeking new knowledge in various biological fields encourage self-directed learning and a lifelong curiosity about science.
CO6, CO7: Analyzing complex environmental issues, staying updated on scientific advancements, and adapting to new technologies promote lifelong learning and intellectual curiosity.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: I**

Course Name: Title of paper: Zoology Practical-II
(Practicals Corresponding to ZOO: 4103, ZOO: 4104)

Course Code: ZOO: 4106

Number of Credits: 04 **Number of Lectures: 60**

Learning Objectives:-

- Preparation and maintenance of a culture of *Paramecium*, *Daphnia* and *Hydra*.
- Study of locomotory and respiratory adaptations in aquatic insects and their larvae.
- Estimation of chlorides in given sample of water.
- Study of bioindicators of pollution by insects, rotifers, algae, diatoms.
- Determinations of LC50 using fish/insect larvae for known pollutant like heavy metal/any pesticide/industrial effluent.
- Compulsory Visit to freshwater body for the study of aquatic ecosystem.
- Visit to fish farm to study breeding *behaviour* of fish

Learning Outcomes:-

After completion of this course students will be able to -

CO1: develop and maintain cultures of diverse aquatic organisms (*Paramecium*, *Daphnia*, *Hydra*) in a controlled laboratory environment. (Skills: Aseptic technique, observation, data recording, maintenance of water quality)

CO2: analyze and compare locomotory and respiratory adaptations in various aquatic insects and their larvae. (Knowledge: Aquatic insect diversity, adaptation to different aquatic environments, functional morphology)

CO3: accurately quantify chloride concentration in water samples using established analytical techniques. (Skills: Chemical analysis, titration, calibration, data interpretation)

CO4: evaluate the suitability of different bioindicators (insects, rotifers, algae, diatoms) for assessing water pollution levels. (Knowledge: Bioindicatory organisms, pollution tolerance levels, ecological monitoring)

CO5: determine the LC50 (lethal concentration at 50%) of a known pollutant (heavy metal, pesticide, industrial effluent) using fish or insect larvae in controlled bioassays. (Skills: Bioassay design, data analysis, dose-response relationships, toxicity assessment)

CO6: gain first-hand experience of aquatic ecosystem dynamics and water purification technology through a visit to a Zoological Survey of India (ZSI) center and a freshwater body. (Knowledge: Ecosystem components, water treatment processes, conservation importance)

CO7: observe and document the breeding behaviour of different fish farm. (Knowledge: Fish reproductive strategies, parental care, environmental influences on spawning)

Course Articulation Matrix of ZOO: 4106 Zoology Practical-II
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	2	3	3	2	3
CO2	3	3	2	3	3	3	2	2	3
CO3	3	3	2	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	2	3
CO5	3	3	2	3	2	3	3	3	3
CO6	3	3	2	3	2	3	3	3	3
CO7	3	3	3	3	3	3	2	3	3

PO1: Disciplinary Knowledge
Mapped with CO1, CO2, CO3, CO4, CO5, CO6: These COs directly involve acquiring and applying knowledge in aquatic biology, including diversity of organisms, adaptations, analytical techniques, pollution indicators, toxicity assessment, and ecosystem dynamics.
Mapped with CO7: Understanding fish reproductive strategies requires knowledge of fish biology, physiology, and behaviour.

PO2: Critical Thinking and Problem Solving
Mapped with CO1, CO2, CO3, CO4, CO5, CO6: These COs require analyzing data, interpreting results, identifying patterns, and drawing conclusions about aquatic systems and water quality. Designing bioassays (CO5) and evaluating bioindicators (CO4) involve problem-solving in specific contexts.
Mapped with CO7: Documenting breeding behaviour involves observation, identification of factors influencing spawning, and making connections between environmental cues and reproductive responses.

PO3: Social Competence
Mapped with CO6: Visiting a ZSI center and interacting with professionals might involve teamwork, communication, and collaboration skills.
Mapped with CO7: Observing breeding behaviour in a fish farm might involve interacting with farmers and understanding their practices, requiring social awareness and communication skills.

PO4: Research-related skills and Scientific temper
Mapped with CO1, CO2, CO3, CO4, CO5, CO6: These COs involve data collection, recording, analysis, and interpretation, which are fundamental research skills. Maintaining scientific temper through careful observation, objective recording, and unbiased analysis is crucial in all these COs.

PO5: Trans-disciplinary knowledge
Mapped with CO3: Chemical analysis in CO3 might involve knowledge from chemistry, applying principles of titration and calibration to assess water quality.
Mapped with CO6: Understanding water purification technology in CO6 might involve knowledge from engineering and environmental science, connecting ecological principles with technological solutions.

PO6: Personal and professional competence
Mapped with all COs: Each CO requires developing skills like time management, organization, accuracy, and responsibility in carrying out laboratory work, fieldwork, and data analysis. These skills contribute to personal and professional competence.

PO7: Effective Citizenship and Ethics
Mapped with CO4, CO6: Understanding bioindicators and water pollution in CO4 and visiting a ZSI center in CO6 raise awareness about environmental issues and the importance of sustainable practices. This fosters responsible citizenship and ethical behaviour towards the environment.
Mapped with CO7: Observing breeding behaviour might involve understanding ethical considerations in fish breeding and conservation practices.

PO8: Environment and Sustainability
Mapped with CO1, CO4, CO5, CO6: Maintaining diverse aquatic cultures (CO1), assessing water pollution (CO4), determining pollutant toxicity (CO5), and understanding water purification (CO6) all contribute to environmental awareness and knowledge about sustainable water management practices.

PO9: Self-directed and Life-long learning
Mapped with all COs: Each CO requires independent learning, research, and initiative to acquire knowledge, design experiments, analyze data, and draw conclusions. These skills foster self-directed learning and a lifelong commitment to knowledge acquisition in aquatic biology.

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI, DIST – PUNE. AUTONOMOUS

POST GRADUATE DEPARTMENT OF ZOOLOGY

SYLLABUS

M.Sc. Zoology Part-I, SEMESTER-II

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI.

AUTONOMOUS

Scheme of Course Structure (CBCS) Faculty of Science

Post Graduate Department of Zoology

SEMESTER II

Class: M.Sc. I **Pattern: 50 (IA) + 50 (EA)**

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	**ZOO:4201**	**Theory**	**Molecular Biology**	**4**	E/I	**60 + 40**
2	**ZOO:4202**	**Theory**	**Developmental Biology**	**4**	E/I	**60 + 40**
3	**ZOO:4203**	**Theory**	**Comparative Animal Physiology and Endocrinology**	**4**	E/I	**60 + 40**
4	**ZOO:4204**	**Theory**	**Biological Techniques**	**4**	E/I	**60 + 40**
5	**ZOO:4205**	Zoology **Practical-III**	**Practicals Corresponding to ZOO:4201 and ZOO:4202**	**4**	E/I	**60 + 40**
6	**ZOO:4206**	Zoology **Practical-IV**	**Practicals Corresponding to ZOO:4203 and ZOO:4204**	**4**	E/I	**60 + 40**
7		**Skill Development**		**2**		
8		**Introduction to Cyber Security – I**		**2**		

IA* - Internal Assessment

EA* - External Assessment

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Class: M.Sc. I (Semester– II)
Paper Code: ZOO: 4201
Paper: I **Title of Paper: Molecular Biology**
Credit: 4 **No. of Lectures: 60**

Course Objectives:-

- Understand the organization and architecture of DNA within the nucleus.
- Explain the concept of supercoiling and its importance in DNA stability and unwinding.
- Explain the principles behind hyperchromicity, hypochromicity, and solubility of DNA.
- Analyze the concept of C-value paradox and its implications for genome complexity.
- Recognize and understand the roles of different RNA types (mRNA, rRNA, tRNA) in cellular processes.
- Elucidate the process of DNA replication in E. coli, including the role of origin, DNA polymerases, and regulatory mechanisms.
- Identify and categorize different types of DNA damage caused by various agents. Explain the roles and interactions of regulatory elements like promoter, enhancer, intron, exon, and silencer in gene expression.

Course Outcomes:-

After completion of this course students will be able to -

CO1: illustrate the structure of chromatin and differentiate between nucleosomes and higher-order DNA packing.
CO2: explain the impact of histone modifications on gene expression and chromatin remodeling.
CO3: analyze the relationship between DNA structure and its physical properties.
CO4: compare and contrast C-value paradox among different organisms.
CO5: explain the structure and functions of various RNA molecules in protein synthesis and other cellular processes.
CO6: draw and explain the steps involved in E. coli DNA replication.
CO7: classify different types of DNA damage based on their severity and potential consequences. Analyze the mechanism of gene transcription, including the role of RNA polymerase and sigma factor.

Course Articulation Matrix of ZOO: 4201: Molecular Biology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	2	3	2	2	3
CO2	3	3	2	3	2	3	3	2	3
CO3	3	3	2	3	2	3	2	2	3
CO4	3	3	2	3	2	3	2	2	3
CO5	3	3	2	3	2	3	2	2	3
CO6	3	3	2	3	2	3	2	2	3
CO7	3	3	2	3	2	3	2	2	3

PO1: Disciplinary Knowledge:
All of the COs are directly mapped to PO1. All COs are directly address PO1 by requiring knowledge of specific concepts in DNA structure, physical properties, genome organization, DNA replication, RNA types, and transcription.

PO2: Critical Thinking and Problem Solving:
All of the COs are directly mapped to PO2. For example- CO3, CO4, CO6 & CO7 Analyzing the relationship between DNA structure and properties, comparing c-value paradox, explaining replication steps, and classifying DNA damage all require critical thinking and problem-solving skills.

PO3: Social Competence:
All of the COs are directly mapped to PO3. All COs showing limited direct address. However, group discussions or problem-solving activities could indirectly address communication and collaboration skills.

PO4: Research-related skills and Scientific temper:
All of the COs are directly mapped to PO4. For example- CO6 & CO7 are drawing replication mechanisms and analyzing transcription process showcase basic research skills and scientific reasoning.

PO5: Trans-disciplinary knowledge:
All of the COs are directly mapped to PO5. For example- CO5 is connecting RNA functions to protein synthesis and other cellular processes demonstrates trans-disciplinary understanding.

PO6: Personal and professional competence:
All of the COs are directly mapped to PO6. For example- CO1, CO2, CO6 and CO7 are illustrating chromatin structures, explaining complex concepts, and drawing mechanisms require attention to detail and communication skills, contributing to PO6.

PO7: Effective Citizenship and Ethics:
All of the COs are directly mapped to PO7. All COs showing limited direct address. However, discussing the ethical implications of genetic engineering or potential environmental risks related to DNA research could indirectly touch on PO7.

PO8: Environment and Sustainability:
All of the COs are directly mapped to PO8. All COs showing limited direct address. However, mentioning environmentally relevant examples of DNA damage or emphasizing sustainable research practices could indirectly address PO8.

PO9: Self-directed and Life-long learning:
All of the COs are directly mapped to PO9. For example- CO2, CO4 and CO7 are explaining histone modifications, interpreting c-value paradox, and analyzing complex processes like transcription all encourage critical evaluation of information and independent learning, fostering PO9 skills.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Class: M.Sc. I (Semester– II)
Paper Code: ZOO: 4202
Paper: II **Title of Paper: Developmental Biology**
Credit: 4 **No. of Lectures: 60**

Course Objectives:-

- Analyze the evolution of diverse developmental patterns from unicellular protists to multicellular metazoans.
- Explore key concepts and model systems used in developmental biology research.
- Understand the processes of spermatogenesis and oogenesis in detail.
- Deeply explore the intricate mechanisms and significance of fertilization.
- Analyze the key developmental stages following fertilization, including cleavage, blastulation, gastrulation, and pattern formation.
- Elucidate the activation of the egg and its transition to development.
- Grasp the role of organizers in establishing body plans and patterns.

Course Outcomes:-

After completion of this course students will be able to –

CO1: explain how developmental mechanisms evolved and diversified, comparing patterns across various organismal groups.
CO2: identify and describe the advantages and limitations of different model organisms like *C. elegans*, *Drosophila*, Zebra fish, frog, chick, and mouse.
CO3: analyze the formation, structure, and functions of sperm and egg cells, including factors like sperm motility, pH regulation, and maternal transcript storage.
CO4: explain pre-fertilization events like capacitation, species recognition, acrosome reaction, signal transduction, and molecular strategies ensuring monospermy and species specificity.
CO5: differentiate between various cleavage patterns, blastula types, and understand the concept of germ layer specification and animal-vegetal axis.
CO6: explain how the cell cycle is regulated and how maternal macromolecules and organelles are utilized during early embryonic stages.
CO7: analyze the function of Spemann's organizers in different model organisms like *X. laevis*, zebrafish, chick, and mammals, and explain their contribution to pattern formation.

Course Articulation Matrix of ZOO: 4202: Developmental Biology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	2	2	2	3
CO2	3	3	2	3	3	2	2	2	3
CO3	3	3	2	3	3	2	2	2	3
CO4	3	3	2	3	3	2	2	2	3
CO5	3	3	2	3	3	2	2	2	3
CO6	3	3	2	3	3	2	2	2	3
CO7	3	3	2	3	3	2	3	2	3

PO1: Disciplinary Knowledge:
All of the COs are directly mapped to PO1. For example CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly address PO1 by requiring knowledge of specific concepts in evolutionary developmental biology, model organisms, gametogenesis, fertilization, post-fertilization events, egg activation, and organizers.

PO2: Critical Thinking and Problem Solving:
All of the COs are directly mapped to PO2. For example CO1, CO4, CO5, CO6 & CO7 are analyzing the evolution of developmental patterns, understanding complex fertilization mechanisms, differentiating blastula types, explaining cell cycle regulation, and interpreting the role of organizers all require critical thinking and problem-solving skills.

PO3: Social Competence:
All of the COs are directly mapped to PO3. All COs showing limited direct address. However, group discussions or presentations on ethical issues in developmental biology could indirectly address communication and collaboration skills.

PO4: Research-related skills and Scientific temper:
All of the COs are directly mapped to PO4. CO1, CO2, CO3, CO4, CO5, CO6, CO7: Understanding complex biological processes, comparing different model systems, and analyzing regulatory mechanisms can indirectly contribute to research skills and scientific reasoning.

PO5: Trans-disciplinary knowledge:
All of the COs are directly mapped to PO5. All COs showing limited direct address. However, connecting developmental biology concepts to other fields like evolution, cell biology, and genetics could showcase trans-disciplinary understanding.

PO6: Personal and professional competence:
All of the COs are directly mapped to PO6. CO2, CO5, CO7: Analyzing advantages and limitations of model systems, differentiating complex structures like blastulae, and understanding organizer functions require attention to detail and critical thinking, contributing to PO6.

PO7: Effective Citizenship and Ethics:
All of the COs are directly mapped to PO7. All COs showing limited direct address. However, discussing the ethical implications of cloning technology or potential environmental concerns related to developmental interventions could indirectly touch on PO7.

PO8: Environment and Sustainability:
All of the COs are directly mapped to PO8. All COs showing limited direct address. However, mentioning examples of environment-sensitive developmental processes or emphasizing sustainable research practices could indirectly address PO8.

PO9: Self-directed and Life-long learning:
All of the COs are directly mapped to PO9. For example CO1, CO4, CO6 & CO7 are analyzing evolutionary trends, interpreting complex mechanisms like fertilization, understanding cell cycle regulation in early development, and critically evaluating the role of organizers all foster critical evaluation of information and independent learning, encouraging PO9 skills.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Class: M.Sc. I (Semester– II)
Paper Code: ZOO: 4203
Paper: III Title of Paper: Comparative Animal Physiology& Endocrinology
Credit: 4 No. of Lectures: 60

Course Objectives:-

- Understand the mechanisms and regulation of digestion and absorption in various animals.
- Analyze the diversity and effectiveness of different respiratory systems in animals.
- Gain in-depth knowledge of the structure and function of skeletal muscle tissue.
- Explore the mechanisms and adaptations animals employ to maintain internal water and electrolyte balance.
- Understand the processes and regulation of urine formation and waste elimination in animals.
- Analyze the physiological response of animals to temperature changes and their thermoregulatory strategies.
- Explore the role of hormones and other chemical messengers in animal physiology and behavior.

Course Outcomes:-

After completion of this course students will be able to –

CO1: explain the functional morphology of digestive organs, analyze enzymatic processes, and compare strategies for nutrient uptake across different taxonomic groups.

CO2: compare the mechanics of gas exchange in gills and lungs, explain the role of blood pigments, interpret oxygen dissociation curves, and discuss factors influencing CO2 transport.

CO3: illustrate the myofilaments organization, analyze the events at the neuromuscular junction, explain the actin-myosin interaction, and understand the role of calcium in contraction.

CO4: define key concepts like osmole, osmolality, and tonicity, differentiate hyper- and hypo-osmotic regulators, and analyze the strategies of ureosmotic animals.

CO5: detail the mechanisms of urine formation in the mammalian kidney, discuss renal pressure systems, and compare the biochemistry of nitrogen excretion across different taxa.

CO6: explain biokinetic zones, differentiate tolerance and resistance, apply thermobiological terminology, explain compensatory patterns in poikilotherms, and compare mechanisms of thermoregulation in homeotherms.

CO7: identify different types of hormones, describe the process of neurosecretion, compare invertebrate and vertebrate hormones, and analyze the mechanisms of hormone action through signal transduction pathways.

Course Articulation Matrix of ZOO: 4203: Comparative Animal Physiology& Endocrinology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	2	2	2	3
CO2	3	3	2	3	3	2	2	2	3
CO3	3	3	2	3	3	2	2	2	3
CO4	3	3	2	3	3	2	2	3	3
CO5	3	3	2	3	3	2	2	3	3
CO6	3	3	2	3	3	2	2	3	3
CO7	3	3	2	3	3	2	3	2	3

PO1: Disciplinary Knowledge:
All of the COs are directly mapped to PO1. For example CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly address PO1 by requiring knowledge of specific concepts in digestive physiology, respiratory physiology, muscle contraction, osmotic regulation, excretory physiology, temperature regulation, and chemical communication.

PO2: Critical Thinking and Problem Solving:
All of the COs are directly mapped to PO2. For example CO2, CO3, CO4, CO5, CO6 & CO7 are analyzing the differences and adaptations in gas exchange (CO2), understanding the complex mechanisms of muscle contraction (CO3), interpreting complex regulatory systems in excretion (CO5), differentiating thermoregulatory strategies (CO6), and explaining hormone action pathways (CO7) all require critical thinking and problem-solving skills.

PO3: Social Competence:
All of the COs are directly mapped to PO3. All COs showing limited direct address. However, group discussions or presentations on comparative physiology or environmental implications of animal thermoregulation could indirectly address communication and collaboration skills.

PO4: Research-related skills and Scientific temper:
All of the COs are directly mapped to PO4. For example CO1, CO2, CO5, CO6 & CO7 are understanding complex physiological processes like digestion, gas exchange, and renal function (CO1, CO2, CO5), analyzing thermoregulatory adaptations (CO6), and interpreting hormone action pathways (CO7) can indirectly contribute to research skills and scientific reasoning.

PO5: Trans-disciplinary knowledge:
All of the COs are directly mapped to PO5. CO1, CO2, CO4, CO6, CO7: Connecting digestive physiology to nutritional ecology (CO1), comparing respiratory mechanisms to evolutionary contexts (CO2), linking osmoregulation to environmental adaptations (CO4), relating thermoregulation to animal distribution and behavior (CO6), and understanding the role of hormones in reproduction and development (CO7) showcase trans-disciplinary thinking.

PO6: Personal and professional competence:
All of the COs are directly mapped to PO6. For example CO2, CO3, CO5, CO6 and CO7 are analyzing complex data like oxygen dissociation curves (CO2), explaining intricate mechanisms like muscle contraction (CO3), interpreting detailed diagrams of renal structures (CO5), applying thermoregulatory terminology (CO6), and summarizing hormone action pathways (CO7) require attention to detail and communication skills, contributing to PO6.

PO7: Effective Citizenship and Ethics:
All of the COs are directly mapped to PO7. All COs showing limited direct address. However, discussing the ethical implications of hormone use in livestock or potential environmental challenges related to animal waste management could indirectly touch on PO7.

PO8: Environment and Sustainability:
All of the COs are directly mapped to PO8. For example CO4, CO5 & CO6 are analyzing adaptations for water balance in different environments (CO4), understanding the impact of waste products on ecosystems (CO5), and discussing the influence of climate change on thermoregulation (CO6) can indirectly address PO8.

PO9: Self-directed and Life-long learning:
All of the COs are directly mapped to PO9. For example CO2, CO3, CO5, CO6 & CO7 are analyzing complex data like oxygen dissociation curves (CO2), understanding the nuances of muscle contraction mechanisms (CO3), interpreting renal function in different animals (CO5), evaluating thermoregulatory adaptations in diverse environments (CO6), and critically exploring diverse hormone pathways (CO7) all foster critical evaluation of information and independent learning, encouraging PO9 skills.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Class: M.Sc. I (Semester– II)
Paper Code: ZOO: 4204
Paper: IV Title of Paper: Biological Techniques
Credit: 4 No. of Lectures: 60

Course Objectives:-

- Understand the principles and applications of various microscopy techniques for visualizing biological structures at different scales.
- Gain expertise in using spectroscopic methods to analyze the chemical composition and structure of biomolecules.
- Master the separation and characterization of proteins and nucleic acids based on their size and charge using electrophoresis techniques.
- Comprehend the principles and applications of centrifugation for isolating and analyzing biomolecules based on their size and density.
- Develop a strong foundation in separation and purification techniques based on different chromatographic principles.
- Gain practical skills in tissue preparation, staining, and visualization for microscopic analysis.
- Understand the principles and applications of cutting-edge molecular biology techniques in research and diagnostics.

Course Outcomes:-

After completion of this course students will be able to –

CO1: analyze the strengths and limitations of Phase Contrast, Fluorescence, Confocal, TEM, SEM, AFM, and Live Cell Imaging techniques, and apply them to study diverse biological samples.

CO2: explain the principles of UV-Vis, Atomic Absorption, Molecular, IR, NMR, and X-Ray Crystallography techniques, interpret spectra to identify functional groups and structure of biomolecules, and utilize advanced methods like Circular Dichroism and MALDI-TOF.

CO3: differentiate between Moving Boundary and Zone Electrophoresis, compare various electrophoresis supports, interpret results from Native and SDS-PAGE, and analyze complex protein mixtures using 2D-Gel Electrophoresis.

CO4: explain the theoretical basis of Ultracentrifugation, distinguish between Differential and Density Gradient Centrifugation, utilize centrifugation for molecular weight determination, and understand its diverse applications in biological research.

CO5: compare and contrast Paper, Thin Layer, Adsorption, Partition, Ion-Exchange, Affinity, and Molecular Exclusion Chromatography methods, choose appropriate techniques for specific biomolecules, analyze results from chromatographic assays, and utilize advanced techniques like GC-MS, HPLC, and HPTLC.

CO6: identify different types of fixatives and their roles, practice various sectioning techniques, apply histochemical and immunohistochemical staining methods, and utilize immunofluorescence for cellular localization studies.

CO7: explain the principles of Real-time PCR, DNA Microarray, Next-Generation DNA Sequencing, Protein Microarray, and FRET analysis, discuss their significance in research areas like gene expression, disease diagnosis, and protein-protein interactions, and interpret data generated from these techniques.

Course Articulation Matrix of ZOO: 4204: Biological Techniques
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	2	2	2	3
CO2	3	3	2	3	3	3	3	2	3
CO3	3	3	2	3	3	2	2	2	3
CO4	3	3	2	3	3	2	2	3	3
CO5	3	3	2	3	3	2	2	3	3
CO6	3	3	2	3	3	2	2	3	3
CO7	3	3	2	3	3	2	3	2	3

PO1: Disciplinary Knowledge:
All of the COs are directly mapped to PO1. For example CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly addressing PO1 by requiring significant knowledge of specific instrumentation techniques in microscopy, spectroscopy, electrophoresis, centrifugation, chromatography, histology, and new generation techniques.

PO2: Critical Thinking and Problem Solving:
All of the COs are directly mapped to PO2. For example CO1, CO2, CO3, CO4, CO5 & CO7 are Choosing the appropriate microscopy technique for a specific sample (CO1), interpreting complex spectra for biomolecule identification (CO2), troubleshooting electrophoresis data for protein characterization (CO3), selecting the best centrifugation method for molecular weight determination (CO4), analyzing chromatographic data to purify specific biomolecules (CO5), and interpreting results from new generation techniques for research applications (CO7) all require critical thinking and problem-solving skills.

PO3: Social Competence:
All of the COs are directly mapped to PO3. All COs showing limited direct address. However, group projects analyzing microscopy images, discussing data from electrophoresis gels, or interpreting results from new generation techniques could indirectly address communication and collaboration skills.

PO4: Research-related skills and Scientific temper:
All of the COs are directly mapped to PO4. For example CO1, CO2, CO4, CO5, CO6 & CO7 are utilizing diverse instrumentation techniques for research projects (CO1, CO2, CO4, CO5, CO6), designing and executing experiments with appropriate controls (CO4, CO5), and critically evaluating data generated from these techniques (CO7) all contribute to research skills and scientific reasoning.

PO5: Trans-disciplinary knowledge:
All of the COs are directly mapped to PO5. For example CO2, CO5 & CO7 are connecting spectroscopy techniques to chemical principles (CO2), relating chromatographic methods to biomolecule properties (CO5), and understanding the applications of new generation techniques in various fields like genetics, medicine, and forensics (CO7) showcase trans-disciplinary thinking.

PO6: Personal and professional competence:
All of the COs are directly mapped to PO6. For example CO1, CO2, CO3, CO6 & CO7 are operating instruments with precision and care (CO1, CO6), analyzing complex data sets and generating concise reports (CO2, CO3, CO5, CO7), and adhering to safety protocols in the laboratory (CO1, CO2, CO3, CO4, CO5, CO6) all require attention to detail, critical thinking, and communication skills, contributing to PO6.

PO7: Effective Citizenship and Ethics:
All of the COs are directly mapped to PO7. All COs showing limited direct address. However, discussing the ethical implications of using specific techniques like DNA sequencing in genetic testing or exploring the environmental impact of certain reagents used in these experiments could indirectly touch on PO7.

PO8: Environment and Sustainability:
All of the COs are directly mapped to PO8. All COs showing limited direct address. However, emphasizing the use of environmentally friendly protocols, minimization of waste generated during experiments, and responsible disposal of reagents could indirectly address PO8.

PO9: Self-directed and Life-long learning:
All of the COs are directly mapped to PO9. For example CO1, CO2, CO5, CO6 & CO7 are keeping up with advancements in instrumentation techniques (CO1, CO2, CO5, CO7), troubleshooting issues without relying solely on instructors (CO3, CO4, CO5, CO6), and independently interpreting complex data from various techniques (CO2, CO5, CO7) all foster critical evaluation of information and independent learning, encouraging PO9 skills.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Class: M.Sc. I (Semester– II)
Paper Code: ZOO: 4205
Paper: V **Title of paper: Zoology Practical-III**
(Practicals Corresponding to ZOO: 4201, ZOO: 4202)
Credit: 4 **No. of Practical: 20**

Course Objectives:-

- Gain hands-on experience in estimating DNA and RNA concentrations using colorimetric assays and UV spectrophotometry.
- Develop skills in isolating DNA from diverse biological samples and analyzing its integrity and size using agarose gel electrophoresis.
- Understand and apply the Western blotting technique for protein detection and localization in biological samples.
- Investigate early embryonic development of chicks through dissection, mounting, and histological analysis.
- Explore developmental processes in different model organisms like Drosophila and frog using live observations and microscopy techniques.
- Investigate pattern formation and regeneration processes in chick limb buds and lower organisms like *Hydra* and *Planaria*.
- Develop the ability to combine different experimental techniques, analyze data from various sources, and draw meaningful conclusions about developmental processes.

Course Outcomes:-

After completion of this course students will be able to –

CO1: isolate DNA and RNA from different sources, quantify their concentrations accurately, and analyze the purity of isolated nucleic acids.

CO2: isolate DNA from bacteria, animal tissues, and plasmids, analyze its fragmentation patterns on gels, and calculate molecular weight.

CO3: perform Western blotting with primary and secondary antibodies, visualize specific proteins on membrane blots, and interpret the results in the context of protein expression patterns.

CO4: observe major organ systems of chick embryos at different stages, prepare histological sections, and identify key developmental events in organs like brain, heart, lens, and ear.

CO5: analyze egg structure and early development in Drosophila, study embryonic and post-embryonic stages in frog, and understand the influence of experimental manipulations like ligature on development.

CO6: visualize morphogenetic cell death in chick limb buds using neutral red staining, observe and analyze regeneration patterns in *Hydra* and *Planaria*, and explore the role of Hensen's node in chick development.

CO7: interpret results from molecular biology and developmental biology practicals, integrate their findings into a broader understanding of development, and communicate their insights effectively.

Course Articulation Matrix of ZOO: 4205: Zoology Practical-III
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	2	2	2	3
CO2	3	3	2	3	3	3	3	2	3
CO3	3	3	2	3	3	2	2	2	3
CO4	3	3	2	3	3	2	2	2	3
CO5	3	3	2	3	3	2	2	2	3
CO6	3	3	2	3	3	2	2	2	3
CO7	3	3	2	3	3	2	3	2	3

PO1: Disciplinary Knowledge:
All of the COs are directly mapped to PO1. For example CO1, CO2, CO3, CO4, CO5 & CO6 are directly address PO1 by requiring knowledge of specific techniques in nucleic acid isolation, protein detection, chick embryo development, and model organism development.

PO2: Critical Thinking and Problem Solving:
All of the COs are directly mapped to PO2. For example CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are troubleshooting technical issues in isolation procedures (CO1, CO2), interpreting gel electrophoresis results for DNA size and fragmentation (CO2), analyzing the specificity of antibody binding in Western blots (CO3), identifying developmental stages in chick embryos (CO4), understanding the effects of experimental manipulations on development (CO5, CO6), and drawing conclusions from combined data sets (CO7) all require critical thinking and problem-solving skills.

PO3: Social Competence:
All of the COs are directly mapped to PO3. All COs showing limited direct address. However, collaborative data analysis, group discussions on experimental results, and peer teaching during protocol demonstrations could indirectly address communication and collaboration skills.

PO4: Research-related skills and Scientific temper:
All of the COs are directly mapped to PO4. For example CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are applying learned techniques to investigate specific research questions (CO1, CO2, CO3), maintaining accurate lab records and data analysis (CO4, CO5, CO6), critically evaluating results and drawing objective conclusions (CO7) all contribute to research skills and scientific reasoning.

PO5: Trans-disciplinary knowledge:
All of the COs are directly mapped to PO5. For example CO3, CO4, CO5, CO6 & CO7 are relating protein expression patterns to developmental processes (CO3), connecting chick embryo observations to human development (CO4), comparing developmental mechanisms across different model organisms (CO5), and integrating molecular data with morphological observations (CO6, CO7) showcase trans-disciplinary thinking.

PO6: Personal and professional competence:
All of the COs are directly mapped to PO6. For example CO1, CO2, CO3, CO4, CO5 & CO6 are following safety protocols meticulously in practical sessions (CO1, CO2, CO3), independently performing complex procedures with precision (CO1, CO2, CO3), managing time effectively during experiments (CO4, CO5, CO6), and documenting results clearly and concisely (CO7) all require attention to detail, organization, and communication skills, contributing to PO6.

PO7: Effective Citizenship and Ethics:
All of the COs are directly mapped to PO7. All COs showing limited direct address. However, discussing the ethical implications of using animal models in research or the environmental impact of lab waste disposal could indirectly touch on PO7.

PO8: Environment and Sustainability:
All of the COs are directly mapped to PO8. All COs showing limited direct address. However, emphasizing green lab practices, minimizing reagent waste, and responsible disposal of chemicals could indirectly address PO8.

PO9: Self-directed and Life-long learning:
All of the COs are directly mapped to PO9. For example CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are independently troubleshooting technical issues (CO1, CO2, CO3), adapting protocols to new research questions (CO4, CO5, CO6), critically evaluating and updating experimental approaches based on new findings (CO7) all foster independent learning and a willingness to adapt to new knowledge and techniques, encouraging PO9 skills.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY (w. e. f. June, 2019)
Academic Year 2019 – 2020

Class: M.Sc. I (Semester– II)
Paper Code: ZOO: 4206
Paper: VI **Title of paper: Zoology Practical-IV**
(Practicals Corresponding to ZOO: 4203, ZOO: 4204)
Credit : 4 **No. of Practical: 20**

Course Objectives:-

- Analyze and compare nitrogenous waste products (ammonia, urea, uric acid) across animals from different habitats.
- Investigate the relationship between body size and oxygen consumption in aquatic animals using respirometry techniques.
- Develop skills in estimating biochemical parameters like sugar, chloride, and lactate in the blood of various organisms.
- Design and execute experiments to assess the effect of insulin on blood sugar levels in mammals (rats).
- Measure and analyze the influence of temperature and ions on the heartbeat rhythm of crabs.
- Dissect and analyze neurosecretory and endocrine structures in invertebrates and vertebrates using histological techniques.
- Perform surgical procedures like gonadectomy and thyroid removal in mammals and observe the consequences on relevant physiological parameters.

Course Outcomes:-

After completion of this course students will be able to –

CO1: identify physiological adaptations related to water conservation and nitrogen excretion efficiency in various animal groups.
CO2: analyze the influence of metabolic rates and diffusion limitations on oxygen use in aquatic animals of different sizes.
CO3: analyze the role of these components in physiological functions and interpret variations in their levels under different conditions.
CO4: gain hands-on experience in studying hormonal regulation of metabolism and interpret the role of insulin in glucose homeostasis.
CO5: investigate the neuronal and hormonal control of cardiac function in invertebrates and appreciate the adaptations for environmental fluctuations.
CO6: visualize and compare the anatomical organization of hormonal production and release systems in different animal groups.
CO7: visualize the role of specific hormones in regulating key physiological functions and analyze the effects of their depletion or modulation.

Course Articulation Matrix of ZOO: 4206: Zoology Practical-IV
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	2	2	3	3
CO2	3	3	2	3	3	2	2	3	3
CO3	3	3	2	3	3	2	2	3	3
CO4	3	3	2	3	3	2	2	3	3
CO5	3	3	2	3	3	2	2	3	3
CO6	3	3	2	3	3	2	2	3	3
CO7	3	3	2	3	3	2	2	3	3

PO1: Disciplinary Knowledge:
All of the COs are directly mapped to PO1. For example CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly address PO1 by requiring knowledge of specific physiological, neurobiological, and endocrinological concepts applied to diverse animal groups.

PO2: Critical Thinking and Problem Solving:
All of the COs are directly mapped to PO2. For example CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are designing and executing experiments (CO3, CO4, CO5), analyzing data and interpreting results in the context of physiological principles (CO1, CO2, CO3, CO5, CO6, CO7), troubleshooting technical issues (CO3, CO5), and drawing conclusions about adaptations and regulatory mechanisms (CO1, CO2, CO5, CO6, CO7) all require critical thinking and problem-solving skills.

PO3: Social Competence:
All of the COs are directly mapped to PO3. All COs showing limited direct address. However, collaborating during experiments, discussing results, and preparing group reports could indirectly address communication and collaborative skills.

PO4: Research-related skills and Scientific temper:
All of the COs are directly mapped to PO4. For example CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are applying learned techniques to investigate specific research questions (CO1, CO2, CO3, CO5, CO6), maintaining accurate lab records and data analysis (CO3, CO4, CO5, CO6), critically evaluating results and drawing objective conclusions (CO1, CO2, CO3, CO5, CO6, CO7) all contribute to research skills and scientific reasoning.

PO5: Trans-disciplinary knowledge:
All of the COs are directly mapped to PO5. For example CO1, CO2, CO3, CO5, CO6 & CO7 are relating physiological adaptations to environmental factors (CO1, CO2, CO5), connecting hormonal regulation to metabolic processes (CO3, CO4), comparing neural and hormonal control mechanisms across animal groups (CO5, CO6), and integrating biochemical analysis with histological observations (CO3, CO6, CO7) showcase trans-disciplinary thinking.

PO6: Personal and professional competence:
All of the COs are directly mapped to PO6. For example CO1, CO2, CO3, CO5, CO6 & CO7 are following safety protocols meticulously in practical sessions (CO3, CO5), independently performing complex procedures with precision (CO3, CO5), managing time effectively during experiments (CO3, CO5), and documenting results clearly and concisely (CO3, CO5, CO6, CO7) all require attention to detail, organization, and communication skills, contributing to PO6.

PO7: Effective Citizenship and Ethics:
All of the COs are directly mapped to PO7. All COs showing limited direct address. However, discussing the ethical implications of animal research, responsible treatment of animal models, and potential environmental concerns of lab reagents could indirectly touch on PO7.

PO8: Environment and Sustainability:
All of the COs are directly mapped to PO8. All COs showing limited direct address. However, emphasizing efficient reagent use, minimizing waste generation, and proper disposal of chemicals could indirectly address PO8.

PO9: Self-directed and Life-long learning:
All of the COs are directly mapped to PO9. For example CO1, CO2, CO3, CO5, CO6 & CO7 are Independently troubleshooting technical issues (CO3, CO5), adapting protocols to new research questions (CO3, CO5, CO6), critically evaluating and updating experimental approaches based on new findings (CO1, CO2, CO3, CO5, CO6, CO7) all foster independent learning and a willingness to adapt to new knowledge and techniques, encouraging PO9 skills.

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI, DIST – PUNE. AUTONOMOUS

POST GRADUATE DEPARTMENT OF ZOOLOGY

SYLLABUS

M.Sc. Zoology Part-II, SEMESTER-III

ACADEMIC YEAR 2020-21

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI.

AUTONOMOUS

Scheme of Course Structure (CBCS)

Faculty of Science

Post Graduate Department of Zoology

SEMESTER IV

Class: M.Sc. II **Pattern: 40 (IA) + 60 (EA)**

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	ZOO: 5301	Theory	Entomology-I Animal Physiology-I Genetics-I	4	I / E	40 + 60
2	ZOO: 5302	Theory	Insect Physiology, Biochemistry and Ecology	4	I / E	40 + 60
3	ZOO: 5303	Theory	Mammalian Reproductive Physiology and Histology & Histochemistry	4	I / E	40 + 60
4	ZOO: 5304	Theory	Economic Zoology	4	I / E	40 + 60
5	ZOO: 5305	Zoology Practical-5	Practicals Corresponding to :ZOO:5301 and ZOO:5302	4	I / E	40 + 60
6	ZOO: 5306	Zoology Practical-6	Practicals Corresponding to :ZOO:5303 and ZOO:5304	4	I / E	40 + 60
7	CC-23		Certificate Course	2	-	-
	SD-24		Skill Development II	2	-	-

IA* - Internal Assessment

EA*- External Assessment

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2020)

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: III**

Course Name: Entomology-I **Course Code: ZOO: 5301**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- To understand the classification of Insecta.
- To be conversant with scientific literature, especially related to insect biology.
- To know and use fundamental concepts in Entomology.
- To articulate positive and negative impacts of insects on human society and economy.
- To Delve into the internal systems of insects, including the digestive, respiratory, circulatory, excretory, reproductive, and nervous systems, gaining insights into their functions.
- To gain insight into the mechanisms of light and sound production in insects, and their role in communication, mating, and species survival.
- To develop proficiency in insect collection and preservation methods, ensuring the proper handling and conservation of valuable entomological specimens.

Course Outcomes:-

After completion of this course students will be able to -

CO1: explain distinguishing characters of class Insecta.
CO2: get well prepared for research in Entomology under life sciences.
CO3: understand socio-economical interactions of insects with human
CO4: well-versed in insect tagmata, specifically the head, thorax, and abdomen, and comprehend their adaptations and modifications, gaining insights into the diversity of insect body plans.
CO5: explain insect internal systems and able to explain their functions within the context of insect biology.
CO6: gain insights into the mechanisms of light and sound production in insects.
CO7: develop the skills necessary for insect collection and preservation, ensuring proper handling and conservation of entomological specimens.

Course Articulation Matrix of ZOO: 5301: Entomology I

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	1	1	1	2	1	2
CO2	3	3	2	1	1	1	2	1	2
CO3	3	1	2	1	1	1	2	1	2
CO4	3	1	1	1	2	2	1	2	1
CO5	3	1	1	1	2	2	1	2	1
CO6	3	1	1	2	2	2	1	2	1
CO7	3	2	1	2	2	3	1	2	1

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1. For example, CO1 requires students to have a deep understanding of insect diversity, which is a key component of disciplinary knowledge in entomology. CO2 requires students to have a sound knowledge of insect evolution, which is another key component of disciplinary knowledge in entomology.

PO2: Critical Thinking and Problem Solving

All of the COs are directly mapped to PO2. For example, CO1 requires students to have a deep

understanding of insect diversity, which is a key component of critical thinking in entomology. CO2 requires students to have a sound knowledge of insect evolution, which is another key component of critical thinking in entomology.

PO3: Social Competence
CO5 is indirectly mapped to PO3 because they require students to interact with others in a professional and effective manner. For example, CO5 requires students develops communication skills to educate others about the fascinating adaptations and behaviours of insects during emergence.

PO4: Research-related skills and Scientific temper
All of the COs are directly mapped to PO4. For example, CO7 requires students to develop the skills necessary for insect collection and preservation, which are essential for conducting entomological research.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5. For example, CO1, CO2, CO3, CO4, and CO5, require students to apply their knowledge of insect biology to other disciplines, such as agriculture, ecology, and medicine.

PO6: Personal and professional competence
All of the COs are directly mapped to PO6 because all of the COs require students to develop personal and professional skills, such as time management, self-motivation, and responsibility.

PO7: Effective Citizenship and Ethics
All of the COs are directly mapped to PO7 because all of the COs require students to demonstrate ethical behaviour in their research and to be aware of the social and environmental implications of their work.

PO8: Environment and Sustainability
All of the COs are directly mapped to PO8. For example CO1, CO2, CO3, CO4, and CO5 require students to understand the role of insects in the environment and to be able to develop sustainable solutions to insect-related problems.

PO9: Self-directed and Life-long learning
All of the COs is directly mapped to PO69 because all of the COs require students to develop their independent learning skills and to be able to stay up-to-date on the latest advances in entomology

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2020)

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: III**

Course Name: Animal Physiology I **Course Code: ZOO: 5301**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- To understand the bioluminescence and electricity physiology of animals.
- To understand the roles and functioning excretory organ systems and osmoregulation.
- To learn the biological membrane dynamics and energy metabolism in animals.
- To study the structure and dynamics of biological membranes and their role in cellular physiology.
- To understand the physiology of digestion, including nutritional requirements, digestion and absorption, and the neuronal and hormonal control of digestion.
- To investigate muscle physiology, including the structure of skeletal muscle, muscle contraction, and types of muscle fiber.
- To introduce students to clinical physiology, including its scope, techniques, and processes involved in clinical science.

Course Outcomes:-

After completion of this course students will be able to -

CO1: demonstrate a comprehensive understanding of the mechanisms behind bioluminescence and electricity physiology in animals.

CO2: explain functioning of Excretion via kidneys and other excretory organs of animals.

CO3: explain the physiology of membrane and physiological aspects of metabolism.

CO4: demonstrate knowledge of biological clocks and their role in regulating physiological rhythms in animals.

CO5: comprehend the physiology of digestion, including nutritional requirements, digestion and processes, and the control mechanisms.

CO6: explain the different modes of respiration, gas exchange, and the neural control of respiration, as well as understand abnormalities in gas transport.

CO7: describe muscle physiology, including muscle structure, contraction mechanisms, and muscle fiber types.

Course Articulation Matrix of ZOO: 5301: Animal Physiology I

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	1	2	1	1	1	1
CO2	3	1	1	3	1	1	1	1	1
CO3	2	2	1	2	1	1	1	1	1
CO4	2	2	1	3	1	1	1	1	1
CO5	2	1	1	1	1	1	1	1	1
CO6	2	1	2	2	1	1	1	1	2
CO7	2	1	3	2	1	3	2	2	2

PO1: Disciplinary Knowledge

CO1 aligns with PO1 as it involves comprehensive knowledge of animal physiology, including the factors influencing it. CO2 aligns with PO1 as it pertains to understanding the structure and importance of biological membranes in cellular physiology, reflecting discipline-specific knowledge. CO3 aligns with PO1 as it requires an in-depth understanding of the concept of homeostasis and its regulation, which is part of animal physiology. CO4 aligns with PO1 as it involves knowledge of biological clocks and their role in animal physiology.

PO2: Critical Thinking and Problem Solving
All the COs are directly mapped to PO2, because understanding membrane-based processes, evaluating metabolic pathways, explaining rhythmic behaviours, investigating digestive control mechanisms, analysing gas exchange mechanisms, and comprehending muscle contraction require critical thinking and problem-solving skills.

PO3 - Social Competence
CO6 directly mapped with PO3, because they primarily focus on individual knowledge and comprehension of animal physiology concepts. Social interaction or collaboration might be involved in group projects or discussions

PO4: Research-related skills and Scientific temper
CO2 involves understanding the structure and dynamics of biological membranes, which is a fundamental aspect of scientific research in physiology. CO4 relates to understanding biological clocks and their role in physiology, which is a part of scientific temper and research-related skills.

PO5: Trans-disciplinary knowledge
CO1 aligns with PO5 as it involves knowledge of factors influencing animal physiology, which can transcend beyond the discipline of physiology.

PO6: Personal and professional competence
CO7 focuses on developing practical skills necessary for personal and professional competence, particularly in the context of specimen handling and conservation.

PO7: Effective Citizenship and Ethics
CO7 aligns with PO7 as it involves ethical considerations related to specimen collection and preservation in the context of entomology.

PO8: Environment and Sustainability
CO9 relates to understanding natural phenomena (bioluminescence and animal electricity) in animals, which can have relevance to environmental and ecological aspects.

PO9: Self-directed and Life-long learning
CO9 encourages self-directed learning by exploring complex topics related to bioluminescence and animal electricity.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2020)

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: III**

Course Name: Genetics I **Course Code: ZOO: 5301**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- To understand the genetics of model organisms.
- To understand the genetics behind evolution.
- To learn the molecular biology techniques and methods of genetic analysis.
- To explore the applications of molecular methodologies in genetic analysis, including gene localization on chromosomes and the use of chromosomal probes.
- To study microbial genetics, covering topics such as conjugation, transformation, and conjugational mapping.
- To gain an understanding of the molecular biology of viruses, including virus structure, classification, and the role of viroids and prions.
- To develop critical thinking and problem-solving skills in the field of genetics.

Course Outcomes:-

After completion of this course students will be able to –

CO1: explain genomics and genetics of model organisms.

CO2: explain the evolution from genetics point of view.

CO3: analyse the concepts of continuous variation, genetic polymorphism, and the genetics of speciation in both classical and modern contexts.

CO4: utilize molecular information to understand phylogenetic relationships and explore the role of molecular methodologies in genetic analysis.

CO5: describe the mechanisms of microbial genetics, including conjugation, transformation, and the concept of Hfr conjugation.

CO6: explain the molecular biology of viruses, including their classification, structure, and the role of viroids and prions.

CO7: develop critical thinking skills and problem-solving abilities by applying genetic principles to various biological systems.

Course Articulation Matrix of ZOO: 5301: Genetics I
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	2	1	1	1	1	1	1
CO2	2	3	1	1	1	1	1	1	1
CO3	2	2	2	1	3	1	1	1	1
CO4	2	2	2	3	1	1	1	1	1
CO5	2	2	1	3	1	1	1	1	1
CO6	2	1	1	1	1	1	1	1	1
CO7	2	3	3	1	1	2	2	2	2

PO1: Disciplinary Knowledge

CO1 aligns with PO1 as it involves acquiring comprehensive knowledge of genetic model systems and their life cycles, demonstrating a strong theoretical understanding in genetics.

CO6 aligns with PO1 as it involves acquiring comprehensive knowledge of virology and virus structure, reflecting discipline-specific knowledge in molecular biology.

PO2: Critical Thinking and Problem Solving
CO2 aligns with PO2 as it requires critical thinking and problem-solving skills in genetic calculations and understanding population genetics. CO7 aligns with PO2 as it focuses on developing critical thinking skills and problem-solving abilities in the context of genetics and biology.

PO3 - Social Competence:
CO7 involves skill development in a social context, reflecting the importance of social competence in collaborative problem-solving.

PO4: Research-related skills and Scientific temper
CO4 aligns with PO4 as it involves using molecular information and methodologies in genetics, demonstrating research-related skills and scientific temper. CO5 aligns with PO4 as it involves understanding mechanisms and techniques in microbial genetics, demonstrating research-related skills.

PO5: Trans-disciplinary knowledge
CO3 aligns with PO5 as it involves integrating genetic concepts with classical and modern perspectives, transcending beyond discipline-specific approaches.

PO6: Personal and professional competence
CO7 focuses on skill development, which is essential for personal and professional competence in the context of genetic problem-solving.

PO7: Effective Citizenship and Ethics
CO7 involves critical thinking with ethical considerations, aligning with effective citizenship and ethical awareness.

PO8: Environment and Sustainability
CO7 may involve addressing biological problems related to environmental sustainability, reflecting the relevance to environmental and sustainability concerns.

PO9: Self-directed and Life-long learning
CO7 encourages self-directed learning and problem-solving, aligning with the development of self-directed and life-long learning skills.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2020)

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: III**

Course Name: Insect Physiology, Biochemistry and Ecology

Course Code: ZOO: 5302

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- To understand the physiology and biochemistry of insects organs and systems.
- To understand the processes like digestion, excretion and circulation of insects.
- To learn the ecological aspects of insects such as population dynamics and plant insect relationships.
- To understand the various hormones in insects.
- To understand the role of insects in ecosystem.
- To understand the different insect enemies.
- To understand the interaction of insects and climate.

Course Outcomes:-

After completion of this course students will be able to -

CO1: explain the insect physiology and biochemistry in depth.

CO2: describe insect population dynamics and behavioural adaptations.

CO3: explain the scope and importance of insect anatomy and physiology.

CO4: describe structure, modification and physiology of different system.

CO5: describe interaction of various climatic factors with insects.

CO6: describe feeding strategies of herbivorous insects.

CO7: describe in detail the plant defences mechanism.

Course Articulation Matrix of ZOO: 5302: Insect Physiology, Biochemistry and Insect Ecology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	3	2	3	2	2	3
CO2	2	3	2	2	1	3	2	2	2
CO3	3	2	3	3	2	3	2	2	3
CO4	2	2	2	1	1	2	2	1	2
CO5	1	1	1	2	3	1	1	3	1
CO6	3	2	2	3	2	3	2	2	3
CO7	2	2	3	2	2	2	3	1	2

PO1: Disciplinary Knowledge

CO1: Understand the insect physiology and biochemistry in depth.

CO2: Have the knowledge of insect population dynamics and behavioural adaptations.

CO3: Understand the scope and importance of insect anatomy and physiology.

CO4: Describe structure, modification and physiology of different system.

PO2: Critical Thinking and Problem Solving

CO2: Have the knowledge of insect population dynamics and behavioural adaptations (analysing factors influencing population levels, predicting potential outbreaks).

CO4: Describe structure, modification and physiology of different system (Identifying physiological adaptations to environmental or dietary challenges).
CO6: Describe interaction of various climatic factors with insects (analysing impact of climate change on insect behaviour and distribution).

PO3: Social Competence
CO7: Describe feeding strategies of herbivorous insects (Understanding the impact of insect herbivory on agricultural yield and food security).
CO8: Describe in detail the Plant defense mechanism (Understanding the complex interactions between insects and their host plants).

PO4: Research-related skills and Scientific temper
CO1: Understand the insect physiology and biochemistry in depth (Formulating research questions, interpreting scientific data).
CO2: Have the knowledge of insect population dynamics and behavioural adaptations (Designing field experiments, collecting and analysing data).
CO3: Understand the scope and importance of insect anatomy and physiology (Understanding the limitations and biases of research methods).

PO5: Trans-disciplinary knowledge
CO6: Describe interaction of various climatic factors with insects (Understanding the connection between entomology, ecology, and climate science).
CO7: Describe feeding strategies of herbivorous insects (Understanding the interplay between entomology, agriculture, and pest management).
CO8: Describe in detail the Plant defense mechanism (Understanding the interdisciplinary field of chemical ecology).

PO6: Personal and professional competence
All COs: (Developing independent learning skills, effective communication through reports and presentations, time management through assignment deadlines).

PO7: Effective Citizenship and Ethics
CO3: Understand the scope and importance of insect anatomy and physiology (Recognizing the ethical implications of using insecticides).
CO7: Describe feeding strategies of herbivorous insects (Understanding the economic and social impact of insect pests).

PO8: Environment and Sustainability
CO6: Describe interaction of various climatic factors with insects (Understanding the impact of human activities on insect populations and ecosystems).
CO7: Describe feeding strategies of herbivorous insects (Developing sustainable pest management strategies).

PO9: Self-directed and Life-long learning
All COs: (Developing curiosity and a passion for entomology, continuous learning through scientific literature and conferences).

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2020)

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: III**

Course Name: Mammalian Reproductive Physiology And Histology & Histochemistry **Course Code: ZOO: 5303**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- To understand the concept of mammalian reproduction.
- To understand the role of hormones in reproduction.
- To understand the concept of pregnancy, parturition and lactation.
- To understand the causes of reproductive dysfunction and artificial control of reproduction
- To understand the different methods of microscopy and tissue preservation and the limits of magnification and resolution.
- To understand the structural organization the various types of muscles.
- Explain the scientific basis of tissue preparation and be able to apply that understanding to the practice of the subjects such as making films, spread and counting.

Course Outcomes:-

After completion of this course students will be able to -

CO1: create awareness about Sexual Transmitted diseases.
CO2: describe the changes that occur in the reproductive system over the lifetime of an individual.
CO3: identify the major hormones involved in reproduction and describe their role in regulating reproduction in males and females.
CO4: describe the processes that can lead to dysfunction of the reproductive system.
CO5: explain the general principles of Histochemistry.
CO6: explain the potential hazards of handling chemicals and chemical waste.
CO7: design an experimental procedure.

Course Articulation Matrix of ZOO: 5303: Mammalian Reproductive Physiology And Histology & Histochemistry

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	2	2	3	2	2
CO2	2	3	2	2	1	3	2	1	2
CO3	2	2	2	2	2	2	2	2	2
CO4	3	2	2	3	2	2	3	2	2
CO5	2	2	1	2	3	2	2	3	1
CO6	2	3	2	2	2	3	2	1	2
CO7	3	2	2	3	2	2	3	2	2

PO1: Disciplinary Knowledge

CO1: Describe the changes that occur in the reproductive system over the lifetime of an individual.
CO2: Identify the major hormones involved in reproduction and describe their role in regulating reproduction in males and females.
CO3: Describe the processes that can lead to dysfunction of the reproductive system.
CO4: Understand the general principles of Histochemistry.

PO2: Critical Thinking and Problem Solving

CO2: Identify the major hormones involved in reproduction and describe their role in regulating reproduction in males and females (analysing the complex hormonal interactions in maintaining reproductive health).
CO3: Describe the processes that can lead to dysfunction of the reproductive system (Identifying potential causes of reproductive disorders and exploring treatment options).
CO5: Able to design an experimental procedure (Formulating research questions, analysing data, and drawing conclusions).

PO3: Social Competence
CO1: Create awareness about Sexual Transmitted diseases (Promoting public health education and responsible sexual behaviour).
CO4: Understand the general principles of Histochemistry (Applying knowledge to diagnose and understand human diseases).

PO4: Research-related skills and Scientific temper
CO4: Understand the general principles of Histochemistry (Developing laboratory skills, interpreting stained tissue samples).
CO5: Able to design an experimental procedure (Following scientific methods, conducting ethical research).

PO5: Trans-disciplinary knowledge
CO1: Create awareness about Sexual Transmitted diseases (Connecting reproductive health with social and cultural norms).
CO3: Describe the processes that can lead to dysfunction of the reproductive system (Understanding the interplay between reproductive health and environmental factors).

PO6: Personal and professional competence
CO5: Able to design an experimental procedure (Developing critical thinking, time management, and communication skills).
CO6: Explore career opportunities and participate in career and graduate school planning through organization and activities (Developing self-awareness, career planning skills, and professional networking).

PO7: Effective Citizenship and Ethics
CO1: Create awareness about Sexual Transmitted diseases (Promoting sexual health awareness and responsible choices).
CO4: Understand the general principles of Histochemistry (Ensuring proper and ethical handling of biological samples).

PO8: Environment and Sustainability
CO3: Describe the processes that can lead to dysfunction of the reproductive system (Understanding the potential impact of environmental toxins on reproductive health).

PO9: Self-directed and Life-long learning
CO1: Create awareness about Sexual Transmitted diseases (Maintaining an inquisitive attitude towards reproductive health issues).
CO6: Explore career opportunities and participate in career and graduate school planning through organization and activities (Developing self-motivation, continuous learning, and career adaptability).

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2020)

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: III**

Course Name: Economic Zoology **Course Code: ZOO: 5304**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- To know the role of protozoans in human welfare.
- To understand various cultivation methods.
- To understand different industries with their roles.
- To study and understand animals used in pharmaceuticals.
- To provide students with a comprehensive understanding of the diversity, ecology, and economic importance of invertebrates and lower chordates.
- To equip students with the knowledge and skills necessary to identify, classify, and control important parasites and pests.
- To raise awareness of the importance of wildlife conservation and the sustainable use of natural resources.

Course Outcomes:-

After completion of this course students will be able to -

CO1: explain the role of different cultures in day to day life.
CO2: understand the different industries with economic profit.
CO3: start up their farms.
CO4: analyze the diverse roles of invertebrates and lower chordates in human health, agriculture, and industry.
CO5: apply taxonomic principles to classify and identify key animal groups..
CO6: evaluate the economic significance of various animal commodities and resources.
CO7: assess the economic impact of poultry, piggery, dairy, animal-based sectors and their relationship to sustainable practices.
CO8: critically assess the ecological importance and conservation needs of wildlife populations.

Course Articulation Matrix of ZOO: 5304: Economic Zoology

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	2	3	2	2	2	2
CO2	3	3	2	2	3	2	2	2	2
CO3	2	2	3	2	2	3	2	2	2
CO4	3	2	2	3	3	2	2	2	2
CO5	2	2	2	2	2	2	2	2	2
CO6	2	2	2	2	2	3	2	2	2
CO7	3	2	2	3	3	2	3	2	2

PO1: Disciplinary Knowledge

CO2: Develop ability to start their farms.
CO4: Analyze the diverse roles of invertebrates and lower chordates in human health, agriculture, and industry.
CO5: Apply taxonomic principles to classify and identify key animal groups.
CO6: Evaluate the economic significance of various animal commodities and resources.
CO7: Studying poultry, piggery, dairy, and other animal-based industries alongside insects with commercial value will equip students to assess the economic impact of these sectors and their relationship to sustainable practices.

PO2: Critical Thinking and Problem Solving
CO4: Analyze the diverse roles of invertebrates and lower chordates in human health, agriculture, and industry (Evaluating the benefits and potential risks associated with different animal groups).
CO5: Apply taxonomic principles to classify and identify key animal groups (Critically analyzing morphological characteristics and using dichotomous keys for identification).
CO6: Evaluate the economic significance of various animal commodities and resources (Assessing the environmental, ethical, and social implications of animal industries).
CO7: Studying poultry, piggery, dairy, and other animal-based industries alongside insects with commercial value will equip students to assess the economic impact of these sectors and their relationship to sustainable practices (Examining potential solutions for balancing economic viability with environmental responsibility).

PO3: Social Competence
CO1: Understand the role of different cultures in day to day life (Appreciating the diverse ways humans interact with animals across cultures).
CO3: Develop ability to start their own farms (Communicating effectively with stakeholders and building collaboration within agricultural communities).

PO4: Research-related skills and Scientific temper
CO4: Analyze the diverse roles of invertebrates and lower chordates in human health, agriculture, and industry (Gathering and interpreting scientific data, formulating research questions).
CO5: Apply taxonomic principles to classify and identify key animal groups (Utilizing scientific literature and databases for reference).
CO7: Studying poultry, piggery, dairy, and other animal-based industries alongside insects with commercial value will equip students to assess the economic impact of these sectors and their relationship to sustainable practices (Evaluating research studies on sustainable practices in animal agriculture).

PO5: Trans-disciplinary knowledge
CO1: Understand the role of different cultures in day to day life (Connecting cultural practices with animal husbandry and environmental conservation).
CO6: Evaluate the economic significance of various animal commodities and resources
CO7: Studying poultry, piggery, dairy, and other animal-based industries alongside insects with commercial value will equip students to assess the economic impact of these sectors and their relationship to sustainable practices (Bridging the gap between economic development and environmental responsibility in animal agriculture).

PO6: Personal and professional competence
CO3: Demonstrating entrepreneurial skills, time management, and problem-solving abilities.
CO5: Apply taxonomic principles to classify and identify key animal groups (Developing observation skills, analytical thinking, and critical decision-making).

PO7: Effective Citizenship and Ethics
CO1: Understand the role of different cultures in day to day life (Promoting cultural sensitivity and respect for diverse perspectives on animal interactions).
CO6: Evaluate the economic significance of various animal commodities and resources (Examining ethical considerations in animal welfare and resource management).
CO7: Critically assess the ecological importance and conservation needs of wildlife populations (Understanding the importance of responsible pet ownership and advocating for wildlife conservation).

PO8: Environment and Sustainability

CO4: Analyze the diverse roles of invertebrates and lower chordates in human health, agriculture, and industry (Understanding the importance of biodiversity and natural ecosystems).

CO7: Studying poultry, piggery, dairy, and other animal-based industries alongside insects with commercial value will equip students to assess the economic impact of these sectors and their relationship to sustainable practices (Evaluating the environmental impact of animal industries and exploring sustainable alternatives).

PO9: Self-directed and Life-long learning

CO1: Understand the role of different cultures in day to day life (Fostering curiosity about animal-human relationships and cultural practices).

CO3: Develop ability to start their farms (Encouraging self-initiative and lifelong learning in agricultural practices).

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2020)

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: III**

Course Name: ZOOLOGY PRACTICAL - 5 **Course Code: ZOO: 5305**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- Develop comprehensive knowledge and practical skills in insect collection, preservation, and presentation techniques. This includes understanding various collecting methods, proper preservation techniques based on specimen type, and effective presentation methods for research and education.
- Gain in-depth understanding of the anatomy and morphology of a generalized insect. Through dissection and analysis, students will be able to identify and describe key morphological features, digestive, nervous, and reproductive systems, and the unique structure of the retro-cerebral complex.
- Analyze the structure and function of specialized head structures and appendages. This learning objective focuses on detailed study of the head capsule, various mouthpart types and their modifications, and antenna morphology and adaptations.
- Develop a comprehensive understanding of various physiological processes in living organisms, ranging from metabolic activities such as carbohydrate and protein metabolism to the impact of environmental factors on organisms, as exemplified by the effects of temperature, salinity, and osmotic stress.
- Develop a solid understanding of the principles underlying the analysis of metric traits and the estimation of phenotypic variance.
- Conduct kymographic studies to analyse ventilatory movements in beetles, gaining insights into the respiratory mechanisms of insects
- Estimate oxygen consumption in dragonfly nymphs to explore the metabolic demands during different stages of development

Course Outcomes:-

After completion of this course students will -

CO1: demonstrate advanced knowledge and practical skills in insect collection, preservation, and presentation. They will be able to employ various collecting methods, apply appropriate preservation techniques for different specimen types, and effectively present insect specimens for research and educational purposes.

CO2: gain in-depth understanding of the anatomy and morphology of a generalized insect. They will be able to identify and describe key morphological features, including the digestive, nervous, and reproductive systems, as well as the unique structure of the retro-cerebral complex through dissection and analysis.

CO3: analyze the structure and function of specialized head structures and appendages. They will gain detailed knowledge of the head capsule, various mouthpart types and their modifications, and antenna morphology and adaptations, enhancing their understanding of insect biology and ecology.

CO4: develop a comprehensive understanding of various physiological processes in living organisms. This includes metabolic activities such as carbohydrate and protein metabolism, as well as the impact of environmental factors on organisms, illustrated by the effects of temperature, salinity, and osmotic stress.

CO5: develop a solid understanding of the principles underlying the analysis of metric traits and the estimation of phenotypic variance.

CO6: capable of conducting kymographic studies to analyze ventilatory movements in beetles, gaining insights into the respiratory mechanisms of insects.

CO7: able to estimate oxygen consumption in dragonfly nymphs, providing insights into the metabolic demands during different developmental stages.

Course Articulation Matrix of ZOO: 5305: ZOOLOGY PRACTICAL - 5
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	2	2	1	2	2
CO2	3	3	2	2	2	2	2	2	2
CO3	3	3	2	2	2	2	2	2	2
CO4	3	2	2	3	3	2	2	2	2
CO5	3	3	2	3	3	2	2	2	2
CO6	3	2	1	2	1	3	2	2	2
CO7	3	3	3	3	3	3	3	3	3

PO1: Disciplinary Knowledge
CO1: This course dives deep into specific entomology techniques, demonstrating advanced knowledge and practical skills in insect collection, preservation, and presentation. This directly contributes to PO1 by building expertise within the discipline.
PO2: Critical Thinking and Problem Solving
CO2: Dissecting and analyzing insect anatomy requires critical thinking to differentiate structures, understand their functions, and identify morphological variations. This strengthens PO2 through practical application of problem-solving skills in a scientific context.
PO3: Social Competence
CO3: Analyzing specialized head structures and appendages often involves collaboration and discussion within groups, fostering communication and teamwork skills, contributing to PO3 development
PO4: Research-related skills and Scientific temper
CO4: Understanding physiological processes requires research-oriented approaches like analyzing data, drawing conclusions, and critically evaluating information. This strengthens PO4 by developing scientific temper and research skills.
PO5: Trans-disciplinary knowledge
CO5: Applying quantitative genetics techniques connects entomology with broader concepts in genetics and statistics, enriching understanding beyond discipline boundaries and contributing to PO5.
PO6: Personal and professional competence
CO6: Conducting kymographic studies equips students with technical skills like operating instruments and analyzing complex data. This builds competence in scientific research and contributes to PO6 development.
PO7: Effective Citizenship and Ethics
CO7: Understanding the physiological adaptations of aquatic insects to environmental changes raises awareness of ecological issues and the importance of environmental stewardship, contributing to responsible citizenship (PO7).
PO8: Environment and Sustainability
CO1, 4, 5: By understanding insect-environment interactions, metabolic demands, and genetic variations, students gain insights into the crucial role of insects in ecosystems and the potential impact of environmental changes. This contributes to PO8 by highlighting the importance of sustainability.
PO9: Self-directed and Life-long learning
CO1, 2, 3, 5: Mastering insect collection, dissection, and analysis techniques instills self-directed learning habits and equips students with the skills to independently explore entomological concepts, contributing to PO9.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2020)

Name of the Program: M.Sc. Zoology

Class: M.Sc. - I **Semester: III**

Course Name: ZOOLOGY PRACTICAL - 6 **Course Code: ZOO: 5306**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- Develop a thorough knowledge of the anatomy of the male and female reproductive systems in rats/mice, including the identification and description of major structures and their functions.
- Gain proficiency in histological techniques to study and analyze the microstructure of male reproductive organs in rats/mice, understanding the cellular composition and organization.
- Acquire skills in histological examination to explore the microstructure of female reproductive organs in rats/mice, including the histology of the ovaries, fallopian tubes, uterus, and other relevant structures.
- Develop proficiency in detecting enzymes, including acid phosphatase, alkaline phosphatase, and esterases. Understand the principles of enzyme detection methods and their applications in biological research.
- Gain practical skills in nucleic acid staining using methyl green, pyronine, and Feulgen stain. Understand the specificity of these stains and their utility in visualizing nucleic acids in different cellular contexts.
- Study various types of tissues using permanent slides. Develop the ability to identify and analyze different tissue structures, including epithelial, connective, muscular, and nervous tissues.
- Develop practical skills and theoretical knowledge in the laboratory culture of prawns in aquarium settings.

Course Outcomes:-

After completion of this course students will be able to -

CO1: students will demonstrate a thorough knowledge of the anatomy of the male and female reproductive systems in rats/mice. They will be able to identify and describe major structures and understand their functions in the context of reproductive physiology.

CO2: graduates will acquire proficiency in histological techniques, specifically in studying the microstructure of male reproductive organs in rats/mice. They will understand the cellular composition and organization of these organs at the microscopic level.

CO3: students will acquire skills in histological examination to explore the microstructure of female reproductive organs in rats/mice. This includes a detailed understanding of the histology of the ovaries, fallopian tubes, uterus, and other relevant structures.

CO4: graduates will develop proficiency in detecting enzymes, including acid phosphatase, alkaline phosphatase, and esterases. They will understand the principles of enzyme detection methods and their applications in biological research.

CO5: students will gain practical skills in nucleic acid staining using methyl green, pyronine, and Feulgen stain. They will understand the specificity of these stains and their utility in visualizing nucleic acids in different cellular contexts.

CO6: graduates will study various types of tissues using permanent slides and develop the ability to identify and analyze different tissue structures, including epithelial, connective, muscular, and nervous tissues. They will become proficient in tissue analysis techniques.

CO7: students will develop practical skills and theoretical knowledge in the laboratory culture of prawns in aquarium settings. They will understand the key principles of prawn culture, including water quality management, feeding regimes, and breeding techniques.

Course Articulation Matrix of ZOO: 5306: ZOOLOGY PRACTICAL - 6
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	1	3	2	2	3
CO2	3	3	2	3	1	3	2	2	3
CO3	3	3	2	3	1	3	2	2	3
CO4	3	3	2	3	1	3	2	2	3
CO5	3	3	2	3	1	3	2	2	3
CO6	3	3	2	3	1	3	2	2	3
CO7	3	3	2	3	1	3	2	2	3

PO1: Disciplinary Knowledge
CO1:The course delves into the anatomy and microstructure of the male and female reproductive systems in rats/mice, providing in-depth knowledge within the discipline of reproductive physiology and histology. This directly contributes to PO1 by building expertise in these specific areas.

PO2: Critical Thinking and Problem Solving
CO2: Histological analysis requires critical thinking to differentiate cell types, interpret tissue organization, and troubleshoot technical challenges. Applying enzyme detection and nucleic acid staining techniques further strengthens PO2 through problem-solving in a laboratory setting.

PO3: Social Competence
CO3: Collaboration and communication skills are crucial for discussing lab observations, interpreting results, and preparing reports. Working in groups on prawn culture projects also fosters teamwork and effective communication, contributing to PO3 development.

PO4: Research-related skills and Scientific temper
CO4: Mastering histological techniques equips students with essential research skills like sample preparation, data analysis, and drawing scientific conclusions. Understanding enzyme functions and interpreting nucleic acid staining patterns also contribute to PO4 by nurturing a scientific approach to research.

PO5: Trans-disciplinary knowledge
CO5: The course connects reproductive physiology and histology with broader concepts in biology, chemistry, and environmental science. Analyzing prawn culture practices bridges the gap between laboratory work and real-world applications, contributing to PO5 development.

PO6: Personal and professional competence
CO6: Gaining proficiency in various laboratory techniques, including tissue preparation, staining, and microscopy, builds technical competence and prepares students for professional careers in research or related fields. This contributes to PO6 development.

PO7: Effective Citizenship and Ethics
CO7: Understanding the ethical implications of animal research and responsible laboratory practices fosters responsible citizenship. Additionally, studying prawn culture raises awareness of sustainable aquaculture practices, contributing to PO7 development.

PO8: Environment and Sustainability

CO1, 5, 6: Understanding the reproductive biology of prawns and the principles of their culture contributes to the development of sustainable aquaculture practices, essential for environmental sustainability. This alignment with PO8 highlights the importance of responsible resource management.

PO9: Self-directed and Life-long learning

CO2, 3, 4, 5, 6: Mastering various practical skills and theoretical knowledge in reproductive physiology and histology equips students with the ability to independently learn and adapt to new techniques and technologies. This contributes to PO9 by fostering self-directed learning and a lifelong learning mind set.

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI, DIST – PUNE. AUTONOMOUS

POST GRADUATE DEPARTMENT OF ZOOLOGY

SYLLABUS
M.Sc. Zoology Part-II, SEMESTER-IV

ACADEMIC YEAR 2020-21

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI.
AUTONOMOUS

Scheme of Course Structure (CBCS)
Faculty of Science
Post Graduate Department of Zoology
SEMESTER IV

Class: M.Sc. II **Pattern: 40 (IA) + 60 (EA)**

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	ZOO: 5401	Theory	Entomology-II Animal Physiology-II Genetics-II	4	I / E	40 + 60
2	ZOO: 5402	Theory	Immunology and Parasitology	4	I / E	40 + 60
3	ZOO: 5403	Theory	Pest Control and Toxicology	4	I / E	40 + 60
4	ZOO: 5404	Theory	Environmental Biology and Animal Systematics & Diversity	4	I / E	40 + 60
5	ZOO: 5405	Zoology Practical-7	Practicals Corresponding to :ZOO:5401, ZOO:5402, ZOO:5403, ZOO:5404	4	I / E	40 + 60
6	ZOO: 5406	Research Project	DISSERTATION (Review of Literature and Summer /Industrial Training)	4	I / E	40 + 60
7	SD-24		Skill Development II	2	-	-

IA* - Internal Assessment

EA*- External Assessment

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2020)

Name of the Program: M.Sc. Zoology

Class: M.Sc. - II **Semester: IV**

Course Name: Entomology-II **Course Code: ZOO: 5401**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- Understand the intricate processes of gametogenesis, including spermatogenesis and oogenesis, and comprehend seminal transfer, fertilization, and oviposition in various organisms.
- Explore the early embryonic development of insects, covering cleavage, blastoderm formation, germ band formation, gastrulation, Blastokinesis, differentiation of germ layers, segmentation, appendage formation, and organogenesis.
- Examine the post-embryonic development stages, including eclosion from the egg, and delve into the distinctive developmental phases such as larva, pupa, and nymph, emergence from pupa/cocoon, metamorphosis, and growth in diverse organisms.
- Analyze Hadorn's experiments, focusing on imaginal disc experiments, regeneration, and aging processes, to gain insights into developmental biology and regeneration capabilities.
- Explore the phenomenon of diapause, covering its occurrence, initiation, preparations for diapause, diapause development, and the regulatory mechanisms controlling diapause in different species.
- Develop a comprehensive understanding of insect metamorphosis and growth, including the factors influencing these processes and their significance in the life cycle of insects.
- Apply acquired knowledge to critically evaluate and synthesize information, fostering the ability to draw connections between different aspects of developmental biology and experimental findings, enabling students to analyse and solve problems in the field.

Course Outcomes:-

After completion of this course students will be able to -

CO1: explain and compare the processes of spermatogenesis and oogenesis across various organisms, highlighting the similarities and differences in gametogenesis.

CO2: gain the ability to analyse and describe the key events in insect early embryonic development, including cleavage, blastoderm formation, germ band development, gastrulation, and organogenesis.

CO3: evaluate and compare the post-embryonic development stages in different organisms, understanding the significance of larval, pupal, nymphal, and emergence phases in the life cycles of diverse species.

CO4: develop the skills to interpret experimental findings from Hadorn's experiments, particularly those involving imaginal discs, regeneration, and aging, and apply this understanding to broader concepts in developmental biology.

CO5: capable of analysing the occurrence, initiation, and developmental processes of diapause, demonstrating an understanding of the ecological and physiological factors influencing diapause in various organisms.

CO6: synthesize knowledge of insect metamorphosis and growth, discerning the molecular, cellular, and environmental factors influencing these processes and recognizing their evolutionary significance.

CO7: develop critical thinking skills by applying acquired knowledge to evaluate and solve problems related to developmental biology, fostering an ability to make connections between different aspects of the syllabus and apply this understanding to novel scenarios.

Course Articulation Matrix of ZOO: 5401: Entomology II
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	2	2	1	2	1	1	1	1	1
CO3	2	2	1	1	2	1	1	1	1
CO4	2	3	1	2	1	1	2	1	1
CO5	2	2	1	2	1	1	1	2	1
CO6	3	2	1	1	2	1	1	2	2
CO7	1	3	1	1	1	1	2	1	1

PO1: Disciplinary Knowledge
All course outcomes involve fundamental principles and concepts in developmental biology. Understanding processes like gametogenesis, embryonic development, and post-embryonic stages requires a strong foundation in the discipline.

PO2: Critical Thinking and Problem Solving
Analytical skills are essential: CO2 involves the analysis of complex events in insect embryonic development, requiring critical thinking. CO4 explicitly focuses on interpreting experimental findings, which demands critical thinking skills. Additionally, CO7 emphasizes the application of acquired knowledge to evaluate and solve problems, aligning with critical thinking and problem-solving skills.

PO3: Social Competence
Limited social aspects in developmental biology: Developmental biology primarily focuses on biological processes, and the course outcomes (COs) are more centered on understanding biological phenomena than social interactions. Therefore, the mapping with social competence is relatively low.

PO4: Research-related skills and Scientific temper
Scientific inquiry is inherent: CO4 involves interpreting experimental findings, which is a key aspect of scientific inquiry. Additionally, CO2 and CO3 require evaluation and comparison, reflecting research-related skills and contributing to the development of a scientific temper.

PO5: Trans-disciplinary knowledge
Broad connections to biological concepts: CO2 (Insect embryonic development) and CO6 (Synthesis of knowledge in insect metamorphosis) have connections to broader biological concepts. These outcomes involve understanding the integration of molecular, cellular, and environmental factors, contributing to a trans-disciplinary perspective.

PO6: Personal and professional competence
Development of critical thinking: CO7 explicitly focuses on developing critical thinking skills. This outcome contributes to personal and professional competence, as critical thinking is a valuable skill in various professional and personal contexts.

PO7: Effective Citizenship and Ethics
Implicit ethical considerations: While not explicitly stated in the COs, the study of developmental biology inherently involves ethical considerations, especially when interpreting experimental findings and understanding the ecological and physiological factors in CO4 and CO5.

PO8: Environment and Sustainability

Implicit environmental considerations: CO5 (Diapause) involves understanding ecological and physiological factors. While not explicitly stated, this includes implicit considerations for the environment, aligning with the broader outcome of environmental and sustainability awareness.

PO9: Self-directed and Life-long learning

PO9 is implicitly addressed in all COs as students are encouraged to apply acquired knowledge, critical thinking skills, and disciplinary knowledge to novel scenarios. This approach fosters a mind-set of self-directed learning and continuous exploration within the field of developmental biology.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV

Name of the Program: M.Sc. Zoology

Class: M.Sc. - II **Semester: IV**

Course Name: Animal Physiology-II **Course Code: ZOO: 5401**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- To gain knowledge of nutrition, including the classification of nutrients, Colorimetry, basal metabolic rate (BMR), and the general mechanism of digestion. This objective encompasses an understanding of autonomous smooth muscle function, intrinsic nerve flexes, extrinsic nerve control, and the role of gastrointestinal hormones in digestion.
- To achieve proficiency in the anatomy of the respiratory system, internal and external respiration, pulmonary respiration, gas exchange across capillaries, and gas transport. This objective also includes an in-depth examination of the neuronal control of respiration, the role of central and peripheral receptors, and other functions of the respiratory system.
- To acquire a detailed understanding of blood composition and function, haematopoiesis, blood clotting, and molecular mechanisms involved. Additionally, they will explore the types of blood vessels, their roles in blood pressure regulation, and the implications of hypertension and hypotension.
- To gain a comprehensive understanding of the anatomy of the heart, the electrical activity of the heart, electrocardiography, events of the cardiac cycle, and the neuronal and hormonal control of the heart. This objective also covers cardiovascular responses to exercise.
- To achieve proficiency in understanding nerve cell structure and function, the excitation and conduction of nerve fibers, the ionic basis of excitation and conduction, neurotransmitter types and receptors, synapse function, neuronal integration, and the impact of drugs and diseases on synaptic transmission.
- Master the structure of skeletal muscles, the molecular basis of skeletal muscle contraction, types of contraction, twitch summation, tetanus, and the relationship between muscle length and tension. Additionally, they will gain insight into pathways of ATP formation during contraction, skeletal muscle fiber types, and the contractile machinery of smooth muscle.
- To integrate concepts from nutrition, digestion, respiration, blood and blood vessels, cardiac physiology, neuronal physiology, and muscle physiology. This objective involves synthesizing knowledge to understand the interconnectedness of physiological processes and their relevance to overall human health and function.

Course Outcomes:-

After completion of this course, students will-

CO1: explain the principles of nutrition, including the classification of nutrients, calorimetry, and basal metabolic rate (BMR). They should demonstrate a comprehensive understanding of the components of the digestive system and the mechanisms involved in digestion, including the roles of autonomous smooth muscle function, intrinsic nerve reflexes, extrinsic nerves, and gastrointestinal hormones.

CO2: analyze and describe the anatomy of the respiratory system and the processes of internal and external respiration. They should demonstrate knowledge of pulmonary respiration, gas exchange, and gas transport, including oxygen and carbon dioxide transport. Additionally, students will explore the neuronal control of respiration and the diverse functions of the respiratory system.

CO3: evaluate the composition and functions of blood, including hematopoiesis and blood clotting. They should understand the structure and functions of various blood vessels, the regulation of blood pressure, and the implications of conditions such as hypertension and hypotension.

CO4: develop an understanding of cardiac anatomy, electrical activity, electrocardiography, events in the cardiac cycle, and the neuronal and hormonal control of the heart. They will also comprehend the cardiovascular responses to exercise.

CO5: master the structure and function of nerve cells, the excitation and conduction of nerve fibers, and the ionic basis of excitation. They should understand neurotransmitter types, receptors, synaptic transmission, neuronal integration, and the impact of drugs and diseases on synaptic function.

CO6: achieve proficiency in understanding the structure of skeletal muscles, the molecular basis of skeletal muscle contraction, different types of contraction, and the physiology of skeletal and smooth muscles. They should also comprehend pathways of ATP formation during contraction and the relationship between muscle length and tension.

CO7: integrate concepts from nutrition, digestion, respiration, blood physiology, cardiac physiology, neuronal physiology, and muscle physiology. They should be able to apply this integrated knowledge to analyze and solve complex physiological problems and understand the holistic functioning of the human body.

Course Articulation Matrix of ZOO: 5401: Animal Physiology-II

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	2	1	1	1	1
CO2	2	2	1	1	1	1	1	1	1
CO3	2	2	1	1	1	1	1	1	1
CO4	2	2	1	1	1	1	1	1	1
CO5	3	2	1	1	2	1	1	1	1
CO6	2	2	1	1	1	1	1	1	1
CO7	3	3	1	1	3	1	1	1	2

PO1 (Disciplinary Knowledge):
All COs address various aspects of human physiology, demonstrating an understanding of complex biological systems. CO7 further strengthens this PO by requiring integration of knowledge across different physiological systems.

PO2 (Critical Thinking & Problem Solving):
CO1, CO5, and CO7 encourage analyzing mechanisms, applying knowledge to solve problems, and integrating information from different fields, highlighting strong contributions to this PO.

PO3 (Social Competence):
While not explicitly addressed in any COs, incorporating group projects, peer-to-peer learning, or communication-based assessments could strengthen this PO.

PO4 (Research Skills & Scientific Temper):
Research skills are implicitly required for understanding complex physiological processes and mechanisms presented in all COs. Explicit research projects or literature reviews could further strengthen this PO.

PO5 (Trans-disciplinary Knowledge):
CO1, CO5, and CO7 explicitly bridge different disciplines like nutrition, biology, and chemistry, demonstrating strong engagement with this PO.

PO6 (Personal & Professional Competence):
Similar to PO3, this PO isn't directly assessed. Encouraging self-reflection, time management skills, or career exploration activities could enhance its connection to the COs.

PO7 (Effective Citizenship & Ethics):
CO5 has potential for exploring ethical considerations in neuroscience, but requires further development to fully address this PO.

PO8 (Environment & Sustainability):
This PO currently lacks a clear connection to the provided COs. Integrating examples or discussions about environmental factors influencing human physiology could strengthen its presence.

PO9 (Self-directed & Lifelong Learning):
CO7 indirectly encourages lifelong learning through critical thinking and applying knowledge to novel situations. Encouraging students to take ownership of their learning and developing independent research skills could further strengthen this PO.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV

Name of the Program: M.Sc. Zoology

Class: M.Sc. - II **Semester: IV**

Course Name: Genetics-II **Course Code: ZOO: 5401**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:

- Develop proficiency in solving numerical problems related to Mendelian and non-Mendelian genetics, including probability estimation, to ensure a solid foundation in genetic problem-solving skills.
- Gain a comprehensive understanding of basic human genetics, covering the history of human genetics, pedigree construction, autosomal inheritance, and the presentation of molecular genetic data in pedigrees. Explore and analyze complications to basic pedigree patterns such as non-penetrance, variable expressivity, and genomic imprinting.
- Apply knowledge of clinical genetics to identify and understand various genetic disorders, including monogenic diseases, triplet repeat-based disorders, inborn metabolic errors, disorders of hematopoietic systems, and prenatal and pre-implantation diagnosis.
- Develop proficiency in low-resolution mapping techniques such as cell hybrids, radiation hybrid mapping, synteny homology, restriction maps, clone contig maps, STS maps, EST maps, and DNA sequence maps.
- Explore the genetic basis of antibody diversity, regeneration of TCR diversity, and the relationship between HLA polymorphism and disease associations in immunogenetics.
- Understand fundamental concepts in oncogenetics, including the role of oncogenes and tumor suppressor genes, as well as the application of cytogenetic studies in understanding genetic factors in cancer.
- Analyze behavioral genetics principles, including experiments on the genetics of bee behavior, the interplay between nature and nurture in behavior, methods to identify genes controlling behavior, and the genetic basis of human behavioral defects like schizophrenia.

Course Outcomes:

After completion of this course, students will-

CO1: students will demonstrate proficiency in solving numerical problems related to Mendelian and non-Mendelian genetics, including probability estimation.

CO2: have a comprehensive understanding of basic human genetics, encompassing the history of human genetics, pedigree construction, autosomal inheritance (dominant and recessive), and the presentation of molecular genetic data in pedigrees.

CO3: apply their knowledge of clinical genetics to identify and understand various genetic disorders, including monogenic diseases, triplet repeat-based disorders, inborn metabolic errors, disorders of hematopoietic systems, and prenatal and pre-implantation diagnosis.

CO4: develop proficiency in low-resolution mapping techniques, including cell hybrids, radiation hybrid mapping, synteny homology, restriction maps, clone contig maps, STS maps, EST maps, and DNA sequence maps.

CO5: understand the genetic basis of antibody diversity, the regeneration of TCR diversity, and the relationship between HLA polymorphism and disease associations in immunogenetics.

CO6: apply their understanding of oncogenetics concepts, including the role of oncogenes and tumor suppressor genes, and demonstrate knowledge of cytogenetic studies in understanding genetic factors in cancer.

CO7: critically analyze behavioural genetics principles, including experiments on the genetics of bee behaviour, the interplay between nature and nurture in behaviour, methods to identify genes controlling behaviour, and the genetic basis of human behavioural defects.

Course Articulation Matrix of ZOO: 5401 : Genetics-II

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	1	1
CO2	2	1	1	2	1	1	1	1	1
CO3	2	1	1	2	1	1	1	1	1
CO4	2	1	1	2	1	1	1	1	1
CO5	3	2	1	1	2	1	1	1	1
CO6	2	1	1	2	1	1	1	1	1
CO7	3	3	1	1	3	1	2	1	2

PO1 (Disciplinary Knowledge):

All COs address various aspects of genetics, requiring an understanding of complex biological concepts and mechanisms. CO1 and CO5 further strengthen this PO by requiring problem-solving and applying knowledge to diverse areas like immunology and neurogenetics.

PO2 (Critical Thinking & Problem Solving):

CO1, CO5, and CO7 encourage analyzing complex genetic data, interpreting research findings, and applying knowledge to novel situations. This demonstrates strong development of critical thinking skills across various subfields of genetics.

PO3 (Social Competence):

While not explicitly addressed in any COs, incorporating group projects, presentations on ethical dilemmas in genetics, or discussions on social implications of genetic research could strengthen this PO.

PO4 (Research Skills & Scientific Temper):

Research skills are required for understanding various genetic concepts and data presented in all COs. Explicit research projects, literature reviews, or critical analysis of scientific papers could further strengthen this PO.

PO5 (Trans-disciplinary Knowledge):

CO5 and CO7 clearly bridge genetics with other disciplines like immunology and neuroscience, showcasing strong engagement with this PO.

PO6 (Personal & Professional Competence):

Similar to PO3, this PO isn't directly assessed. Encouraging self-reflection on career paths in genetics, time management skills for research projects, or ethical considerations in professional practice could enhance its connection to the COs.

PO7 (Effective Citizenship & Ethics):

CO7 has potential for exploring ethical considerations in genetic testing, gene therapy, or disease screening. However, this aspect needs further development through explicit assignments, case studies, or discussions on ethical frameworks in genetics research and applications.

PO8 (Environment & Sustainability):

This PO currently lacks a clear connection to the provided COs. Integrating examples or discussions about environmental factors influencing genetic mutations, disease susceptibility, or potential applications of genetics in environmental research could strengthen its presence.

PO9 (Self-directed & Lifelong Learning):

CO7 indirectly encourages lifelong learning through critical thinking and applying knowledge to novel topics in behavioral and neurogenetics. However, explicitly encouraging students to take ownership of their learning, developing independent research skills, and reflecting on the evolving nature of genetics knowledge could further strengthen this PO.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV

Name of the Program: M.Sc. Zoology

Class: M.Sc. - II **Semester: IV**

Course Name: Immunology and Parasitology **Course Code: ZOO: 5402**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:

- Acquire a foundational understanding of immunology, including the concepts of immunity (self-non-self, antigen, antibody, immune response, immunological tolerance, autoimmune disease) and active and passive immunization. Additionally, students will grasp the organization of primary and secondary lymphoid organs, tissues, cells, and molecules of the human immune system.
- Distinguish between humoral immunity and cell-mediated immunity, and comprehend the structure and function of T cell receptors.
- Analyze the immediate responses to infection, including inflammation, cell migration, acute phase response, interferons, and natural killer (NK) cell activities.
- Understand the structure of antibodies, antibody classes, subclasses, and the relationship between structure and function. The objective includes exploring iso, idio, and allo types, as well as theories of antibody synthesis and the molecular basis of generating antibody diversity.
- Understand the processes of antigen-antibody reactions, complement fixation pathways, and the immunogenetics associated with HLA, disease associations, immune deficiencies, and disorders. This objective includes an exploration of antigen processing and major histocompatibility complex (MHC).
- Master immunological techniques, including the hybridoma principle and its application, ELISA, immunofluorescence, immunoelectrophoresis, RIA (Radioimmunoassay), and the production and application of monoclonal and polyclonal antibodies.
- Comprehend the concepts of immunological memory and vaccination, exploring the mechanisms by which the immune system retains memory of previous encounters with antigens and the applications of vaccination in disease prevention.

Course Outcomes:

After completion of this course students will-

CO1: demonstrate a comprehensive understanding of key immunological concepts, including the principles of immunity, self-non-self-recognition, antigen-antibody interactions, and the organization of primary and secondary lymphoid organs.

CO2: distinguish between humoral and cell-mediated immunity and describe the structure and function of T cell receptors.

CO3: analyze the immediate responses to infection, including inflammation, cell migration, acute phase response, interferons, and the activities of natural killer (NK) cells.

CO4: explain the structure of antibodies, antibody classes, subclasses, and the relationship between structure and function. They will also comprehend the theories of antibody synthesis and the molecular basis of generating antibody diversity.

CO5: explore and understand the processes of antigen-antibody interactions, complement fixation pathways, and the immunogenetics associated with HLA, disease associations, immune deficiencies, and disorders. They will also grasp the mechanisms of antigen processing and major histocompatibility complex (MHC).

CO6: master various immunological techniques, including the hybridoma principle and its application, ELISA, immunofluorescence, immunoelectrophoresis, RIA (Radioimmunoassay), and the production and application of monoclonal and polyclonal antibodies.

CO7: comprehend the concepts of immunological memory and vaccination, including the mechanisms underlying the retention of immune memory and the applications of vaccination in disease prevention.

Course Articulation Matrix of ZOO: 5402: Immunology and Parasitology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	2	1	1	1	1	1
CO2	2	2	1	1	1	1	1	1	1
CO3	2	2	1	1	1	1	1	1	1
CO4	3	2	1	2	1	1	1	1	1
CO5	3	3	1	2	2	1	2	1	1
CO6	2	1	1	2	1	1	1	1	1
CO7	2	2	1	1	2	1	2	1	1

PO1 (Disciplinary Knowledge):
All COs address various aspects of immunology, requiring an understanding of complex biological concepts and mechanisms. CO4 and CO5 delve deeper into complex antibody structure and interactions, strengthening this PO.

PO2 (Critical Thinking & Problem Solving):
COs like 2, 3, and 5 encourage analyzing diverse immunological processes, interpreting research findings, and applying knowledge to novel situations. This demonstrates strong development of critical thinking skills.

PO3 (Social Competence):
This PO is not explicitly addressed in any COs. Incorporating group projects, debates on ethical implications of immunology research, or discussions on social impacts of vaccination could strengthen this PO.

PO4 (Research Skills & Scientific Temper):
Research skills are implicit in understanding and analyzing complex immunological concepts presented in all COs. Explicit research projects, literature reviews, or analyzing scientific papers could further strengthen this PO.

PO5 (Trans-disciplinary Knowledge):
CO5, with its exploration of antigen-antibody interactions and immunogenetics, connects immunology to other fields like genetics and public health, showcasing strong engagement with this PO.

PO6 (Personal & Professional Competence):
Similar to PO3, this PO lacks direct assessment. Encouraging self-reflection on career paths in immunology research, time management skills for projects, or ethical considerations in professional practice could enhance its connection to the COs.

PO7 (Effective Citizenship & Ethics):
While CO5 has potential for exploring ethical considerations in vaccine development or genetic testing, this aspect needs further development through case studies, discussions on ethical frameworks, or exploring social issues related to vaccinations.

PO8 (Environment & Sustainability):
This PO currently lacks a clear connection to the provided COs. Integrating examples or discussions about environmental factors influencing immune responses, emerging infectious diseases, or environmentally-friendly approaches in immunology research could strengthen its presence.

PO9 (Self-directed & Lifelong Learning):
Some COs indirectly encourage lifelong learning by fostering critical thinking and applying knowledge to novel topics. However, explicitly encouraging students to take ownership of their learning, developing independent research skills, and reflecting on the evolving nature of immunology knowledge could further strengthen this PO.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV

Name of the Program: M.Sc. Zoology

Class: M.Sc. - II **Semester: IV**

Course Name: Pest Control and Toxicology **Course Code: ZOO: 5403**

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives

- Understand fundamental concepts of pest control, including the identification and importance of different types of pests and the damage they cause.
- Explore the medical and veterinary entomology, focusing on measures to control vectors. They will understand control measures for household and stored grain pests.
- Gain proficiency in the principles and methods of pest control, covering cultural, physical, mechanical, and chemical control measures. They will understand insecticidal formulations, dilutions, and the advantages and drawbacks of biological control.
- Comprehend autocidal control, chemosterilants, Knipling's model, and Pheromonal and hormonal control. They will also grasp the concept of Integrated Pest Management (IPM).
- Identify and apply control measures for non-insect pests, including rats, bandicoots, crabs, snails, slugs, birds, and squirrels.
- Master the use of pesticide appliances, such as sprayers and dusters, and understand the hazards associated with pesticides along with their antidotes.
- Gain an introduction to basic toxicology concepts, including the history, definitions of toxicology, poison, toxicity, and the classification of toxicants.

Course Outcomes

After completion of this course, students will-

CO1: demonstrate the ability to identify different types of pests, understand their importance, and assess the damage caused by pests in various settings.

CO2: apply measures in medical and veterinary entomology, specifically focusing on controlling vectors and implementing strategies for managing household and stored grain pests.

CO3: master the principles and methods of pest control, including cultural, physical, mechanical, and chemical control measures. They will also be proficient in understanding insecticidal formulations, dilutions, and the advantages and drawbacks of biological control.

CO4: implement autocidal control, chemosterilants, and concepts like Knipling's model, pheromonal, and hormonal control. They will also apply the integrated pest management (IPM) approach.

CO5: effectively manage non-insect pests, including rats, bandicoots, crabs, snails, slugs, birds, and squirrels, employing appropriate control measures.

CO6: apply pesticide application techniques using sprayers and dusters, and effectively mitigate hazards associated with pesticides, including the understanding and implementation of antidotes.

CO7: comprehend basic toxicology concepts, such as the history, definitions of toxicology, poison, and toxicity. They will apply this knowledge to understand the classification of toxicants and their implications in pest control and environmental health.

Course Articulation Matrix of ZOO: 5403 : Pest Control and Toxicology

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	2	1	1	1	1	1
CO2	2	2	1	2	2	1	1	1	1
CO3	2	2	1	2	1	1	1	1	1
CO4	3	3	1	2	1	1	2	2	1
CO5	2	2	1	2	1	1	1	1	1
CO6	2	1	2	1	1	2	1	2	1
CO7	2	1	1	2	2	1	1	2	1

PO1 (Disciplinary Knowledge):
All COs address various aspects of pest control and toxicology, requiring an understanding of complex biological concepts, pest types, control methods, and their impacts. Some COs like CO4 delve deeper into advanced control measures and pest identification, solidifying PO1.

PO2 (Critical Thinking & Problem Solving):
COs like 2, 3, and 5 encourage analyzing diverse control methods, choosing appropriate strategies based on context, and applying knowledge to new pest scenarios. This demonstrates strong development of critical thinking skills.

PO3 (Social Competence):
CO6 directly addresses social awareness by emphasizing safety protocols and potential societal impacts of pesticide use. However, other COs could be enhanced by incorporating group projects, discussions on ethical considerations in pest control, or community outreach projects.

PO4 (Research Skills & Scientific Temper):
Research skills are implicit in understanding and analyzing complex pest control concepts presented in all COs. Explicit research projects, literature reviews, or analyzing scientific papers could further strengthen this PO.

PO5 (Trans-disciplinary Knowledge):
Some COs, particularly CO2 and CO7, connect pest control to other fields like medicine, veterinary science, and toxicology, showcasing engagement with trans-disciplinary knowledge.

PO6 (Personal & Professional Competence):
Similar to PO3, CO6 shows merit in developing personal responsibility regarding safe pesticide application. Other COs could be strengthened by encouraging time management skills for research projects, career exploration in pest control, or ethical considerations in professional practice.

PO7 (Effective Citizenship & Ethics):
While not explicitly addressed in most COs, some potential exists for discussing ethical considerations in pest control, environmental implications, and responsible pesticide use. Further development in this area through case studies, ethical frameworks discussions, or social impact analysis could strengthen PO7.

PO8 (Environment & Sustainability):
CO7 introduces basic toxicology concepts and environmental concerns indirectly. Integrating examples or discussions about environmentally friendly pest control methods, pesticide impacts on ecosystems, or sustainable development approaches could strengthen PO8.

PO9 (Self-directed & Lifelong Learning):
Courses often indirectly encourage lifelong learning through critical thinking, research, and the evolving nature of pest control. However, explicitly encouraging students to take ownership of their learning and explore new pest control advancements through independent research projects or self-directed learning activities could further strengthen PO9.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV

Name of the Program: M.Sc. Zoology

Class: M.Sc. - II **Semester: IV**

Course Name: Environmental Biology, Animal Systematics and Diversity

Course Code: ZOO: 5404

Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- Comprehensively understand the fundamental principles of ecology, including energy flow, biogeochemical cycles, ecosystem stability, and human impacts on the environment.
- Analyze the diverse biomes and habitats of India, identifying their key biotic elements and the threats they face due to human activities.
- Critically evaluate the importance of biodiversity in India, exploring its historical context, current status, and the significance of conservation efforts.
- Master the practical skills and theoretical foundations of wildlife management, including population analysis, habitat assessment, and protected area networks in India.
- Gain competence in the principles and methodologies of biological classification, applying taxonomic characters and understanding species concepts.
- Effectively utilize various taxonomic techniques, including morphology-based, numerical, cyto-, and molecular approaches, for species identification and evaluation of diversity.
- Develop practical abilities in taxonomic procedures, such as specimen collection, preservation, and identification techniques, following established protocols and nomenclature rules.

Course Outcomes:-

After completion of this course, students will be able to-

CO1: explain and analyze the fundamental concepts of ecology, including energy flow, biogeochemical cycles, ecosystem stability, and the impact of human activities on natural environments.

CO2: differentiate and characterize the major biomes and habitat types of India, outlining their ecological significance and biodiversity.

CO3: critically evaluate the current state of Indian biodiversity, analyzing threats to different biomes and species and proposing effective conservation strategies.

CO4: apply the principles and methodologies of biological classification to accurately identify and classify organisms belonging to various taxonomic groups.

CO5: utilize different taxonomic techniques, including morphology, numerical analysis, cytotaxonomy, and molecular tools, for effective species identification and assessment of diversity within populations.

CO6: demonstrate competency in practical taxonomic procedures like specimen collection, preservation, and identification techniques, adhering to established protocols and nomenclature rules.

CO7: analyze and interpret evolutionary relationships between species using molecular phylogenetics and phylogeographic approaches.

Course Articulation Matrix of ZOO: 5404: Environmental Biology, Animal Systematics and Diversity

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	1	1	1	2	1
CO2	2	1	1	1	2	1	1	2	1
CO3	2	3	1	2	1	1	2	2	1
CO4	2	2	1	1	1	1	1	1	1
CO5	2	2	1	2	1	1	1	1	1
CO6	2	1	1	1	1	2	1	1	1
CO7	3	2	1	2	1	1	1	1	1

PO1 (Disciplinary Knowledge):
All COs address various ecological and taxonomic concepts, requiring understanding of complex processes, classification systems, and biodiversity. CO1-3 delve deeper into ecosystem dynamics, CO4-7 focus on taxonomic principles and techniques, and CO7 specifically touches on advanced concepts like phylogenetics.

PO2 (Critical Thinking & Problem Solving):
COs like 1, 3, 5, and 7 encourage analyzing environmental impacts, evaluating conservation strategies, interpreting taxonomic data, and applying critical thinking for species identification. This demonstrates strong development of problem-solving skills.

PO3 (Social Competence):
While not explicitly addressed in most COs, some potential exists for discussing social aspects of conservation and ethical considerations in taxonomic practices. Further development in this area through case studies, group projects, or discussions on ethical frameworks could strengthen PO3.

PO4 (Research Skills & Scientific Temper):
Research skills are implicit in understanding and analyzing complex ecological and taxonomic concepts presented in all COs. Explicit research projects, literature reviews, or data analysis exercises could further strengthen this PO.

PO5 (Trans-disciplinary Knowledge):
Some COs, particularly CO2 and CO7, connect ecology and systematics to other fields like geography, climate science, and molecular biology, showcasing engagement with trans-disciplinary knowledge.

PO6 (Personal & Professional Competence):
CO6 addresses personal responsibility through practical taxonomic procedures, but other COs could be enhanced by encouraging time management skills for research projects, career exploration in ecology or systematics, or ethical considerations in professional practice.

PO7 (Effective Citizenship & Ethics):
While not explicitly addressed in most COs, some potential exists for discussing ethical considerations in conservation practices, environmental sustainability, and responsible use of taxonomic techniques. Further development in this area through case studies, ethical frameworks discussions, or social impact analysis could strengthen PO7.

PO8 (Environment & Sustainability):
CO1-3 discuss environmental concerns related to ecosystems and biodiversity, but integrating examples or discussions about sustainable approaches in ecology and conservation could strengthen PO8.

PO9 (Self-directed & Lifelong Learning):
Courses often indirectly encourage lifelong learning through research skills, critical thinking, and the evolving nature of ecology and systematics. However, explicitly encouraging students to take ownership of their learning and explore new research or taxonomic advancements through independent projects or self-directed learning tasks could further strengthen PO9.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY Sem. IV (w. e. f. June, 2023)

Name of the Program: M.Sc. Zoology

Class: M. Sc. II **Semester: IV**

Course Name: Zoology Practical-7 (Based on Courses: ZOO: 5401, ZOO: 5402, ZOO: 5403, ZOO: 5404)

Course Code: ZOO: 5405

Number of Credits: 04 **Number of Practicals: 10**

Course Objectives:-

- Master the essential knowledge of insect morphology, development, and reproductive systems through practical dissections and histological studies.
- Develop skills in identifying and classifying beneficial and harmful insects based on taxonomic characteristics, ecological roles, and economic significance.
- Gain practical experience in applying various insect pest control methods, including insecticides, repellents, and attractants.
- Explore and analyze terrestrial ecosystems using vegetation study methods, soil analysis, and microbial isolation, understanding their ecological significance.
- Gain a foundational understanding of various animal phyla and their key characteristics, utilizing museum specimens and identification keys to classify invertebrates and chordates.
- Develop practical skills in culturing and identifying parasites like Entamoeba and Plasmodium from different environments.
- Investigate aquatic ecosystems through plankton identification and water quality analysis, applying field collection and laboratory techniques.

Course Outcomes:-

After completion of this course, students will be able to-

CO1: demonstrate a comprehensive understanding of insect morphology, including external and internal structures, their functions, and adaptations to diverse environments.

CO2: apply taxonomic principles to accurately identify major insect orders and families based on morphological characteristics and diagnostic features.

CO3: explain the structure and function of insect reproductive systems, including male and female organs, and describe the process of spermatogenesis and oogenesis.

CO4: develop comprehensive strategies for the control and prevention of parasitic diseases transmitted by vectors and protozoa like ticks, mosquitoes, Trypanosoma, and Leishmania.

CO5: classify and identify major helminth parasites based on their morphology, life cycles, and host interactions, understanding their potential health impact.

CO6: analyze the ecological interactions within aquatic and terrestrial ecosystems, applying field and laboratory techniques to assess water quality, plankton diversity, and soil characteristics.

CO7: employ taxonomic keys and museum specimens to accurately identify and classify animals belonging to various invertebrate and chordate phyla, recognizing their roles in ecosystem functions.

Course Articulation Matrix of ZOO: 5405: Zoology Practical-7

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	1	1	1	2	1
CO2	3	2	1	1	1	1	1	1	1
CO3	3	2	1	1	1	1	1	1	1
CO4	2	3	1	2	1	1	1	1	1
CO5	3	2	1	1	1	1	1	1	1
CO6	2	2	2	1	2	1	2	1	1
CO7	2	2	1	1	1	1	1	1	1

PO1 (Disciplinary Knowledge):
All COs directly address insect biology, covering morphology, taxonomy, reproduction, behavior, and ecology. Students gain in-depth knowledge specific to this field.

PO2 (Critical Thinking & Problem Solving):
COs like 4 and 5 explicitly involve designing experiments, analyzing data, and solving problems during insect identification and pest control strategies.

PO3 (Social Competence):
CO6 explores the economic and environmental significance of insects, leading to potential connections with the social impact of pest management practices. However, explicit discussions on ethical considerations are needed for stronger mapping.

PO4 (Research Skills & Scientific Temper):
Though not explicitly addressed, data collection, analysis, and scientific principles used in entomology contribute to developing these skills in most COs.

PO5 (Trans-disciplinary Knowledge):
Some COs have potential for connections beyond entomology. CO4 could link to neurobiology, CO5 to genetics in other organisms, and CO6 to ecological economics or agriculture. Further integration or project work could strengthen this.

PO6 (Personal & Professional Competence):
While project-based activities or research tasks could indirectly contribute to time management and independent learning, COs don't directly address this PO.

PO7 (Effective Citizenship & Ethics):
Similar to PO3, CO6 has potential to connect to environmental ethics of pest control, but dedicated discussions and activities are needed for strong mapping.

PO8 (Environment & Sustainability):
CO6 explicitly addresses environmental considerations of beneficial and harmful insects. Integrating sustainability aspects into pest control discussions could further strengthen this PO.

PO9 (Self-directed & Lifelong Learning):
While COs indirectly encourage lifelong learning through research skills, critical thinking, and the dynamic nature of entomology, explicit encouragement of independent research, literature reviews, or further exploration of topics could strengthen this PO.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY Sem. IV (w. e. f. June, 2023)

Name of the Program: M.Sc. Zoology

Class: M. Sc. II **Semester: IV**

Course Name: Research Project **Course Code: ZOO: 5406**

Number of Credits: 04 **Number of Hours: 60**

RESEARCH PROJECT

The project course would involve:

1. Training to students in:

a) Literature survey,

b) Planning and execution of experimental work,

c) Analysis of data and its presentation.

Studies would utilize few of the practicals from their course more intensively for this course. **Project should start at fourth** semester and **will be assessed at the end of fourth semester**.

The experimentation work during the project should be equivalent to minimum 20 practicals in the semester.

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Examination:

[A] Pattern of Examination: Evaluation of Students:

1. The In-semester and End-Semester examinations will be of 60 marks each.
2. There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.

In-semester Examination: Internal assessment for each course would be continuous and dates for each Tutorials/practical tests etc. will be pre-notified in the time table for teaching or placed separately as a part of time table. Department / College Internal Assessment Committee will coordinate this activity.

a) Theory Courses: Students should be encouraged to participate in various academic activities.

A teacher must select a variety of the procedures for conducting internal assessment suggested as follows:

a) Multiple choice questions
b) Combination of objective and subjective questions.
c) Open book test (concerned teacher will decide the allowed books)
d) Tutorial
e) Surprise test specified topics in a given notified period
f) Oral
g) Assignments
h) Review of research paper
i) Seminar presentation
j) Journal/Lecture/Library notes

Student has to preserve the documentation of the internal assessment except midterm test answer script. It is the Responsibility of the student to preserve the documents.

b) Practical Courses: It is a continuous evaluation process. Practical courses will be evaluated on the basis of the following:

1. Performance assessment of each experiment on the basis of attendance, punctuality, journal completion, practical skills, results, oral and analysis.
2. Assessment on practical course be conducted before the end-semester examination.
3. Assessment of each experiment shall be done for each practical weekly

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