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 2022-2023

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	PSZO 111	**Theory**	**Biochemistry & Bioenergetics**	**4**	I / E	**40 + 60**
2	PSZO 112	**Theory**	**Cell Biology**	**4**	I / E	**40 + 60**
3	PSZO 113	**Theory**	**Fresh Water Zoology & Ichthyology**	**4**	I / E	**40 + 60**
4	PSZO 114	**Theory**	**Biostatistics & Genetics**	**4**	I / E	**40 + 60**
5	PSZO 115	Zoology **Practical-I**	**Practicals Corresponding to PSZO 111 and PSZO 112**	**4**	I / E	**40 + 60**
6	PSZO 116	Zoology **Practical-II**	**Practicals Corresponding to PSZO 113 and PSZO 114**	**4**	I / E	**40 + 60**
7			**Skill Development**	2	-	
8			**Certificate Course**	2	-	

IA* - Internal Assessment

EA*- External Assessment

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Biochemistry and Bioenergetics **Course Code: PSZO 111**

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

Course Objectives:-

- To comprehend processes of gametogenesis, fertilization, and oviposition.
- To understand early insect embryonic development.
- To give a brief overview of segmentation, appendage formation, and organogenesis.
- To explore post-embryonic insect development.
- To explore strategies of emergence of adults from pupae or cocoons.
- To analyse Hadorn's experiments, specifically focusing on imaginal disc experiments.
- To familiarize with diapause in insects, and control mechanisms, gaining a precise understanding of this biological phenomenon.

Course Outcomes:-

After completion of this course students will-

CO1: analyse the structure and function of key biomolecules like water, carbohydrates, lipids, proteins, and vitamins, explaining their interactions in biological systems.

CO2: describe the different levels of protein structure (primary, secondary, tertiary, and quaternary) and explain the forces stabilizing and influencing protein folding. Apply this knowledge to predict the impact of changes on protein function.

CO3: calculate and interpret enzyme kinetics using Michaelis-Menten equation and Lineweaver-Burk plots. Explain factors affecting enzyme activity and design experiments to investigate enzyme inhibition and regulation.

CO4: diagram and analyse major metabolic pathways like glycolysis, TCA cycle, and oxidative phosphorylation, explaining their roles in energy production and regulation.

CO5: differentiate between various types of lipids, discuss their diverse functions in the body, and analyse the processes like biosynthesis of palmitic acid and beta oxidation of fatty acids.

CO6: demonstrate proficiency in conducting enzyme assays and kinetics experiments in the laboratory, interpreting data, and applying statistical methods to evaluate results.

CO7: integrate knowledge of biomolecules, enzymes, and metabolism to explain real-world biological phenomena, critically evaluate scientific research, and apply biochemical principles to solve problems in healthcare and biotechnology.

Course Articulation Matrix of PSZO 111: 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	1	1	1	1	1	1	1
CO2	3	3	1	2	1	1	1	1	1
CO3	3	3	1	3	1	2	1	1	1
CO4	3	3	1	2	1	1	1	1	1
CO5	3	2	1	1	1	2	1	1	1
CO6	2	3	1	3	1	3	1	1	1
CO7	3	3	2	3	2	1	2	1	2

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts of Biochemistry. For example, CO1,2, and 5 requires students to have an in-depth

understanding of biomolecule structure, protein folding, enzyme kinetics, metabolic pathways, and lipid functions.

PO2: Critical Thinking and Problem Solving
All of the COs are directly mapped to PO2 because they require students to design experiments, interpretation and evaluation of data and applying biochemistry to solve problems demand high-level critical thinking and problem-solving abilities.

PO3: Social Competence
CO6 and 7 are directly 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 Conducting laboratory experiments, presenting data, and working on research projects.

PO4: Research-related skills and Scientific temper
CO6 and 7 are directly mapped to PO3 because they involves designing experiments, conducting assays, analysing data statistically, and critically evaluating research directly contribute to research skills and scientific methodology.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems in the field of biochemistry. Applying biochemical principles to solve problems in healthcare and biotechnology demonstrates the ability to connect biochemistry to other fields.

PO6: Personal and professional competence
CO1-5 are directly mapped to PO6 because these COs primarily focus on technical skills and knowledge within biochemistry. Personal and professional competence might be indirectly developed through independent learning and critical thinking.

PO7: Effective Citizenship and Ethics
All of the COs are indirectly mapped to PO7 because they require students to uphold the ethical standards in zoology. For example, CO6 and 7 involves applying biochemical knowledge to solve problems in healthcare and biotechnology might involve ethical considerations and responsible application of knowledge.

PO8: Environment and Sustainability
CO6 and 7 are indirectly mapped to PO3 because applying biochemical principles to solve problems in biotechnology might indirectly contribute to developing sustainable technologies or addressing environmental challenges.

PO9: Self-directed and Life-long learning
All of the COs are directly mapped to PO9 because they require students to design experiments, applying knowledge to real-world problems requires self-directed learning, independent research, and continuous learning to stay updated with scientific developments.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Cell Biology **Course Code: PSZO 112**

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

Course Objectives:-

- Understand the basic chemical principles that underlie the structure and function of biological molecules.
- Explain the structure and function of the plasma membrane, including the various mechanisms of membrane transport.
- Describe the structure and function of the organelles of the endomembrane system and peroxisomes.
- Explain the structure and function of the nucleus, including the role of the nuclear envelope in regulating gene expression.
- Compare and contrast the structure and function of mitochondria and chloroplasts.
- Explain the different types of cell signaling pathways and the role of cell adhesion molecules in cell communication.
- Describe the cell cycle and the factors that regulate it.

Course Outcomes:-

After completion of this course students will-

CO1: analyse the interactions and roles of key biomolecules like carbohydrates, lipids, proteins, and nucleic acids, understanding how their chemical properties dictate their functions within the cell.

CO2: explain the different models of plasma membrane structure and describe the various mechanisms of membrane transport along with their regulation and energetics.

CO3: compare and contrast the structure and function of cell organelles, including their roles in protein processing, secretion, and intracellular digestion.

CO4: differentiate between the components of the nucleus, like the nuclear envelope, nucleolus, and nuclear lamina, and explain their roles in regulating gene expression, DNA replication, and cell division.

CO5: distinguish between the structures and functions of mitochondria and chloroplasts, analysing their roles in energy production and protein import processes.

CO6: evaluate the different types of cell signaling pathways and the roles of receptors, second messengers, and G-protein coupled receptors in cell communication and response.

CO7: describe the phases of the cell cycle and their importance in maintaining cell integrity and preventing proliferation errors

Course Articulation Matrix of PSZO 112: Cell Biology

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	1	1	1
CO2	3	3	1	2	1	1	1	1	1
CO3	3	3	1	2	1	1	1	1	1
CO4	3	3	1	2	1	1	1	1	1
CO5	3	3	1	2	1	1	1	1	1
CO6	3	3	1	2	1	1	1	1	1
CO7	3	3	1	2	1	1	1	1	1

PO1: Disciplinary Knowledge
All of the COs are directly mapped to PO1 because analysing biomolecule interactions, understanding membrane structure and transport, comparing organelle functions, dissecting nuclear components, contrasting energy production in organelles, evaluating signaling pathways, and describing cell cycle phases require in-depth knowledge of cell biology concepts.

PO2: Critical Thinking and Problem Solving
All of the COs are directly mapped to PO2 because understanding how chemical properties affect biomolecule functions, comparing membrane models, evaluating transport mechanisms, analysing organelle roles, distinguishing nuclear components and their functions, differentiating energy production processes, interpreting signaling pathways, and explaining cell cycle phases require critical thinking and problem-solving skills.

PO3: Social Competence
All of the COs are directly mapped to PO3 because they primarily focus on individual knowledge and comprehension of cell biology concepts. Social interaction or collaboration might be involved in group projects or research settings.

PO4: Research-related skills and Scientific temper
All of the COs are directly mapped to PO4 because, analysing biomolecule interactions, understanding membrane models, and relating functions to biochemical properties contribute to a scientific mind-set.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines like medicine, biotechnology, or ecology to solve problems.

PO6: Personal and professional competence
All of the COs are directly mapped to PO6 because these COs primarily focus on technical knowledge and understanding of cell biology concepts. Personal and professional competence might be indirectly developed through independent learning and critical thinking.

PO7: Effective Citizenship and Ethics
All of the COs are indirectly mapped to PO7 because understanding cell biology principles might indirectly relate to responsible use of biotechnologies or ethical considerations in medical research.

PO8: Environment and Sustainability
All of the COs are indirectly mapped to PO8 because understanding cellular processes might relate to understanding environmental issues like bioremediation or cellular adaptations.

PO9: Self-directed and Life-long learning
All of the COs are directly mapped to PO9 because understanding complex cell biology concepts, analysing intricate pathways, and relating functional relationships encourages self-directed learning and staying updated with advancements in the field.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Freshwater Zoology and Ichthyology **Course Code: PSZO 113**

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

Course Objectives:-

- Develop a comprehensive understanding of different types of aquatic habitats, their physical conditions, chemical compositions, and their significance in supporting aquatic life.
- Explore and comprehend the physiological and protective adaptations in diverse freshwater organisms and emphasizing their survival strategies.
- Analyze and understand the diagnostic features and life cycles of temporary rainwater pool animals like shrimps and highlighting their biological traits and ecological roles.
- Examine the general characteristics of zooplankton with a focus on taxonomic features in groups like Rotifera, Copepoda, Cladocera, and Ostracoda, emphasizing traits used in classification.
- Gain proficiency in the classification of fish orders and explore external morphology, body forms, appendages, pigmentation, skin, scales, and phylogeny.
- Comprehend the endoskeleton structures, anatomy, physiology and emphasizing their adaptations for survival in aquatic environments.
- Evaluate and appreciate the economic importance of freshwater animals and the productivity of aquatic habitats.

Course Outcomes:-

After completion of this course students will-

CO1: demonstrate a comprehensive understanding of various aquatic habitats, including their physical conditions, chemical compositions, and the pivotal role they play in sustaining diverse aquatic life forms, fostering an appreciation for the intricate ecosystems.

CO2: develop a nuanced comprehension of the physiological and protective adaptations in a wide array of freshwater organisms, recognizing and emphasizing their intricate survival strategies in diverse aquatic environments.

CO3: analyse and understand the diagnostic features and life cycles of temporary rainwater pool animals such as shrimps, elucidating their biological traits and ecological roles within the context of dynamic freshwater ecosystems.

CO4: gain proficiency in examining the general characteristics of zooplankton, with a specific focus on taxonomic features in groups like Rotifera, Copepoda, Cladocera, and Ostracoda.

CO5: attain proficiency in the classification of fish orders, enabling a comprehensive understanding of the diversity within the aquatic vertebrate group.

CO6: comprehend the endoskeleton structures, anatomy, physiology, and various adaptations of fishes, fostering a detailed understanding of their physiological mechanisms.

CO7: evaluate and appreciate the economic importance of freshwater animals and the overall productivity of aquatic habitats, recognizing the ecological significance.

Course Articulation Matrix of PSZO 113: Freshwater Zoology and Ichthyology

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

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

PO1: Disciplinary Knowledge
All of the COs are directly mapped to PO1 because understanding diverse aquatic habitats, adaptations of freshwater organisms, fish classification, and fish anatomy require deep knowledge of freshwater ecology concepts.

PO2: Critical Thinking and Problem Solving
All of the COs are directly mapped to PO2 because understanding intricate ecosystems, analysing survival strategies, interpreting diagnostic features, and linking physiological mechanisms to adaptations require critical thinking and problem-solving skills.

PO3: Social Competence
All of the COs are directly mapped to PO3 because they primarily focus on individual knowledge and comprehension of freshwater ecology concepts. Social interaction or collaboration might be involved in group projects or field work.

PO4: Research-related skills and Scientific temper
All of the COs are indirectly mapped to PO4 because, analysing ecosystems, adaptations, life cycles, and physiological mechanisms contribute to research skills and a scientific mind-set.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines like conservation biology, water resource management, or environmental science to understand freshwater ecology.

PO6: Personal and professional competence
All of the COs are directly mapped to PO6 because these COs primarily focus on technical knowledge and understanding of freshwater ecology concept. Personal and professional competence might be indirectly developed through independent learning and critical thinking.

PO7: Effective Citizenship and Ethics
All of the COs are indirectly mapped to PO7 because appreciating the importance of aquatic habitats and their inhabitants, recognizing ecological significance, and understanding freshwater resource management can relate to environmental ethics and responsible citizenship.

PO8: Environment and Sustainability
All of the COs are indirectly mapped to PO8 because understanding diverse habitats, adaptations, and fish physiology directly relate to understanding environmental issues and the importance of sustainable resource management.

PO9: Self-directed and Life-long learning
All of the COs are directly mapped to PO9 because understanding complex ecological concepts, analysing adaptations, and fostering appreciation for biodiversity encourages self-directed learning and staying updated with advancements in freshwater ecology.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc. - I **Semester: I**
Course Name: Genetics and Biostatistics **Course Code: PSZO 114**
Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:-

- Develop a comprehensive understanding of Mendelian principles, gene interactions, and deviations from Mendelian inheritance, multiple alleles, linkage, and crossing over, emphasizing genetic variations.
- Analyze and interpret inheritance mechanisms for qualitative and quantitative traits, and QTL mapping.
- Explore the genetic structure of populations, applications of Hardy-Weinberg equilibrium, and comprehend how gene pools and allele frequencies contribute to population genetics.
- Evaluate the applications of somatic cell genetics, gene therapy, and gene transfer technology.
- Investigate the various types, causes, detection methods of gene mutations, and gain an introductory understanding of epigenetics.
- Gain foundational knowledge in biostatistics; understand data classification, measures of central tendency and dispersion, correlation, regression, probability, and probability distributions, preparing for statistical applications in biological sciences.
- Develop competence in conducting hypothesis tests for mean, proportions, equality of population means and variances, chi-square tests, t-tests, F-tests, ensuring a sound grasp of statistical inference in biological data analysis.

Course Outcomes:-

After completion of this course students will-

CO1: demonstrate a comprehensive understanding of Mendelian principles, gene interactions, variations from Mendelian inheritance, multiple alleles, linkage, and crossing over, showcasing their ability to interpret and explain genetic variations.

CO2: proficiently analyse and interpret inheritance mechanisms for qualitative and quantitative traits, including QTL mapping, demonstrating their capability to apply genetic principles in trait analysis and mapping.

CO3: showcase a profound grasp of population genetics, elucidating the genetic structure of populations, applications of Hardy-Weinberg equilibrium, and explaining the contribution of gene pools and allele frequencies in shaping populations.

CO4: illustrate their understanding and competency in applying somatic cell genetics principles, gene therapy, and gene transfer technology, demonstrating their ability to explore and utilize genetic technologies.

CO5: demonstrate knowledge of various gene mutation types, their causes, detection methods, and gain introductory insight into epigenetics, showcasing their awareness of genetic alterations and epigenetic mechanisms.

CO6: exhibit foundational knowledge in biostatistics, adeptly applying data classification, measures of central tendency and dispersion, correlation, regression, probability, and distributions, preparing for statistical applications in biological sciences.

CO7: showcase competence in conducting hypothesis tests for various parameters, such as mean, proportions, equality of population means and variances, employing tests like chi-square, t-tests, F-tests, displaying their proficiency in statistical inference within biological data analysis.

Course Articulation Matrix of PSZO 114: Genetics and Biostatistics
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	1	2
CO2	3	2	1	2	1	1	1	1	2
CO3	3	2	1	2	1	1	1	1	2
CO4	3	2	1	2	1	1	1	1	2
CO5	3	2	1	2	1	1	1	1	2
CO6	2	1	2	3	2	2	2	2	3
CO7	2	1	2	3	2	2	2	2	3

PO1: Disciplinary Knowledge
All of the COs are directly mapped to PO1 because for in-depth understanding of Mendelian principles, quantitative trait analysis, population genetics, gene transfer technologies, and mutation types requires deep knowledge of genetic concepts.

PO2: Critical Thinking and Problem Solving
All of the COs are directly mapped to PO2 because interpreting genetic variations, analysing trait inheritance, explaining population structures, evaluating gene therapy techniques, and understanding mutation effects require critical thinking and problem-solving skills.

PO3: Social Competence
All of the COs are directly mapped to PO3 because they primarily focus on individual knowledge and comprehension of genetic concepts. Social interaction or collaboration might be involved in group projects or research settings.

PO4: Research-related skills and Scientific temper
All of the COs are indirectly mapped to PO4 because, analysing inheritance patterns, applying QTL mapping, understanding population dynamics, interpreting gene transfer mechanisms, and appreciating mutation impact contribute to research skills and a scientific mind-set.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines like medicine and physiology to understand genetic principles.

PO6: Personal and professional competence
All of the COs are directly mapped to PO6 because these COs primarily focus on technical knowledge and understanding of genetic concepts. Personal and professional competence might be indirectly developed through independent research or critical thinking.

PO7: Effective Citizenship and Ethics
All of the COs are indirectly mapped to PO7 because analysing data objectively, reporting results accurately, and interpreting them responsibly are crucial for upholding scientific integrity and contributing to effective citizenship.

PO8: Environment and Sustainability
All of the COs are indirectly mapped to PO8 because applying statistical tools to analyse environmental data can contribute to research in areas like sustainability, resource management, and ecological studies.

PO9: Self-directed and Life-long learning
All of the COs are directly mapped to PO9 because designing and interpreting statistical analyses, mastering data analysis techniques, and staying updated with statistical tools requires self-directed learning, independent research, and continuous learning to stay updated with advancements in biological data analysis.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Zoology Practical-I (Practicals Corresponding to PSZO 111, PSZO 112) **Course Code: PSZO 115**

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

Course Objectives:-

- Demonstrate proficiency in preparing standard acid and alkali solutions and conduct accurate acid-base titrations, showcasing fundamental skills in solution preparation and titration techniques.
- Acquire the ability to prepare buffers of known pH and molarity, determine pH levels in various samples, and assess their buffering capacity.
- Develop expertise in biochemical estimation techniques by accurately estimating inorganic phosphates, sugar (glucose), tyrosine, vitamin C, amylase activity, and protein levels using respective methods.
- Analyze enzyme behaviour by determining optimum pH, investigating the impact of substrate concentration, pH, temperature, inhibitors, and activators on enzyme activity.
- Gain proficiency in measuring cell size using micrometres, conducting differential centrifugation for subcellular molecule harvesting, and assessing cell viability through various assays.
- Demonstrate competency in differential staining for DNA and RNA, Feulgen staining for DNA, collagen demonstration, cell culturing, and aseptic technique application.
- Develop skills in preparing metaphase chromosomes, evaluating the effect of colchicine treatment on mitosis, and conducting short-term cultures for chromosome analysis.

Course Outcomes:-

After completion of this course students will-

CO1: proficiently prepare standard acid and alkali solutions and execute accurate acid-base titrations, establishing a strong foundation in fundamental solution preparation and titration techniques.

CO2: gain proficiency in preparing buffers of known pH and molarity, along with evaluating pH levels in diverse samples and assessing their buffering capacities.

CO3: demonstrate competency in employing various biochemical estimation techniques to precisely measure inorganic phosphates, sugar (glucose), tyrosine, vitamin C, amylase activity, and protein levels using respective methods.

CO4: analyse enzyme behaviour by investigating optimal pH conditions and exploring the impact of substrate concentration, pH, temperature, inhibitors, and activators on enzyme activity.

CO5: gain proficiency in measuring cell dimensions using micrometres, performing differential centrifugation for subcellular molecule harvesting, and assessing cell viability via various assays.

CO6: demonstrate competency in executing differential staining for DNA and RNA, Feulgen staining for DNA, collagen demonstration, cell culturing, and aseptic technique application.

CO7: skilfully prepare metaphase chromosomes, assess the effects of colchicine treatment on mitosis, and conduct short-term cultures for chromosome analysis.

Course Articulation Matrix of PSZO 115: 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	1	2	1	2	1	1	2
CO2	3	2	1	2	1	2	1	1	2
CO3	3	2	1	2	1	2	1	1	2
CO4	3	2	1	2	1	2	1	1	2
CO5	3	2	1	2	1	2	1	1	2
CO6	3	2	1	2	1	2	1	1	2
CO7	3	2	1	2	1	2	1	1	2

PO1: Disciplinary Knowledge
All of the COs are directly mapped to PO1 because Preparing solutions, buffers, conducting enzymatic assays, staining techniques, cell culture, chromosome analysis require in-depth knowledge of biochemical and cell biology concepts.

PO2: Critical Thinking and Problem Solving
All of the COs are directly mapped to PO2 because Optimizing techniques, interpreting results, analyzing enzyme behavior, troubleshooting experiments, assessing cell viability, and analysing chromosome preparations require critical thinking and problem-solving skills.

PO3: Social Competence
All of the COs are directly mapped to PO3 because they primarily focus on individual technical skills and knowledge in the laboratory. Social interaction or collaboration might be involved in group work or sharing techniques.

PO4: Research-related skills and Scientific temper
All of the COs are indirectly mapped to PO4 because, preparing reagents, measuring parameters, observing results, and recording data contribute to developing research skills and a scientific mind-set.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines like medicine and biotechnology to understand biochemical and cell biology principles.

PO6: Personal and professional competence
All of the COs are directly mapped to PO6 because mastering laboratory techniques, following protocols, managing time effectively, and maintaining accurate records contribute to developing personal and professional competence.

PO7: Effective Citizenship and Ethics
All of the COs are indirectly mapped to PO7 because practicing aseptic techniques, handling biological materials responsibly, and using chemicals safely might indirectly relate to ethical conduct in research.

PO8: Environment and Sustainability
All of the COs are indirectly mapped to PO8 because practicing proper waste disposal, minimizing reagent use, and following safety protocols might indirectly relate to environmental sustainability in the laboratory.

PO9: Self-directed and Life-long learning
All of the COs are directly mapped to PO9 because mastering techniques, analysing results, troubleshooting problems, and adapting protocols encourage self-directed learning and staying updated with advancements in laboratory techniques.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Zoology Practical-II (Practicals Corresponding to PSZO 113, PSZO 114) **Course Code: PSZO 116**

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

Course Objectives:-

- Acquire proficiency in qualitative and quantitative analysis of zooplankton using Sedgwick rafter counting cell, demonstrating adeptness in aquatic fauna assessment techniques.
- Investigate locomotory and respiratory adaptations in aquatic insects and their larvae (*Ranatra*, *Notonecta*, *Gerris*, *Belostoma*, *and Dytiscus*), emphasizing specialized adaptations for aquatic habitats.
- Develop skills in estimating chlorides in water samples and analyse bioindicators of pollution using insects, rotifers, algae, and diatoms, showcasing competence in water quality assessment.
- Proficiently analyze water hardness (total and calcium), estimate primary productivity using dark and light bottle methods, demonstrating expertise in freshwater quality evaluation.
- Gain proficiency in analyzing external fish characteristics, fins, scales, and morphometric measurements, and conducting anatomical observations of digestive and reproductive systems of specific fish species (carp/catfish/Tilapia).
- Develop competency in studying sex-linked inheritance, gene distances, gene order in three-point test crosses, and chromosomal banding patterns, showcasing skill in genetic analysis.
- Acquire skills in statistical analysis using computer software packages.

Course Outcomes:-

After completion of this course students will-

CO1: demonstrate mastery in assessing and categorizing aquatic fauna through the qualitative and quantitative analysis of zooplankton, using precise techniques like the Sedgwick rafter counting cell.

CO2: showcase an in-depth understanding of specialized locomotory and respiratory adaptations in aquatic insects and their larvae, emphasizing their unique strategies for survival in aquatic environments.

CO3: Display expertise in evaluating water quality by proficiently estimating chlorides and analysing pollution bioindicators.

CO4: demonstrate expertise in freshwater quality assessment by accurately analysing water hardness, estimating primary productivity, and understanding the ecosystem dynamics through light and dark bottle methods.

CO5: showcase mastery in morphometric analysis and anatomical observations of fish species, exemplifying a comprehensive understanding of their external features and internal systems.

CO6: exhibit advanced skills in genetic analysis, including the study of sex-linked inheritance, gene distances, three-point test crosses, and chromosomal banding patterns.

CO7: demonstrate expertise in statistical analysis using computer software packages, showcasing proficiency in data interpretation and analysis within biological contexts.

Course Articulation Matrix of PSZO 116: 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	1	2	1	2	1	3	2
CO2	3	2	1	2	1	2	1	3	2
CO3	3	2	1	2	1	2	1	3	2
CO4	3	2	1	2	1	2	1	3	2
CO5	3	2	1	2	1	2	1	2	2
CO6	2	3	2	3	2	3	2	2	3
CO7	2	3	2	3	2	3	2	2	3

PO1: Disciplinary Knowledge
All of the COs are directly mapped to PO1 because analysing zooplankton, understanding insect adaptations, assessing water quality, fish morphology, and conducting genetic analysis require deep knowledge of aquatic ecology and fish biology concepts.

PO2: Critical Thinking and Problem Solving
All of the COs are directly mapped to PO2 because categorizing zooplankton, interpreting adaptations, evaluating pollution indicators, analysing water hardness and productivity, and understanding morphometric data require critical thinking and problem-solving skills.

PO3: Social Competence
All of the COs are directly mapped to PO3 because they primarily focus on individual knowledge and technical skills in aquatic ecology and fish biology. Social interaction or collaboration might be involved in group work or data sharing.

PO4: Research-related skills and Scientific temper
All of the COs are indirectly mapped to PO4 because, designing and conducting genetic experiments, analysing data statistically, and interpreting results directly contribute to research skills and scientific methodology.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5 Applying statistical analysis skills and interpreting data are relevant across various scientific disciplines and research fields.

PO6: Personal and professional competence
All of the COs are directly mapped to PO6 because designing and conducting complex experiments, mastering statistical software, and independently interpreting data contribute significantly to developing personal and professional competence.

PO7: Effective Citizenship and Ethics
All of the COs are indirectly mapped to PO7 because analysing data objectively, reporting results accurately, and interpreting them responsibly are crucial for upholding scientific integrity and contributing to effective citizenship.

PO8: Environment and Sustainability
All of the COs are indirectly mapped to PO8 because understanding fish biology and applying statistical analysis for environmental data can contribute to research in areas like fish conservation, water quality monitoring, and sustainable resource management.

PO9: Self-directed and Life-long learning
All of the COs are directly mapped to PO9 because mastering different zooplankton identification, analysing complex adaptations, understanding water quality parameters, and studying fish morphology encourage self-directed learning and adapting to new challenges.

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

POST GRADUATE DEPARTMENT OF ZOOLOGY

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

ACADEMIC YEAR 2022-2023

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: 40 (IA) + 60 (EA)**

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	PSZO:121	Theory	Molecular Biology	4	I / E	40 + 60
2	PSZO:122	Theory	Developmental Biology	4	I / E	40 + 60
3	PSZO:123	Theory	Comparative Animal Physiology and Endocrinology	4	I / E	40 + 60
4	PSZO:124	Theory	Tools and Techniques in Biology	4	I / E	40 + 60
5	PSZO:125	Zoology Practical-III	Molecular and Developmental Biology Lab	4	I / E	40 + 60
6	PSZO:126	Zoology Practical-IV	Physiology, Endocrinology and Biological Techniques Lab	4	I / E	40 + 60
7			Skill Development	2	-	
8			Certificate Course	2	-	

IA* - Internal Assessment

EA*- External Assessment

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc. - I **Semester: II**
Course Name: Molecular Biology **Course Code: PSZO 121**
Number of Credits: 04 **Number of Lectures: 60**

Course Objectives: -

- Understand nucleotides, Watson-Crick model, different DNA forms, and physical properties like Tm and hyperchromicity.
- Compare replication modes, delve into the Meselson-Stahl experiment, and differentiate prokaryotic and eukaryotic mechanisms.
- Grasp the structure and organization of chromatin, distinguish euchromatin from heterochromatin, and explore the role of histones in gene expression.
- Comprehend prokaryotic genome structure, differentiate repetitive and non-repetitive sequences, understand introns and exons, and analyse genome size through C-value paradox and Cot curves.
- Classify various types of DNA damage, explore repair mechanisms like photo-reactivation and excision repair, and understand their significance.
- Define the transcriptional unit, understand RNA polymerases, elucidate the roles of promoter, enhancer, and splicing, and compare prokaryotic and eukaryotic mechanisms.
- Decode the genetic code, compare variations across organisms, understand ribosome structure and function, and explore post-translational modifications.

Course Outcomes: -

After completion of this course students will-

CO1: Demonstrate a comprehensive grasp of DNA's structural diversity, encompassing its various forms (A, B, Z) and their specific physical properties.

CO2: Apply knowledge of DNA replication mechanisms, distinguishing between prokaryotic and eukaryotic processes, and understanding the pivotal role played by enzymes and accessory proteins.

CO3: Analyse and articulate the significance of the Meselson and Stahl experiment, showcasing an understanding of its pivotal role in confirming the semi-conservative nature of DNA replication.

CO4: Illustrate a comprehensive understanding of chromatin's complex structural organization, linking higher-order chromatin structures to functional differences between euchromatin and heterochromatin.

CO5: Evaluate the impact of histones on chromatin architecture, demonstrating an understanding of their role in gene regulation and overall chromatin functionality.

CO6: Assess and elucidate the mechanisms of DNA replication inhibitors, discussing their relevance in both biological research and medical contexts.

CO7: Integrate knowledge across DNA's various facets, including its structure, replication, chromatin organization, and functional implications, demonstrating a holistic grasp of DNA biology.

Course Articulation Matrix of PSZO 121: Molecular Biology
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	2	1	1	2
CO2	3	2	1	2	1	2	1	1	2
CO3	3	3	1	2	1	2	1	1	2
CO4	3	2	1	2	1	2	1	1	2
CO5	3	2	1	2	1	2	1	1	2
CO6	3	2	1	2	1	2	1	1	2
CO7	3	3	2	3	2	3	2	2	3

PO1: Disciplinary Knowledge
All of the COs are directly mapped to PO1 because understanding diverse DNA forms, replication mechanisms, the Meselson-Stahl experiment, chromatin structure, histone impact, and DNA replication inhibitors requires in-depth knowledge of DNA biology concepts.

PO2: Critical Thinking and Problem Solving
All of the COs are directly mapped to PO2 because analysing the significance of the Meselson-Stahl experiment and integrating knowledge across DNA aspects demand higher-order critical thinking and problem-solving abilities.

PO3: Social Competence
CO6 and 7 are directly mapped to PO3 because integrating and synthesizing knowledge might involve presenting findings or discussing complex concepts with peers, encouraging some social interaction and communication skills.

PO4: Research-related skills and Scientific temper
CO6 and 7 are directly mapped to PO3 because integrating knowledge across DNA facets, understanding research implications, and applying concepts to specific scenarios directly contribute to research skills and a critical scientific mind-set.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems in the field of biochemistry. Applying biochemical principles to solve problems in healthcare and biotechnology demonstrates the ability to connect biochemistry to other fields.

PO6: Personal and professional competence
CO1-5 are directly mapped to PO6 because analysing the historical experiment and integrating knowledge across facets might have indirect implications for understanding the historical development of scientific knowledge or translating DNA concepts to other fields.

PO7: Effective Citizenship and Ethics
All of the COs are indirectly mapped to PO7 because Integrating knowledge across facets might encourage a broader understanding of the societal implications of DNA research and the importance of responsible scientific conduct.

PO8: Environment and Sustainability
CO6 and 7 are indirectly mapped to PO3 because analysing the historical experiment and integrating knowledge across facets might have indirect implications for understanding the environmental impact of DNA research or its potential in sustainability efforts.

PO9: Self-directed and Life-long learning
All of the COs are directly mapped to PO9 because mastering complex mechanisms, understanding diverse DNA forms, and analysing inhibitor functions encourage self-directed learning and adapting to new information.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc. - I **Semester: II**
Course Name: Developmental Biology **Course Code: PSZO 122**
Number of Credits: 04 **Number of Lectures: 60**

Course Objectives: -

- Explore growth in animals and plants, and understand commitment, specification, and determination in developmental biology.
- Study spermatogenesis, oogenesis, and the regulation of sperm motility and vitellogenesis.
- Classify types of fertilization and examine pre-fertilization events with their significance.
- Investigate cleavage types, blastulation, gastrulation, and axis formation in various organisms.
- Grasp basic concepts of organizers and analyze their role in different species.
- Examine the development of Drosophila and the process of axis formation.
- Understand neural competence and molecular signaling during neural induction.

Course Outcomes: -

After completion of this course students will-

CO1: demonstrate understanding of growth in animals and plants, and apply concepts of commitment, specification, and determination in developmental biology.
CO2: illustrate knowledge of spermatogenesis, oogenesis, and regulatory mechanisms in sperm motility and vitellogenesis.
CO3: classify and analyze types of fertilization, and evaluate the significance of pre-fertilization events.
CO4: analyze cleavage types, blastulation, gastrulation, and axis formation in various organisms.
CO5: define and apply concepts related to organizers, and assess their role in different species.
CO6: evaluate the development of Drosophila and the associated axis formation process.
CO7: demonstrate understanding of neural competence and molecular signaling in neural induction processes.

Course Articulation Matrix of Paper Code: PSZO: 122: Developmental Biology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Disciplinary Knowledge

CO1 demonstrates understanding of growth in animals and plants, applying concepts of commitment, specification, and determination in developmental biology. CO2 and CO3 contribute to disciplinary knowledge by illustrating knowledge of gametogenesis and fertilization, respectively.

PO2: Critical Thinking and Problem-Solving

Critical thinking skills are engaged in CO4, analyzing cleavage types, blastulation, gastrulation, and axis formation in various organisms. CO5 applies critical thinking to define and assess concepts related to organizers, exploring their role in different species. CO6 evaluates the development of Drosophila and the associated axis formation process, showcasing problem-solving skills.

PO3: Social Competence
Understanding developmental biology principles (CO1-CO6) enhances social competence, enabling informed discussions on topics related to growth, reproduction, and developmental processes.

PO4: Research-related Skills and Scientific Temper
CO7 delves into neural competence and molecular signaling during neural induction processes, contributing to research-related skills and cultivating a scientific temper in developmental biology.

PO5: Trans-disciplinary Knowledge
CO7, covering neural competence and molecular signaling, provides a trans-disciplinary perspective, linking developmental biology to broader biological concepts.

PO6: Personal and Professional Competence
The comprehensive knowledge provided by CO1-CO7 enhances personal and professional competence, establishing a strong foundation in developmental biology applicable in various professional settings.

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions on developmental processes (CO1-CO7) may indirectly contribute to effective citizenship by raising awareness of ethical issues in developmental biology.

PO8: Environment and Sustainability
While not explicitly addressed in the syllabus, discussions related to developmental processes (CO1-CO7) may have implications for environmental conservation and sustainability, particularly in considerations related to growth, reproduction, and developmental biology.

PO9: Self-directed and Life-long Learning
The extensive coverage of developmental biology topics (CO1-CO7) encourages self-directed and life-long learning. Students are equipped with a foundation for ongoing exploration in the dynamic field of developmental biology, fostering a commitment to continuous learning throughout their professional journey.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Comparative Animal Physiology and Endocrinology

Course Code: PSZO 123

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

Course Objectives: -

- Gain knowledge of diverse nutritional strategies and special dietary needs in animals.
- Analyze food intake, feeding mechanisms, and compare the physiological processes of digestion in different animal species.
- Explore the regulation of digestion, including the involvement of the visceral autonomic system and gastrointestinal hormones.
- Compare respiratory surfaces and ventilation strategies associated with gills and pulmonary respiration.
- Understand the ultrastructure of skeletal muscles and the molecular mechanisms involved in muscle contraction.
- Investigate concepts of osmole, osmolality, tonicity, and the osmoregulatory mechanisms in different environments.
- Explore biokinetic zones, thermos-biological terminologies, and comparative thermoregulatory mechanisms in poikilotherms and homeotherms.

Course Outcomes: -

After completion of this course students will-

CO1: apply knowledge of varied nutrition types and special dietary needs to address real-world scenarios.

CO2: demonstrate competence in understanding food intake, feeding mechanisms, and the comparative physiology of digestion.

CO3: proficiently apply knowledge of the regulatory aspects of digestion, including the visceral autonomic system and gastrointestinal hormones.

CO4: exhibit expertise in comparing respiratory surfaces and ventilation mechanisms associated with gills and pulmonary respiration.

CO5: master the understanding of skeletal muscle ultrastructure and the intricacies of molecular mechanisms in muscle contraction.

CO6: demonstrate expertise in applying concepts of osmole, osmolality, tonicity, and understanding osmoregulation in diverse environments.

CO7: demonstrate proficiency in applying knowledge of biokinetic zones, thermos-biological terminologies, and comparative thermoregulatory mechanisms in different temperature conditions.

Course Articulation Matrix of Paper Code: PSZO: 123 Comparative Animal Physiology and Endocrinology

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

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

PO1: Disciplinary Knowledge
CO1 applies knowledge of varied nutrition types and special dietary needs, providing a foundation for understanding nutritional requirements in diverse animals.

PO2: Critical Thinking and Problem-Solving
CO2 demonstrates competence in understanding food intake, feeding mechanisms, and the comparative physiology of digestion, engaging critical thinking in assessing digestive processes across different species.

PO3: Social Competence
While not explicitly outlined, knowledge of physiological processes (CO1-CO7) can enhance social competence, facilitating informed discussions on topics related to nutrition and physiological functions in various environments.

PO4: Research-related Skills and Scientific Temper
CO7 demonstrates proficiency in applying knowledge of biokinetic zones, thermos-biological terminologies, and comparative thermoregulatory mechanisms, contributing to research-related skills and fostering a scientific temper in the field of animal physiology.

PO5: Trans-disciplinary Knowledge
The coverage of physiological processes (CO1-CO7) provides trans-disciplinary knowledge, linking animal physiology with broader biological concepts, nutrition, and environmental adaptation.

PO6: Personal and Professional Competence
CO1-CO7 collectively enhance personal and professional competence, equipping students with a comprehensive understanding of animal physiology applicable in various professional settings.

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions on physiological processes (CO1-CO7) may indirectly contribute to effective citizenship by raising awareness of ethical considerations related to animal nutrition and well-being.

PO8: Environment and Sustainability
The understanding of osmoregulation in different environments (CO6) indirectly contributes to environmental awareness, highlighting the adaptability of animals to diverse ecological conditions.

PO9: Self-directed and Life-long Learning
The comprehensive coverage of animal physiology (CO1-CO7) encourages self-directed and life-long learning, providing a foundation for ongoing exploration in the dynamic field of animal physiology and endocrinology.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc. - I **Semester: II**
Course Name: Tools and Techniques in Biology **Course Code: PSZO:124**
Number of Credits: 04 **Number of Lectures: 60**

Course Objectives: -

- Understand microscopy principles, emphasizing resolution and improvement techniques.
- Grasp UV-Visible, Atomic Absorption, Molecular, IR, Circular Dichroism, and MALDI-TOF spectroscopy principles for diverse applications.
- Understand ultracentrifuge principles and master differential/density gradient centrifugation.
- Introduce electrophoresis and gain expertise in Native PAGE, SDS-PAGE, and 2D-Gel Electrophoresis.
- Master thin layer chromatography, adsorption chromatography, partition chromatography, GC-MS, HPLC, and HPTLC.
- Proficiency in advanced molecular methods - PCR, fingerprinting, markers, microarray, sequencing, protein analysis, FRET, and flow cytometry.
- Explore databases and bioinformatics. Understand cell culture and its applications. Grasp nanotechnology concepts and applications.

Course Outcomes: -

After completion of this course students will-

CO1: apply fundamental microscopy principles, emphasizing resolution enhancement.
CO2: demonstrate proficiency in UV-Visible, Atomic Absorption, Molecular, IR, Circular Dichroism, and MALDI-TOF spectroscopy.
CO3: execute ultracentrifuge principles and perform differential/density gradient centrifugation with expertise.
CO4: integrate electrophoresis principles and demonstrate proficiency in Native PAGE, SDS-PAGE, and 2D-Gel Electrophoresis.
CO5: master thin layer chromatography, adsorption chromatography, partition chromatography, GC-MS, HPLC, and HPTLC for analytical applications.
CO6: demonstrate proficiency in real-time PCR, DNA fingerprinting, markers (RAPD, RFLP, AFLP), DNA microarray, sequencing (Sanger, Next generation), protein microarray, sequencing, FRET, and flow cytometry.
CO7: apply knowledge in databases and bioinformatics; demonstrate understanding of cell culture basics and their research applications; apply nanotechnology concepts and methods for characterization and applications in biology.

Course Articulation Matrix of Paper Code: PSZO: 124 Tools and Techniques In Biology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Disciplinary Knowledge
CO1 equips students with the ability to apply fundamental microscopy principles, emphasizing resolution enhancement. CO2-CO7 collectively contribute to disciplinary knowledge by covering a broad range of techniques, from spectroscopy and centrifugation to electrophoresis, chromatography, and advanced biological techniques.

PO2: Critical Thinking and Problem Solving
The proficiency demonstrated in various techniques, such as spectroscopy (CO2), electrophoresis (CO4), chromatography (CO5), and advanced biological techniques (CO6), showcases critical thinking and problem-solving skills in experimental design and interpretation.

PO3: Social Competence
While not explicitly addressed, an understanding of advanced laboratory techniques (CO1-CO7) enhances social competence by fostering collaborative skills in research and experimental settings.

PO4: Research-related Skills and Scientific Temper
CO7, covering computer applications in databases, bioinformatics, and nanotechnology, contributes to research-related skills and cultivates a scientific temper by integrating technology and data analysis into experimental biology.

PO5: Trans-disciplinary Knowledge
The incorporation of nanotechnology concepts (CO7) provides a trans-disciplinary perspective, connecting biological techniques with nanoscale applications.

PO6: Personal and Professional Competence
The mastery of a diverse array of techniques (CO1-CO7) enhances personal and professional competence, preparing students for versatile roles in research and biotechnology.

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions related to advanced techniques (CO1-CO7) may involve ethical considerations, contributing to effective citizenship by raising awareness of ethical issues in experimental biology and biotechnology.

PO8: Environment and Sustainability
While not explicitly covered, the use of advanced techniques in biology (CO1-CO7) may indirectly contribute to environmental awareness through applications in environmental monitoring and analysis.

PO9: Self-directed and Life-long Learning
The comprehensive coverage of advanced techniques (CO1-CO7) encourages self-directed and life-long learning, providing a foundation for ongoing exploration in the dynamic field of experimental biology and biotechnology.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Molecular and Developmental Biology Lab **Course Code: PSZO 125**

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

Course Objectives: -

- Proficiency in quantifying DNA using diphenylamine reagent.
- Skill development in quantifying RNA using orcinol reagent.
- Expertise in isolating bacterial DNA, including quantification and quality assessment.
- Mastery in isolating DNA from sheep/chicken liver, with quantification and quality assessment.
- Efficient isolation of RNA from biological samples.
- Competence in isolating plasmid DNA from bacteria.
- Ability to study UV light/mutagen-induced DNA damage using comet assay.

Course Outcomes: -

After completion of this course students will-

CO1: demonstrated proficiency in accurately quantifying DNA using diphenylamine reagent.

CO2: exhibited skill development in precise quantification of RNA using the orcinol reagent.

CO3: displayed expertise in the successful isolation of bacterial DNA, coupled with accurate quantification and quality assessment.

CO4: showcased mastery in the isolation of DNA from sheep/chicken liver, including accurate quantification and quality assessment.

CO5: demonstrated efficiency in the isolation of RNA from diverse biological samples.

CO6: showed competence in the isolation of plasmid DNA from bacterial sources.

CO7: illustrated the ability to study DNA damage induced by UV light/mutagen through the comet assay.

Course Articulation Matrix of Paper Code: PSZO 125: Zoology Practical-III -Molecular and Developmental Biology Lab

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

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

PO1: Disciplinary Knowledge

CO1-CO7 collectively contribute to disciplinary knowledge in molecular biology, covering essential techniques such as DNA and RNA quantification, isolation, and damage assessment, along with the study of induced mutations.

PO2: Critical Thinking and Problem Solving

Practicals like the study of UV light/mutagen-induced DNA damage (CO7) and induced mutation by chemical/physical mutagens (Practical 8 and 9) engage critical thinking and problem-solving skills in assessing genetic alterations and mutations.

PO3: Social Competence

While not explicitly outlined, hands-on experience with molecular biology techniques (CO1-CO7) enhances social competence by preparing students for collaborative research environments and fostering effective communication in the scientific community.

PO4: Research-related Skills and Scientific Temper
The proficiency demonstrated in molecular biology techniques (CO1-CO7) contributes to research-related skills, fostering a scientific temper by emphasizing precision in quantification, quality assessment, and the study of genetic alterations.

PO5: Trans-disciplinary Knowledge
The study of induced mutations (Practicals 8 and 9) connects molecular biology with broader biological concepts, providing a trans-disciplinary perspective on genetic changes and their implications.

PO6: Personal and Professional Competence
The mastery showcased in molecular biology practicals (CO1-CO7) enhances personal and professional competence, preparing students for roles in research, biotechnology, and genetic studies.

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions related to molecular biology (CO1-CO7) may involve ethical considerations, contributing to effective citizenship by raising awareness of ethical issues in genetic research and experimentation.

PO8: Environment and Sustainability
While not explicitly covered, the techniques employed in molecular biology (CO1-CO7) may have applications in environmental monitoring and sustainability, indirectly contributing to environmental awareness.

PO9: Self-directed and Life-long Learning
The practical exposure to molecular biology techniques (CO1-CO7) encourages self-directed and life-long learning, providing a foundation for ongoing exploration in the dynamic field of molecular biology and genetics.

SYLLABUS (CBCS) FOR M.Sc. ZOOLOGY Sem. IV (w. e. f. June, 2022)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Physiology, Endocrinology and Biological Techniques Lab **Course Code: PSZO 126**

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

Course Objectives: -

- Develop practical skills in studying nitrogenous waste products across various animal habitats.
- Gain a comprehensive understanding of the correlation between body size and oxygen consumption in aquatic animals.
- Acquire proficiency in estimating sugar and chloride content in rat/crab samples.
- Demonstrate the ability to determine heart rate and explore the effects of temperature and ions in crabs.
- Investigate the impact of eye stalk ablation on chloride and glucose levels in crab hemolymph.
- Apply practical techniques to determine oxalic acid levels in mammalian urine using titration.
- Understand the histology of neurosecretory and endocrine structures in both invertebrates and vertebrates.

Course Outcomes: -

After completion of this course students will-

CO1: develop practical expertise in analysing nitrogenous waste products in diverse animal habitats.

CO2: achieve a comprehensive understanding of the relationship between body size and oxygen consumption in aquatic animals.

CO3: demonstrate proficiency in accurately estimating sugar and chloride content in rat/crab samples.

CO4: apply knowledge to determine heart rate and explore the effects of temperature and ions in crab physiology.

CO5: investigate and analysed the physiological impact of eye stalk ablation on chloride and glucose levels in crab haemolymph.

CO6: utilize practical techniques to determine oxalic acid levels in mammalian urine through titration.

CO7: gain a comprehensive understanding of the histology of neurosecretory and endocrine structures in both invertebrates and vertebrates.

Course Articulation Matrix of Paper Code: PSZO: 126 Zoology Practical-IV- Physiology, Endocrinology and Biological Techniques Lab

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

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

PO1: Disciplinary Knowledge
CO1-CO7 contribute to disciplinary knowledge in comparative animal physiology and endocrinology, covering various physiological aspects such as nutrition, digestion, respiration, muscle physiology, osmoregulation, excretion, temperature regulation, nervous system neurophysiology, and endocrinology.

PO2: Critical Thinking and Problem-Solving
Practical's such as the comparison of respiratory surfaces (CO2), muscle anatomy and physiology (CO3), and the study of nervous system neurophysiology (CO7) engage critical thinking and problem-solving skills in understanding and analyzing physiological processes.

PO3: Social Competence
While not explicitly outlined, practical expertise in comparative animal physiology (CO1-CO7) enhances social competence by preparing students for collaborative research environments and fostering effective communication in the scientific community.

PO4: Research-related Skills and Scientific Temper
The proficiency demonstrated in practical (CO1-CO7) contributes to research-related skills, fostering a scientific temper by emphasizing precision in analysis, experimentation, and data interpretation.

PO5: Trans-disciplinary Knowledge
The study of endocrinology (CO7) connects physiological knowledge with broader biological concepts, providing a trans-disciplinary perspective on signaling mechanisms and hormonal regulation.

PO6: Personal and Professional Competence
The mastery showcased in comparative animal physiology and endocrinology (CO1-CO7) enhances personal and professional competence, preparing students for roles in research, physiology, and laboratory-based work.

PO7: Effective Citizenship and Ethics
While not explicitly addressed, discussions related to animal physiology and endocrinology (CO1-CO7) may involve ethical considerations, contributing to effective citizenship by raising awareness of ethical issues in animal experimentation and research.

PO8: Environment and Sustainability
While not explicitly covered, the techniques employed in biological analysis (CO1-CO7) may have applications in environmental monitoring and sustainability, indirectly contributing to environmental awareness.

PO9: Self-directed and Life-long Learning
The practical exposure to comparative animal physiology and endocrinology (CO1-CO7) encourages self-directed and life-long learning, providing a foundation for ongoing exploration in the dynamic field of physiology and biological sciences.

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 2023-2024

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 III

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

Sr. No.	Code	Paper	Paper Title	Credit	Exam	Marks
1	PSZO 231A	**Theory**	**Entomology-I**	**4**	I / E	**40 + 60**
	PSZO 231B	**Theory**	**Animal Physiology-I**	**4**	I / E	**40 + 60**
	PSZO 231C	**Theory**	**Genetics-I**	**4**	I / E	**40 + 60**
2	PSZO 232	**Theory**	**Physiology, Biochemistry and Ecology of Insects**	**4**	I / E	**40 + 60**
3	PSZO 233	**Theory**	**Reproductive Physiology, Histology and Histochemistry of Mammals**	**4**	I / E	**40 + 60**
4	PSZO 234	**Theory**	**Economic Zoology**	**4**	I / E	**40 + 60**
5	PSZO 235A	Zoology **Practical-V**	**Practicals Corresponding to : PSZO 231A , PSZO 232**	**4**	I / E	**40 + 60**
6	PSZO 235B		**Practicals Corresponding to : PSZO 231B , PSZO 232**	**4**	I / E	**40 + 60**
7	PSZO 235C		**Practicals Corresponding to : PSZO 231C , PSZO 232**	**4**	I / E	**40 + 60**
8	PSZO 236	Zoology **Practical-VI**	**Practicals Corresponding to : PSZO 233 , PSZO 234**	**4**	I / E	**40 + 60**
			Skill Development	**2**	-	
			Certificate Course	**2**	-	

IA* - Internal Assessment

EA*- External Assessment

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc. - II **Semester: III**
Course Name: Entomology-I **Course Code: PSZO 231A**
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-

CO 1: know the Systematics of class insecta.
CO 2: get well prepared for research in Entomology under life sciences.
CO 3: understand socio-economical interactions of insects with human
CO 4: be 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.
CO 5: have a strong understanding of insect internal systems and able to explain their functions within the context of insect biology.
CO 6: 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 PSZO 231A: 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

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.
CO3 requires students to have a comprehensive understanding of the insect integument and its derivatives, which is essential for understanding insect adaptation and survival.
CO4 requires students to be well-versed in insect tagmata and their adaptations and modifications, which is essential for understanding the diversity of insect body plans.

PO2: Critical Thinking and Problem Solving
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.

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

PO5: Trans-disciplinary knowledge
CO1, CO2, CO3, CO4, and CO5 all 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 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 require students to demonstrate ethical behavior in their research and to be aware of the social and environmental implications of their work.

PO8: Environment and Sustainability
CO1, CO2, CO3, CO4, and CO5 all 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
The entire COs requires 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. III (w. e. f. June, 2023)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc. - II **Semester: III**
Course Name: Animal Physiology -I **Course Code: PSZO 231B**
Number of Credits: 04 **Number of Lectures: 60**

Course Objectives:

- To understand the factors affecting animal physiology, including both extrinsic and intrinsic factors.
- To explore the concept of homeostasis and its regulatory mechanisms, including tolerance, resistance, acclimatization, and acclimation.
- To examine the role of biological clocks in regulating physiological rhythms, such as circadian rhythms, lunar and tidal rhythms, and photoperiodism.
- 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 fibre
- 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-:

CO 1: understand functioning of Excretion via kidneys and other excretory organs of animals.
CO 2: understand the physiology of membrane and physiological aspects of metabolism.
CO 3: demonstrate knowledge of biological clocks and their role in regulating physiological rhythms in animals.
CO 4: comprehend the physiology of digestion, including nutritional requirements, digestion and absorption processes, and the control mechanisms.
CO 5: explain the different modes of respiration, gas exchange, and the neural control of respiration, as well as understand abnormalities in gas transport.
CO 5: describe muscle physiology, including muscle structure, contraction mechanisms, and muscle fibre types.
CO 6: explain the concept of homeostasis, its regulation, and the mechanisms involved in maintaining internal stability.
CO 7: describe muscle physiology, including muscle structure, contraction mechanisms, and muscle fibre types.

Course Articulation Matrix of PSZO 231B: 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

CO1 encourages critical thinking by examining the complex factors influencing animal physiology.

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. III (w. e. f. June, 2023)

Name of the Program: M.Sc. Zoology | **Program Code: PSZO**
Class: M.Sc. - II | **Semester: III**
Course Name: Genetics - I | **Course Code: PSZO 231C**
Number of Credits: 04 | **Number of Lectures: 60**

Course Objectives: -

- To understand the life cycles and advantages of model genetic systems used in genetic studies.
- To recapitulate the basic concepts of population genetics and explore the Hardy-Weinberg law.
- To delve into evolutionary genetics, including concepts of continuous variation, genetic polymorphism, and the genetics of speciation.
- 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 the life cycles and advantages of model genetic systems such as *Neurospora*, *E. coli*, and *Drosophila*.

CO2: Apply the principles of the Hardy-Weinberg law and estimate gene frequencies in populations through mutation and genetic equations.

CO3: Analyze 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 PSZO 231C: 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 Se. III (w. e. f. June, 2023)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M. Sc. - II **Semester: III**
Course Name: Physiology, Biochemistry and Ecology of Insects
Course Code: PSZO 232
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, plant insect relationships etc.
- 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-:
CO 1: understand the insect physiology and biochemistry in depth.
CO 2: gain knowledge of insect population dynamics and behavioural adaptations.
CO 3: understand the scope and importance of insect anatomy and physiology.
CO 4: describe structure, modification and physiology of different system.
CO 5: describe interaction of various climatic factors with insects.
CO 6: describe feeding strategies of herbivorous insects.
CO 7: describe in detail the plant defense mechanism.

Course Articulation Matrix of PSZO 232: Physiology, Biochemistry and Ecology of Insects
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 understands 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 (Analyzing 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 (Analyzing 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 analyzing 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 Se. III (w. e. f. June, 2023)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Reproductive Physiology, Histology and Histochemistry of Mammals

Course Code: PSZO 233

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
- Mention and describe the different types of tissue.

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: gather information of hazardous materials and will recognize and respond properly to potential hazards of handling chemicals and chemical waste.

CO6: able to design an experimental procedure.

CO7: explore career opportunities and participate in career and graduate school planning through organization and activities.

Course Articulation Matrix of PSZO 233: Reproductive Physiology, Histology and Histochemistry of Mammals

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 (Analyzing 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, analyzing 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. III (w. e. f. June, 2023)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M.Sc.-II **Semester: III**
Course Name: Economic Zoology **Course Code: PSZO 234**
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: understand the role of different cultures in day to day life.
CO2: understand the different industries with economic profit.
CO3: 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. such as 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.
CO7: critically assess the ecological importance and conservation needs of wildlife populations. Examining coral reefs, amphibians, reptiles, birds, and mammals will enable students to understand the crucial role these creatures play in ecosystems and the challenges they face, fostering awareness of conservation efforts.

Course Articulation Matrix of PSZO 234: 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
CO1 understand the role of different cultures in day-to-day life.CO2 understand the different industries with economic profit.CO3 develop ability to start their own 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.

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).

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: Analyse the diverse roles of invertebrates and lower chordates in human health, agriculture, and industry (Gathering and interpreting scientific data, formulating research questions).

PO5: Trans-disciplinary knowledge
CO1 understand the role of different cultures in life (Connecting cultural practices with animal husbandry and environmental conservation).CO6 evaluate the economic significance of various animal commodities and resources (Understanding the interplay between animal industries, economics, and public health).

PO6: Personal and professional competence
CO3 develop ability to start their own farms (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 life (Promoting cultural sensitivity and respect for diverse perspectives on animal interactions).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 analyse the diverse roles of invertebrates and lower chordates in human health, agriculture, and industry (Understanding the importance of biodiversity and natural ecosystems).

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 own farms (Encouraging self-initiative and lifelong learning in agricultural practices).

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M. Sc. II **Semester: III**
Course Name: Zoology Practical-V (Practicals Corresponding to PSZO 231A and PSZO 232)
Course Code: PSZO 235A
Number of Credits: 04 **Number of Practicals: 10**

Course Objectives:-

- Develop comprehensive knowledge and practical skills in insect collection, preservation, and presentation techniques.
- 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.
- Analyse 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.
- Conduct kymographic studies to analyse ventilatory movements in beetles, gaining insights into the respiratory mechanisms of insects
- Acquire expertise in the dissection of laboratory-cultured insects, specifically focusing on the digestive, nervous, and reproductive systems to understand their anatomical structures and functions.
- Assess the impact of temperature on water loss in cockroaches, gaining insights into the physiological responses of insects to environmental conditions
- Use the quadrate method to study insect populations, demonstrating proficiency in ecological techniques for assessing and analyzing insect communities in a given area.

Course Outcomes:-

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

CO1: demonstrate advanced knowledge and practical skills in insect collection, preservation, and presentation, employ various collecting methods, apply appropriate preservation techniques for different specimen types, for research and educational purposes.

CO2: understand 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: analyse 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. Demonstrate Proficiency in Insect Collection and Preservation:

CO4: acquire expertise in the dissection of laboratory-cultured insects, with a specific focus on the digestive, nervous, and reproductive systems. This outcome aims to ensure a deep understanding of anatomical structures and functions in insect biology.

CO 5: comprehend the impact of temperature on water loss in cockroaches, gaining insights into the physiological responses of insects to environmental conditions. also student will able to understand how insects adapt to varying temperatures.

CO6 demonstrate proficiency in ecological techniques for assessing and analyzing insect communities in a given area.

CO7: focuses on the practical application of ecological methods for studying insect populations in their natural habitats.

Course Articulation Matrix of PSZO 235A: Zoology practical corresponding to PSZO 231A and PSZO 232

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 (PO1)

CO 1 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 (PO2)

CO2 consist of 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 (PO3)

CO3 involve analyzing specialized head structures and appendages often involve collaboration and discussion within groups, fostering communication and teamwork skills, contributing to PO3 development.

PO4: Research-related skills and Scientific temper

CO 4 involves 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

CO 5 consists of 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

CO 6 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 involve 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 (PO8)

CO2, CO5 involve 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 (PO9)

CO 1, CO3 involve mastering insect collection, dissection, and analysis techniques in stills 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. III (w. e. f. June, 2023)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M. Sc. II **Semester: III**
Course Name: Zoology Practical-V (Practicals Corresponding to PSZO 231B and PSZO 232)
Course Code: PSZO 235B
Number of Credits: 04 **Number of Practicals: 10**

Course Objectives:-

- Develop proficiency in laboratory techniques for the accurate estimation of serum uric acid, enhancing skills in biochemical analysis and understanding the clinical significance of uric acid levels.
- Gain a comprehensive understanding of absorption spectra principles and their application in analyzing blood pigments, fostering knowledge about the optical properties of biological molecules in blood.
- Explore the physiological responses of earthworms to osmotic stress, specifically focusing on changes in volume. Develop practical skills in studying the impact of environmental factors on organismal physiology.
- Acquire practical skills in estimating carbohydrates in the mammalian gut, emphasizing the importance of carbohydrate analysis in the context of digestive processes and nutrient absorption.
- Acquire expertise in the dissection of laboratory-cultured insects, specifically focusing on the digestive, nervous, and reproductive systems to understand their anatomical structures and functions.
- Understand the impact of temperature on water loss in cockroaches, gaining insights into the physiological responses of insects to environmental conditions
- Use the quadrate method to study insect populations, demonstrating proficiency in ecological techniques for assessing and analyzing insect communities in a given area**.**

Course Outcomes:

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

CO1: develop proficiency in laboratory techniques for accurately estimating serum uric acid levels.
CO2: gain a comprehensive understanding of absorption spectra principles and their application in analyzing blood pigments. This outcome aims to foster knowledge about the optical properties of biological molecules in blood, enabling a thorough interpretation of spectroscopic data.
CO3: develop practical skills in studying the physiological responses of earthworms to osmotic stress, with a specific focus on changes in volume.
CO4: acquire practical skills in estimating carbohydrates in the mammalian gut, emphasizing the importance of carbohydrate analysis in the context of digestive processes and nutrient absorption.
CO5: comprehend the impact of temperature on water loss in cockroaches, gaining insights into the physiological responses of insects to environmental conditions. also student will able to understand how insects adapt to varying temperatures.
CO6: demonstrate proficiency in ecological techniques for assessing and analyzing insect communities in a given area.
CO7: focuses on the practical application of ecological methods for studying insect populations in their natural habitats.

Course Articulation Matrix of PSZO 235B: Zoology practical corresponding to PSZO 231B and PSZO 232

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 directly aligns with PO1 the objective by ensuring that students not only gain theoretical knowledge but also practical proficiency in the laboratory techniques necessary for accurate serum uric acid estimation.

PO2: Critical Thinking and Problem Solving (PO2)

CO2 aligns with the objective by ensuring that students not only grasp the theoretical principles of absorption spectra but also apply this knowledge to analyze blood pigments. This strengthens PO2 through practical application of problem-solving skills in a scientific context.

PO3: Social Competence

CO3 directly align with PO3 fulfil the objective by emphasizing the development of practical skills in studying physiological responses to osmotic stress. The focus on changes in volume ensures that students can apply their knowledge to real-world scenarios, demonstrating a practical understanding of organismal physiology.

PO4: Research-related skills and Scientific temper

CO 4 aligns with PO4 by emphasizing the acquisition of practical skills in carbohydrate estimation. Understanding the importance of carbohydrate analysis in digestive processes and nutrient absorption ensures that students can apply their knowledge to investigate dietary contributions to metabolic health.

PO5: Trans-disciplinary knowledge

CO 5 directly supports the PO4 by ensuring that students acquire expertise in the dissection of laboratory-cultured insects. Focusing on the digestive, nervous, and reproductive systems enhances their understanding of insect anatomy and function, aligning with the overall goal of the objective.

PO6: Personal and professional competence

CO6 provides insights into the physiological responses of cockroaches to temperature variations, especially in terms of water loss. This aligns with the objective's focus on understanding how insects adapt to environmental conditions.

PO7: Effective Citizenship and Ethics (PO7)

CO7 involve 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 (PO8)

CO2, CO5 involve 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 (PO9)

CO 1, CO3 involve mastering insect collection, dissection, and analysis techniques in stills 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. III (w. e. f. June, 2023)

Name of the Program: M.Sc. Zoology **Program Code: PSZO**
Class: M. Sc. II **Semester: III**
Course Name: Zoology Practical-V (Practicals Corresponding to PSZO 231C and PSZO 232)
Course Code: PSZO 235C
Number of Credits: 04 **Number of Practicals: 10**

Course Objectives:-

- Develop a solid understanding of the principles and methods involved in the analysis of metric traits. Gain proficiency in the estimation of phenotypic variance to evaluate and interpret the variation present within a population.
- Acquire knowledge and practical skills in partitioning phenotypic variance into genetic and nongenetic components in a simulated population
- Gain expertise in the detection of variation within a population using biochemical methods, such as enzyme and protein analysis. Understand the principles and techniques involved in assessing population diversity at the biochemical level.
- Explore Population Cage Experiments and Genetic Manipulation in Drosophila and envelop practical skills in manipulating and analyzing genetic factors within a controlled environment.
- Acquire expertise in the dissection of laboratory-cultured insects, specifically focusing on the digestive, nervous, and reproductive systems to understand their anatomical structures and functions.
- Understand the impact of temperature on water loss in cockroaches, gaining insights into the physiological responses of insects to environmental conditions.
- Use the quadrate method to study insect populations, demonstrating proficiency in ecological techniques for assessing and analyzing insect communities in a given area**.**

Course Outcomes:

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

CO1: demonstrate proficiency in the analysis of metric traits, including the ability to measure and analyze phenotypic variance. They will develop skills in statistical methods for assessing variability within a population.

CO2: gain a comprehensive understanding of the process of partitioning phenotypic variance into genetic and nongenetic components. They will be able to estimate Dominance Genetic Deviation (DGD) and interpret its implications for genetic variation in populations.

CO3: acquire expertise in using biochemical methods, such as enzyme and protein analysis, to detect and quantify variation within a population.

CO4: develop practical skills in conducting population cage experiments using Drosophila. Additionally, they will become proficient in genetic manipulation, including the extraction of genomic DNA, to study and modify genetic factors in Drosophila populations.

CO5: comprehend the impact of temperature on water loss in cockroaches, gaining insights into the physiological responses of insects to environmental conditions. also student will able to understand how insects adapt to varying temperatures.

CO6 demonstrate proficiency in ecological techniques for assessing and analyzing insect communities in a given area.

CO7: focuses on the practical application of ecological methods for studying insect populations in their natural habitats.

Course Articulation Matrix of PSZO 235C: Zoology practical corresponding to PSZO 231C and PSZO 232

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

CO1 demonstrate proficiency in the analysis of metric traits, including the ability to measure and analyze phenotypic variance. Align with PO1 to develop skills in statistical methods for assessing variability within a population.

PO2: Critical Thinking and Problem Solving

CO2 align with PO1 in estimating Dominance Genetic Deviation (DGD) requires critical thinking skills to interpret complex genetic data, contributing to the development of problem-solving abilities.

PO3: Social Competence

CO 3 acquires expertise in using biochemical methods, such as enzyme and protein analysis, to detect and quantify variation within a population contributing to PO3 development.

PO4: Research-related skills and Scientific temper

CO 4 able to Develop practical skills in conducting population cage experiments using Drosophila. Additionally, they will become proficient in genetic manipulation, including the extraction of genomic DNA, to study and modify genetic factors in Drosophila populations. This strengthens PO4 by developing scientific temper and research skills.

PO5: Trans-disciplinary knowledge

CO 5 applying quantitative genetics techniques connects entomology with broader concepts in genetics and statistics, enriching understanding beyond discipline boundaries.

PO6: Personal and professional competence

CO 6 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

CO 7 able to understand the physiological adaptations of aquatic insects to environmental changes raises awareness of ecological issues and the importance of environmental stewardship, contributing to responsible citizenship.

PO 8: Environment and Sustainability

CO1, CO4 and CO5 able to understand 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, CO2, CO3 and CO 4 contributing mastering insect collection, dissection, and analysis techniques instils self-directed learning habits and equips students with the skills to independently explore entomological concepts.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Zoology Practical-VI (Practicals Corresponding to PSZO 233 and PSZO 234)

Course Code: PSZO 236

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

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

CO5: 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: study various types of tissues using permanent slides and develop the ability to identify and analyse different tissue structures, including epithelial, connective, muscular, and nervous tissues. They will become proficient in tissue analysis techniques.

CO7: 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 PSZO 236: Practicals Corresponding to PSZO 233 and PSZO 234)
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

PO 1: Disciplinary Knowledge
CO1 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 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 align with PO3 in 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.

PO4: Research-related skills and Scientific temper
CO4 involves 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 connects reproductive physiology and histology with broader concepts in biology, chemistry, and environmental science. Analysing prawn culture practices bridges the gap between laboratory work and real-world applications, contributing to PO5 development.

PO6: Personal and professional competence
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 involve ethical implications of animal research and responsible laboratory practices foster responsible citizenship. Additionally, studying prawn culture raises awareness of sustainable aquaculture practices, contributing to PO7 development.

PO8 Environment and Sustainability
CO 1, CO5, CO 6, involve 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, CO3, CO4, CO5, and CO6 align with PO9 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.

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 2023-2024

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	PSZO 241A	Theory	Entomology-II	4	I / E	40 + 60
	PSZO 241B	Theory	Animal Physiology-II	4	I / E	40 + 60
	PSZO 241C	Theory	Genetics-II	4	I / E	40 + 60
2	PSZO 242	Theory	Immunology and Parasitology	4	I / E	40 + 60
3	PSZO 243	Theory	Pest Control and Toxicology	4	I / E	40 + 60
4	PSZO 244	Theory	Environmental Biology and Animal Systematics & Diversity	4	I / E	40 + 60
5	PSZO 245A	Zoology Practical-VII	Practicals Corresponding to : PSZO 241A , PSZO 242, PSZO 244	4	I / E	40 + 60
6	PSZO 245B		Practicals Corresponding to : PSZO 241B , PSZO 242, PSZO 244	4	I / E	40 + 60
7	PSZO 245C		Practicals Corresponding to : PSZO 241C , PSZO 242, PSZO 244	4	I / E	40 + 60
8	PSZO 246	Research Project	DISSERTATION (Review of Literature and Summer /Industrial Training)	4	I / E	40 + 60
	SD-24		Skill Development	2	-	-

IA* - Internal Assessment

EA*- External Assessment

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Entomology-II **Course Code: PSZO 241A**

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

Course Objectives:-

- To comprehend processes of gametogenesis, fertilization, and oviposition.
- To understand early insect embryonic development.
- To give a brief overview of segmentation, appendage formation, and organogenesis.
- To explore post-embryonic insect development.
- To explore strategies of emergence of adults from pupae or cocoons.
- To analyse Hadorn's experiments, specifically focusing on imaginal disc experiments.
- To familiarize with diapause in insects, and control mechanisms, gaining a precise understanding of this biological phenomenon.

Course Outcomes:-

After completion of this course students will-

CO1: grasp the intricacies of gametogenesis, fertilization, and oviposition processes in insects.

CO2: achieve a clear understanding of early insect embryonic development.

CO3: explain process of segmentation, appendage formation, and organogenesis.

CO4: explore post-embryonic insect development.

CO5: familiarize with strategies of emergence of adults from pupae or cocoons.

CO6: proficiently analyse Hadorn's experiments, particularly focusing on imaginal disc experiments and their significance in insect developmental studies.

CO7: become acquainted with diapause in insects and its control mechanisms, developing a precise understanding of biological phenomenon.

Course Articulation Matrix of PSZO 241A: 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	2	2	1	1	2	2
CO2	3	2	1	2	2	1	1	2	2
CO3	3	2	1	2	2	1	1	2	2
CO4	3	2	1	2	2	1	1	2	2
CO5	3	2	1	2	2	1	1	2	2
CO6	3	2	1	3	2	1	1	1	3
CO7	3	2	1	2	2	1	1	3	2

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts and practices in taxonomy and zoology. For example, CO1 requires students to have an in-depth understanding of reproductive processes in insects, including gamete formation, fertilization, and egg laying.

PO2: Critical Thinking and Problem Solving
All of the COs are directly mapped to PO2 because they require students to apply critical thinking and problem-solving skills. For example, CO3 requires students to analyse the complex interactions between genetic factors and environmental cues in shaping insect body plan and function.

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 because they require students to apply the principles of scientific research to their work. For example, CO5 encourage students to observe, collect the data and analysis of emergence behaviour for research into insect physiology and behaviour.

PO5: Trans-disciplinary knowledge
All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems in the field of zoology. For example, CO5 requires students to integrate with ecology, evolution, and behaviour studies for understanding diverse emergence strategies and adaptations in insects.

PO6: Personal and professional competence
All of the COs are indirectly mapped to PO6 because they require students to demonstrate the personal and professional skills that are essential for success in the field of zoology. For example, CO6 indirectly contributes to scientific thinking and research skills, potentially valuable for research careers in developmental biology or entomology.

PO7: Effective Citizenship and Ethics
All of the COs are indirectly mapped to PO7 because they require students to uphold the ethical standards in zoology. For example, CO7 promotes appreciation for the historical development of scientific knowledge and the importance of rigorous experimentation.

PO8: Environment and Sustainability
All of the COs are directly mapped to PO8 because they require students to be aware of the environmental changes and sustainability implications of their work. For example, CO5 requires students to focus on understanding of how environmental factors, like climate change, affect insect emergence timings and its potential impact on pest populations and ecosystem dynamics.

PO9: Self-directed and Life-long learning
All of the COs are directly mapped to PO9 because they require students to develop the skills necessary for self-directed and lifelong learning. For example, CO7 provides foundation for further exploration of mammalian diversity, evolution, and conservation research.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Animal Physiology-II **Course Code: PSZO 241B**

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

Course Objectives:-

- Gain insights into the process of energy metabolism.
- To provide students with a deep understanding of the effects of oxygen concentration, with a focus on diving and deep-sea hydrothermal vent environments.
- To explore excretion processes, including nitrogenous waste products, organs of excretion, and renal regulation of acid– base balance.
- To examine osmoregulation in different environments, including freshwater, terrestrial, and marine habitats.
- To understand the mechanism of osmoregulation in animals.
- To study blood composition, functions, clotting mechanisms, blood vessel types, and their roles in blood pressure.
- To investigate cardiac physiology and neuronal and hormonal control of heart rate during exercise.

Course Outcomes:-

After completion of this course, students will-

CO1: proficiently grasp the intricacies of energy metabolism.

CO2: explain the responses to varying oxygen concentrations, specifically in the context of diving and deep-sea hydrothermal vent environments.

CO3: confidently explain excretion processes, focusing on the elimination of nitrogenous waste products and the regulatory mechanisms for acid-base balance in the body.

CO4: clearly describe osmoregulation in different environments, showcasing their understanding of how animals maintain water and electrolyte balance in freshwater, terrestrial, and marine habitats.

CO5: explain the mechanism of osmoregulation in animals.

CO6: effectively articulate the functions of blood components, blood clotting mechanisms, and the role of different blood vessel types in controlling blood pressure.

CO7: demonstrate a comprehensive understanding of cardiac physiology, including heart rate regulation through neuronal and hormonal control during exercise, enabling them to analyse cardiovascular function, particularly in the context of physical activity.

Course Articulation Matrix of PSZO 241B: Animal Physiology-II

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

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

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts and practices in physiology. For example, CO1 requires students to have an in-depth understanding of complex biochemical pathways and regulatory mechanisms.

PO2: Critical Thinking and Problem Solving

All of the COs are directly mapped to PO2 because they require students to apply critical thinking and problem-solving skills. For example, CO2 requires students to analyse the and explains adaptations to different oxygen levels.

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 animals during emergence.

PO4: Research-related skills and Scientific temper

All of the COs are directly mapped to PO4 because they require students to apply the principles of scientific research to their work. For example, CO4 encourage students to observe, collect the data and analysis of emergence behaviour for research into animal physiology and behaviour.

PO5: Trans-disciplinary knowledge

All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems in the field of zoology. For example, CO4 requires students to Applies knowledge of osmoregulation to different environmental contexts.

PO6: Personal and professional competence

All of the COs are indirectly mapped to PO6 because they require students to demonstrate the personal and professional skills that are essential for success in the field of zoology. For example, CO6 requires strong communication skills and the ability to explain complex concepts related to blood physiology to both scientific and non-scientific audiences.

PO7: Effective Citizenship and Ethics

All of the COs are indirectly mapped to PO7 because they require students to uphold the ethical standards in zoology. For example, CO2 may contribute to environmental awareness by understanding of extreme environments.

PO8: Environment and Sustainability

All of the COs are directly mapped to PO8 because they require students to be aware of the environmental changes and sustainability implications of their work. For example, CO4 requires students to focus on understanding of how environmental factors, like climate change, affecting animals and ecosystem dynamics.

PO9: Self-directed and Life-long learning

All of the COs are directly mapped to PO9 because they require students to develop the skills necessary for self-directed and lifelong learning. Cos provides understanding of the intricate mechanisms of energy metabolism, oxygen response, excretion, osmoregulation, blood physiology, and cardiac function in mammals lays the groundwork for independent research in these areas.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Genetics-II **Course Code: PSZO 241C**

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

Course Objectives:

- Apply principles of probability and statistics to solve problems in Mendelian and non-Mendelian genetics
- Analyze patterns of human inheritance through pedigree construction and interpretation, understanding autosomal, sex-linked, and mitochondrial inheritance patterns.
- Explain the complexities of human genetic inheritance, including non-penetrance, variable expressivity, pleiotropy, and other factors.
- Diagnose and understand the mechanisms of monogenic and multifactorial diseases, including cystic fibrosis, triplet repeat disorders, and various metabolic errors.
- Evaluate and compare different prenatal and pre-implantation diagnostic methods in genetic disease detection.
- Analyze the genetic basis of complex behaviours, exploring Rothen Buhler's bee experiment and the genetics of human behavioural traits like schizophrenia.
- Understand the genetic components of biological processes like circadian rhythms and neurodegenerative diseases like Alzheimer's.

Course Outcomes:

After completion of this course, students will-

CO1: calculate and interpret probability ratios to predict offspring genotypes or phenotypes in various genetic crosses.

CO2: construct and analyse a family pedigree to identify the mode of inheritance (autosomal, sex-linked, mitochondrial) for a specific trait.

CO3: explain how non-penetrance, variable expressivity, and pleiotropy can complicate the relationship between genotype and phenotype in human genetic disorders.

CO4: diagnose cystic fibrosis based on clinical symptoms and characteristic mutations in the CFTR gene, understanding the underlying molecular mechanisms.

CO5: critically evaluate the advantages and limitations of non-invasive (e.g., ultrasound) and invasive (e.g., amniocentesis) prenatal diagnostic methods for genetic diseases.

CO6: explain how hygienic behaviour in bees has a polygenic basis and can be influenced by environmental factors.

CO7: investigate the association between specific genes and circadian rhythm regulation, discussing the potential genetic contribution to Alzheimer's disease.

Course Articulation Matrix of PSZO 241C: Genetics-II

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

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

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts and practices in physiology. For example, CO1 requires students to have an in-depth understanding of complex biochemical pathways and regulatory mechanisms.

PO2: Critical Thinking and Problem Solving

All of the COs are directly mapped to PO2 because they require students to apply critical thinking and problem-solving skills. For example, CO2 requires students to analyse the and explains adaptations to different oxygen levels.

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 animals during emergence.

PO4: Research-related skills and Scientific temper

All of the COs are directly mapped to PO4 because they require students to apply the principles of scientific research to their work. For example, CO4 encourage students to observe, collect the data and analysis of emergence behaviour for research into animal physiology and behaviour.

PO5: Trans-disciplinary knowledge

All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems in the field of zoology. For example, CO4 requires students to Applies knowledge of osmoregulation to different environmental contexts.

PO6: Personal and professional competence

All of the COs are indirectly mapped to PO6 because they require students to demonstrate the personal and professional skills that are essential for success in the field of zoology. For example, CO6 requires strong communication skills and the ability to explain complex concepts related to blood physiology to both scientific and non-scientific audiences.

PO7: Effective Citizenship and Ethics

All of the COs are indirectly mapped to PO7 because they require students to uphold the ethical standards in zoology. For example, CO2 may contribute to environmental awareness by understanding of extreme environments.

PO8: Environment and Sustainability

All of the COs are directly mapped to PO8 because they require students to be aware of the environmental changes and sustainability implications of their work. For example, CO4 requires students to focus on understanding of how environmental factors, like climate change, affecting animals and ecosystem dynamics.

PO9: Self-directed and Life-long learning

All of the COs are directly mapped to PO9 because they require students to develop the skills necessary for self-directed and lifelong learning. Cos provides understanding of the intricate mechanisms of energy metabolism, oxygen response, excretion, osmoregulation, blood physiology, and cardiac function in mammals lays the groundwork for independent research in these areas.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Immunology and Parasitology **Course Code: PSZO 242**

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

Course Objectives:

- Define and explain fundamental immunological concepts like self-non-self, antigens, antibodies, and immune response, differentiating active and passive immunization.
- Distinguish between humoral and cell-mediated immunity, elucidating the role of T cell receptors in the latter.
- Analyse the immediate response to infection, including inflammation, cell migration, the acute phase response, and the role of interferon's and NK cells.
- Comprehend the structure and diverse types of antibodies, exploring the molecular basis of antibody synthesis and diversity.
- Explain the mechanisms of antigen-antibody reactions and complement fixation pathways, understanding their relevance in immune function.
- Analyse the role of HLA in disease association and immune deficiencies, exploring antigen processing and MHC interactions.
- Evaluate the principles and applications of immunological techniques like hybridoma technology, ELISA, and immunofluorescence for research and diagnostics.

Course Outcomes:

After completion of this course students will-

CO1: differentiate self from non-self-antigens, explain antibody structure and function, and contrast active and passive immunization strategies.

CO2: distinguish between humoral and cell-mediated immunity, and explain the role of T cell receptors in antigen recognition and activation in cell-mediated responses.

CO3: analyse the key components of the immediate inflammatory response, including cell migration, acute phase proteins, and the roles of interferon's and NK cells in early host defense.

CO4: describe the structure and functional diversity of immunoglobulins, and explain the molecular mechanisms of antibody gene rearrangement and antigen-specific selection.

CO5: elucidate the mechanisms of antigen-antibody binding and complement activation, and evaluate their roles in opsonisation, neutralization, and clearance of pathogens.

CO6: analyse the relationship between HLA polymorphism, antigen presentation, and disease susceptibility, and explain the impact of immune deficiencies on host defense.

CO7: critically evaluate the principles and applications of hybridoma technology, ELISA, and immunofluorescence techniques in immunological research and diagnostic procedures.

Course Articulation Matrix of PSZO 242: Immunology and Parasitology
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	1	1	2
CO2	2	2	2	1	2	2	3	1	2

CO3	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
CO4	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
CO5	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
CO6	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
CO7	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts Immunology. For example, CO1 requires students to have an in-depth understanding of self-Vs. non-self-antigens, antibody structure and function, and immunization strategies.

PO2: Critical Thinking and Problem Solving

All of the COs are directly mapped to PO2 because they require students to apply critical thinking and problem-solving skills. For example, CO7 requires students to critically evaluate the principles and applications of immunological research and diagnostic techniques.

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, CO6 requires students develops communication skills to educate others about impact of immune deficiencies on individuals and society.

PO4: Research-related skills and Scientific temper

All of the COs are directly mapped to PO4 because they require students to apply the principles of scientific research to their work. For example, CO4 encourage students to acquire knowledge of antibody gene rearrangement for research.

PO5: Trans-disciplinary knowledge

All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems in the field of immunology. For example, CO1 requires students to apply knowledge of molecular biology and biochemistry.

PO6: Personal and professional competence

All of the COs are indirectly mapped to PO6 because they require students to demonstrate the personal and professional skills that are essential for success in the field of zoology. For example, CO6 requires strong communication skills to explain the ethical implications of genetic testing in the context of HLA polymorphism and disease susceptibility.

PO7: Effective Citizenship and Ethics

COs are indirectly mapped to PO7 because they require students to uphold the ethical standards in immunology. For example, CO2 may contribute to educate others about impact of immune deficiencies on individuals and society.

PO8: Environment and Sustainability

All of the COs are not directly mapped to PO8. Some immunological concepts might be relevant to understanding environmental pollutants or emerging infectious diseases.

PO9: Self-directed and Life-long learning

All of the COs are directly mapped to PO9 because they require students to develop the skills necessary for self-directed and lifelong learning. Cos provides understanding of the intricate mechanisms in immunology and parasitology, lays the groundwork for independent research in these areas.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Pest Control and Toxicology **Course Code: PSZO 243**

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

Course Objectives

- Classify common pests and their associated damage, identifying appropriate control measures for different types.
- Distinguish between physical, chemical, and biological pest control methods, evaluating their advantages and limitations in various scenarios.
- Explain the principles and modes of action of insecticides, including factors influencing their effectiveness and proper application techniques.
- Analyze the concept of autocidal control methods like chemosterilants and pheromones, understanding their potential in pest management strategies.
- Identify and describe control methods for non-insect pests like rodents, molluscs, and birds, considering habitat modification and other integrated approaches.
- Apply basic toxicological principles to understand the interaction of Xenobiotics, including absorption, distribution, biotransformation, and excretion within an organism.
- Evaluate the toxicity of pesticides and heavy metals, analyzing their sources, adverse effects on human health and ecosystems, and risk assessment methods.

Course Outcomes

After completion of this course, students will-

CO1: implement Integrated Pest Management (IPM) strategies by classifying pests, assessing damage, and selecting appropriate control methods based on species and situation.

CO2: critically evaluate physical, chemical, and biological pest control methods, choosing the most sustainable and effective option for specific scenarios.

CO3: explain the mechanisms of action of different insecticide classes and apply practical knowledge for safe and effective pesticide application.

CO4: analyse the potential and limitations of autocidal control methods like chemosterilants and pheromones, evaluating their contribution to sustainable pest management.
CO5: develop comprehensive control strategies for non-insect pests like rodents, molluscs, and birds, encompassing habitat manipulation and integrated approaches.
CO6: trace the journey of Xenobiotics within an organism, explaining absorption, distribution, biotransformation, and excretion pathways.
CO7: assess the toxicological risks of pesticides and heavy metals, analysing their sources, health and environmental impacts, and employing risk assessment methods.

Topics:

UNIT	SUB UNIT	SYLLABUS	NO. OF LECTURES
1. Introduction of the pest control			6
	1.1	Types of pests, damage caused by pest and their control measures	
	1.2	Brief outline of medical and veterinary entomology	
2. Principles and methods of pest control			
	2.1	physical and chemical pest control	12
	2.2	Insecticides: Types and mode of action; formulations and dilutions.	
	2.3	Biological control measures: Biological agents, Advantages and Drawbacks of Biological control	
3. Autocidal control			06
	3.1	Chemosterilants, Kniplings model, Pheromonal and hormonal control, Concept of Integrated pest management	
4. Non- insect pest and their control: Rat, Bandicoots, Crabs, Snails, Slugs, Birds and Squirrels			02
5. Appliances/machines/devices used in pest control applications: Sprayers and Dusters, Hazards of Pesticides and Antidotes.			03
6. Basic Concept of Toxicology			03
	6.1	Introduction of toxicology, history of toxicology, concept of toxicology, poison, and toxicity; classification of toxicants.	
7. Xenobiotics			07
	7.1	Introduction, Important of Xenobiotics concerned to Human health, Adverse effects of Xenobiotics through Biomagnification and Biotransformation,	
	7.2	Mechanism of Xenobiotics Translocation, absorption of Xenobiotics, distribution of Xenobiotics, accumulation of Xenobiotics, biotransformation and excretion.	
8. Pesticides and Toxicity: Pesticides and their toxicological effects			04
9. Heavy Metals and Toxicity			10
	9.1	General principal of metal toxicity	

	9.2	Sources of toxic metals and their toxicity (Arsenic, Aluminium, Cadmium (Itai-Itai disaster), Chromium Lead, Mercury, Manganese, Zinc and Nickel.	
10. Evaluation of toxicity			7
	10.1	Acute sub-Acute and chronic assays LD50 and LC50	
	10.2	Concepts of Ecotoxicology, clinical toxicology, occupational and nanotoxicology.	
	10.3	Maintenance and general handling of animals for toxicological laboratory	

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Course Articulation Matrix of PSZO 243: Pest Control and Toxicology
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**	**2**	**1**	**1**	**2**
CO2	**3**	**3**	**1**	**1**	**1**	**2**	**1**	**2**	**2**
CO3	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
CO4	**3**	**3**	**1**	**1**	**2**	**1**	**1**	**2**	**2**
CO5	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**
CO6	**3**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**1**
CO7	**3**	**3**	**1**	**3**	**2**	**1**	**3**	**3**	**3**

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts Toxicology. For example, CO1, CO3, CO5, and CO7 directly involve understanding core concepts like pest classification, control methods, insecticide mechanisms, Xenobiotic pathways, and toxicological risks. Mastering these concepts is crucial for successful pest management and requires in-depth knowledge in the field.

PO2: Critical Thinking and Problem Solving

All of the COs are directly mapped to PO2 because they require students to apply critical thinking and problem-solving skills. For example, CO1, CO2, CO4, and CO5 require analysing specific situations, evaluating different control options, and choosing the most effective and sustainable approach. CO7 involves critical thinking to assess toxicological risks, analyze data, and employ risk assessment methods.

PO3: Social Competence

CO5 is indirectly mapped to PO3 because they require students to interact with others in a professional and effective manner. CO5 involves collaboration and communication with stakeholders, but these aspects are not directly assessed in the COs.

PO4: Research-related skills and Scientific temper

All of the COs are directly mapped to PO4 because they require students to apply the principles of scientific research to their work. For example, CO3, 6 and 7 requires students to understand insecticide mechanisms, Xenobiotic pathways, and toxicological risks might involve basic research methodologies and critical analysis, which are essential for scientific investigation in pest management.

PO5: Trans-disciplinary knowledge

All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems in the field of Toxicology. CO2, 5 and 7 requires students to evaluating pest control methods, developing strategies for non-insect pests, and assessing toxicological risks might involve considering factors from other disciplines like economics, sociology, ecology, or environmental science. Pest management often requires integrating knowledge from different fields to address complex problems.

PO6: Personal and professional competence

CO3 and 7 are directly mapped to PO6 because they promotes safe pesticide application and advocating for responsible pesticide use promote professional responsibility and ethical awareness, respectively.
These COs emphasize the importance of ethical and responsible practices in pest management.

PO7: Effective Citizenship and Ethics

COs are directly mapped to PO7 because they require students to uphold the ethical standards in toxicology. For example, CO5 and 7 contributes to development of environmentally friendly control strategies and communicating toxicological risks to the public contribute to environmental stewardship and ethical considerations. Pest management has significant implications for environmental protection and public health, requiring responsible citizenship and ethical decision-making.

PO8: Environment and Sustainability

All of the COs are directly mapped to PO8. For example, CO2, 4, 5 and 7 promotes selection of sustainable methods, exploring autocidal alternatives, promoting integrated control, and mitigating toxicological risks are all crucial for environmental protection and sustainable pest management.
These COs directly address the environmental impact of pest control practices.

PO9: Self-directed and Life-long learning

All of the COs are directly mapped to PO9 because they require students to develop the skills necessary for self-directed and lifelong learning. Learning pest management principles, critically evaluating methods, and staying updated on new technologies can foster self-directed and lifelong learning skills.
The entire course fosters curiosity and a desire to learn more about this dynamic field.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Environmental Biology, Animal Systematics and Diversity

Course Code: PSZO 244

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

Course Objectives:-

- Analyze the fundamental aspects of ecosystems, including energy flow, biogeochemical cycles, food webs, and factors influencing their stability.
- Describe the role of microorganisms in environmental processes, their interactions with other organisms, and their potential applications in various fields.
- Characterize major biomes across the globe, identify key biotic elements within each, and assess the impact of human activities on natural environments.
- Evaluate the significance of India's unique biogeographically history and understand the influence of climate on its diverse flora and fauna.
- Explain the principles of population and community ecology, focusing on interspecific interactions, population dynamics, and ecological niches.
- Analyze the ecological status and conservation challenges of Indian wetlands, forests, and semi-arid habitats, emphasizing management strategies and community involvement.
- Apply the basic principles of taxonomy to classify organisms, understand different species concepts, and utilize various methodologies like DNA barcoding for systematic analysis.

Course Outcomes:-

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

CO1: predict the consequences of environmental disturbance on ecosystem stability by analysing energy flow, nutrient cycling, and interspecies interactions.

CO2: evaluate the potential of microorganisms as bioremediation agents, disease control agents, and sustainable industrial partners, understanding their ecological roles and interactions.

CO3: compare and contrast the dominant flora and fauna in different biomes, critically assessing the impact of human activities on global biodiversity patterns.
CO4: explain the evolution of India's unique biotic communities through its biogeographically history, linking climate patterns to specific flora and fauna distributions.
CO5: predict population growth trends and community composition shifts based on interspecific competition, predator-prey dynamics, and niche competition principles.
CO6: develop sustainable management strategies for Indian wetlands, forests, and semi-arid habitats by analysing current ecological challenges, considering community participation and conservation methods.
CO7: classify organisms effectively using taxonomic keys, apply different species concepts in real-world scenarios, and utilize molecular methodologies like DNA barcoding for species identification and phylogenetic analysis.

Topics:

UNIT	SUB UNIT	SYLLABUS	NO. OF LECTURES
1. Introduction to ecosystems			6
	1.1	Fundamentals of Ecology and Ecosystems	
	1.2	Energy flow and nutritional flux in ecosystems.	
	1.3	Development and Evolution of the ecosystems.	
	1.4	Biogeochemical cycles, Food-chains, ecotone, edge effects, ecological niche, and ecosystem stability	
2. Environmental Microbiology			2
	2.1	Microbes - classification and their applications in the environmental sciences.	
	2.2	Cultivation and growth of microorganisms.	
	2.3	Microorganisms and their association with man, animals and plants.	
	2.4	Microbes as anti-microbial agents.	
3. Biomes and Habitat Diversity:			2
	3.1	Classification of biomes	
	3.2	Major biotic elements of each biome and their characteristics	
	3.3	Human impact on the natural environment.	
4. Biological diversity in India			4
	4.1	India's biogeographically history and diversity of flora and fauna	
	4.2	Climate and its impact on biodiversity.	
5. Population and Community Ecology			3
6. Wetlands Forests and Semi-arid Habitats of India			5
	6.1	Definition and types of wetlands	
	6.2	Important wetlands of India and their conservation issues	
	6.3	Forests, semi-arid habitats their distribution in India	

	6.4	Ecological status of forests and arid lands, and their conservation.	
7. Wildlife management and conservation			8
	7.1	Goals and strategies for of management	
	7.2	Factors influencing wildlife management	
	7.3	Tools for data collection and analysis.	
	7.4	Important projects for the conservation of wildlife in India	
	7.5	Role of local communities in wildlife management.	
	7.6	Categories of IUCN Red data book, Overview of extinct species of India	
8. Fundamental of Systematics			09
	8.1	Biological classification	
	8.2	Hierarchy of categories and higher taxa	
	8.3	Taxonomic characters – procedures and keys	
	8.4	Species concepts: varieties, subspecies, sibling species and race.	
9. Kingdoms of Life			3
	9.1	General outline of kingdoms including Monera & Protista	
	9.2	Broad outline & Diversity in kingdom Animalia	
10. Methodologies in Systematics			10
	10.1	Morphology based and numerical taxonomy	
	10.2	Cyto-taxonomy and chemotaxonomy	
	10.3	Molecular Systematics: DNA barcoding & Molecular markers for detection/evaluation of polymorphism-RFLP, RAPD etc.	
	10.4	Molecular phylogenetics and phylogeography.	
11. Taxonomic keys			05
	11.1	Types of taxonomic keys, their merits and demerits	
	11.2	International code of Zoological nomenclature.	
12. Taxonomic procedures: Taxonomic collection preservation, curetting process and identification.			03

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Course Articulation Matrix of PSZO 244: 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	3	1	1	1	1	1	2	2
CO2	3	2	1	1	2	1	1	2	2
CO3	3	2	1	1	1	1	2	3	2
CO4	3	2	1	1	2	1	1	2	2
CO5	3	3	1	1	1	1	1	2	2
CO6	3	3	2	2	2	3	3	3	3
CO7	3	2	1	2	1	1	1	1	2

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts Toxicology. For example, CO1 directly involves understanding of energy flow, nutrient cycling, and interspecies interactions are core concepts in ecology.

PO2: Critical Thinking and Problem Solving

All of the COs are directly mapped to PO2 because they require students to apply critical thinking and problem-solving skills. For example, CO2 requires evaluation of the potential of microorganisms, involves critical analysis of their ecological roles and limitations for various applications.

PO3: Social Competence

COs are indirectly mapped to PO3, but understanding human impacts on biodiversity might involve raising awareness or advocacy. Collaboration and communication with communities are crucial for developing and implementing sustainable management strategies.

PO4: Research-related skills and Scientific temper

All of the COs are directly mapped to PO4 because they develops research skills might be required for data collection and analysis related to environmental disturbances and developing sustainable management strategies.

PO5: Trans-disciplinary knowledge

All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems in the field of Ecology. For example, knowledge from agriculture, biotechnology, or medicine is relevant for understanding the potential applications of microorganisms.

PO6: Personal and professional competence

CO6 is directly mapped to PO6 because it promotes developing sustainable management strategies involves professional responsibility and consideration of environmental ethics. This CO encourages responsible resource management and stakeholder engagement, demonstrating professional competence.

PO7: Effective Citizenship and Ethics

COs are directly mapped to PO7 because they require students to uphold the ethical standards in toxicology. For example, CO3 contributes to critical assessment of impact of human activities on

biodiversity promotes environmental awareness and responsible citizenship. This CO encourages students to think about the consequences of their actions and advocate for sustainable practices.

PO8: Environment and Sustainability

All of the COs are directly mapped to PO8. For example, CO3 promotes critically assessment of impact of human activities on biodiversity and promoting conservation aligns with environmental sustainability goals. This CO encourages responsible resource management and ecosystem protection.

PO9: Self-directed and Life-long learning

All of the COs are directly mapped to PO9 because they require students to develop the skills necessary for self-directed and lifelong learning. Adapting and refining sustainable management strategies based on on-going research and changing environmental challenges demonstrates self-directed learning and critical thinking in response to new situations. Continuously learning about biogeographical history and its link to ecological patterns promotes self-directed learning and exploring new connections within the field.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Zoology Practical-VII (Practicals Corresponding to: PSZO 241A, PSZO 242, PSZO 244)

Course Code: PSZO 245A

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

Course Objectives:-

- To gain practical experience in the study of insect morphology, development, and taxonomy.
- To develop the skills necessary to dissect and mount insect specimens.
- To develop the skills necessary to perform a variety of immunological techniques, including Ouchterlony agar gel diffusion, ELISA, and dot immunobinding assay.
- To gain practical experience in the study of the morphology and life cycles of medically important ticks, mosquitoes, flies, protozoa, and helminths.
- To develop the skills necessary to collect, identify, and quantify plankton from freshwater samples.
- To study museum specimens and methods of collecting, preserving, and curating insect specimens.
- Evaluate the physical, chemical, and biological attributes of aquatic and terrestrial ecosystems using field and laboratory techniques to assess their health and ecological balance.

Course Outcomes:-

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

CO1: precisely identify and classify insect species based on morphological features and taxonomic keys, recognizing agricultural pests and applying control strategies.

CO2: expertly dissect and prepare temporary mounts of insect organs for detailed morphological analysis.

CO3: skilfully apply Ouchterlony, ELISA, and dot immunobinding assays to detect immune responses, diagnose infections, and analyze blood compatibility.

CO4: diagnose and understand the life cycles, roles as vectors, and control measures of medically important arthropods and parasitic protozoa and helminths.

CO5: effectively collect, identify, and quantify plankton organisms to assess the health and diversity of freshwater ecosystems.

CO6: master the collection, preservation, and curetting techniques for insect specimens, enabling proper museum specimen preparation and curation.

CO7: integrate knowledge of physical, chemical, and biological parameters to accurately assess the health and ecological balance of aquatic and terrestrial ecosystems.

Section I –PSZO 241 A: Entomology-II			
Sr. No.	**Title of the Practical**	**E/D**	**Practical weightage**
1	Study of different types of insect eggs.	D	1P
2	Study of post embryonic development of insects: Collection and study of types of larvae, pupae, Nymph (Aquatic and Terrestrial).	E	1P
3	Dissections of House fly: a) Digestive system and nervous system b) Male and female reproductive system c) Temporary mountings of antenna, halters, legs and ovipositor.	E	3P
4	Morphological and taxonomic study of agricultural pest imp (any 10).	D	2P
5	Study of insect repellents and attractants	D	1P
Section II –PSZO 242: Immunology and Parasitology			
1	Ouchterlony technique of agar gel diffusion	E	2P
2	Histology of Lymphoid organ- Skin, Spleen, Thymus, Ilium, Lymph node, Bone marrow	D	2P
3	Preparation of blood smear to observe blood cells	E	1P
4	Blood group analysis with reference to cross matching	E	1P
5	To perform ELISA	E	2P
6	Dot immunobinding assay to detect antibodies in the serum	E	2P
7	Study of life cycle, role as vector & control measures of: Ticks(*Argas*, *Boophilus*) Mosquito - anyone from- *Anopheles/ Aedes/ Culex* Any two flies: *Tabanus/ Phlebotomus/ Sarcophaga.*	D	2P
8	Study of life cycle of parasitic protozoa: *Trypanosoma* and *Leishmania*	D	1P
9	Study of life cycle of helminth parasites: *Schistosoma*, *Echinococcus*, *Ancylostoma* and *Dracunculus*.	D	2P
10	Study of Parasites from digestive tract of Cockroach /gut parasites of hen	E	1P
Section III –PSZO 244: Environmental Biology and Animal Systematics & Diversity			
1	A visit to aquatic ecosystem and methods for water and plankton collection	E	1P
2	Plankton identification and quantification from river / lake water samples.	E	1P
3	Water analysis for physico-chemical characteristics.	E	2P
4	Physico-chemical analysis of soil.	E	1P
5	Study of museum specimens and slides (invertebrates, one example from each phyla)	D	1P
6	Study of museum specimens (protochordates and chordates, one	D	1P

	example from each phyla)		
7	Method of collection, preservation, and curetting of any insect specimen	E	2P
8	Visits to scientific institute like Zoological Survey of India and report writing		1P
E*-Experimental D*- Demonstration			

Course Articulation Matrix of PSZO 245 A: Zoology Practical-VII (Practicals Corresponding to: PSZO 241A, PSZO 242, PSZO 244)

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	2
CO2	3	2	1	1	1	1	1	1	1
CO3	3	2	1	2	2	2	1	1	2
CO4	3	2	1	2	2	3	3	3	2
CO5	3	2	1	2	1	1	1	1	1
CO6	3	1	1	1	1	1	1	1	1
CO7	3	3	1	3	3	2	3	3	3

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts Toxicology. For example, CO1 directly involves precise identification and classification of insects requires in-depth knowledge of morphology, taxonomy, and agricultural pests.

PO2: Critical Thinking and Problem Solving

All of the COs are directly mapped to PO2 because they require students to apply critical thinking and problem-solving skills. For example, CO4 involves diagnosing complex life cycles, transmission pathways, and designing control measures for vector-borne diseases require critical thinking and problem-solving skills.

PO3: Social Competence

COs are indirectly mapped to PO3, but applying immunological assays might involve collaboration in research setting.

PO4: Research-related skills and Scientific temper

All of the COs are directly mapped to PO4 because they develops research skills. For example, CO5, involves collecting plankton and assessing diversity requires research skills for data collection, analysis, and interpretation of ecological relationships.

PO5: Trans-disciplinary knowledge

All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems. For example CO3, applying immunological assays might involve basic knowledge of biochemistry and immunology concepts.

PO6: Personal and professional competence

CO4 is directly mapped to PO6 because diagnosing diseases and implementing control measures can contribute to professional responsibility and ethical implications for public health..

PO7: Effective Citizenship and Ethics

COs are directly mapped to PO7 because they require students to uphold the ethical standards in toxicology. For example, CO4 directly contributes to public health and environmental citizenship by understanding of controlling and prevention of vector-borne diseases.

PO8: Environment and Sustainability

All of the COs are directly mapped to PO8. For example, CO7 involves the Assessing and maintaining ecosystem health directly contributes to environmental sustainability and conservation efforts. CO4 contributes to environmental sustainability by understanding of controlling and prevention of vector-borne diseases that impact ecosystems and wildlife.

PO9: Self-directed and Life-long learning

All of the COs are directly mapped to PO9 because they require students to develop the skills necessary for self-directed and lifelong learning. Adapting immunological assays based on new technologies and research requires self-directed learning and staying abreast of advancements in the field. Adapting ecosystem assessment methods and interpreting new data requires self-directed learning and critical thinking about evolving environmental challenges.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Zoology Practical-VII (Practicals Corresponding to: PSZO 241B, PSZO 242, PSZO 244)

Course Code: PSZO 245B

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

Course Objectives:-

- To gain practical experience in the study of physiological processes.
- To develop the skills necessary to perform a variety of biochemical assays.
- To develop the skills necessary to perform a variety of immunological techniques, including Ouchterlony agar gel diffusion, ELISA, and dot immunobinding assay.
- To gain practical experience in the study of the morphology and life cycles of medically important ticks, mosquitoes, flies, protozoa, and helminths.
- To develop the skills necessary to collect, identify, and quantify plankton from freshwater samples.
- To study museum specimens and methods of collecting, preserving, and curating insect specimens.
- Evaluate the physical, chemical, and biological attributes of aquatic and terrestrial ecosystems using field and laboratory techniques to assess their health and ecological balance.

Course Outcomes:-

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

CO1: demonstrate a hands-on understanding of physiological processes through experimentation and data analysis, explaining their underlying mechanisms.

CO2: master and interpret various biochemical assays with precision, drawing accurate conclusions from the results.

CO3: expertly execute immunological techniques like Ouchterlony, ELISA, and dot immunobinding assays for research and diagnostic applications.

CO4: confidently identify and differentiate medically important arthropods, protozoa, and helminths based on morphology, life cycles, and public health significance.

CO5: collect, identify, and quantify plankton diversity in freshwater samples, accurately assessing ecosystem health and dynamics.

CO6: proficiently utilize museum specimens and insect collection/preservation techniques to classify and compare invertebrates and vertebrates across phyla.

CO7: integrate knowledge of physical, chemical, and biological parameters to accurately assess the health and ecological balance of aquatic and terrestrial ecosystems.

Section I –PSZO 241 B: Animal Physiology-II			
Sr. No.	**Title of the Practical**	**E/D**	**Practical weightage**
1	Study of Osmotic stress and volume change in erythrocytes	E	1P
2	Detection of allantoin in mammalian urine	E	1P
3	Determination of Glomerular filtration rate by creatinine clearance	E	1P
4	To study the normal & abnormal constituents of human urine	E	2P
5	Estimation of alkaline & acid phosphatases in blood	E	1P
6	Study of invertebrate (earthworm and crab) heart	E	1P
7	Determination of bleeding time and clotting time in man	E	1P
8	Effect of exercise on breathing rate, pulse rate and blood lactate of man	E	1P
9	Study of glycerinated muscles fibers	E	1P
Section II –PSZO 242: Immunology and Parasitology			
1	Ouchterlony technique of agar gel diffusion	E	2P
2	Histology of Lymphoid organ- Skin, Spleen, Thymus, Ilium, Lymph node, Bone marrow	D	2P
3	Preparation of blood smear to observe blood cells	E	1P
4	Blood group analysis with reference to cross matching	E	1P
5	To perform ELISA	E	2P
6	Dot immunobinding assay to detect antibodies in the serum	E	2P
7	Study of life cycle, role as vector & control measures of: Ticks(*Argas*, *Boophilus*) Mosquito - anyone from- *Anopheles/ Aedes/ Culex* Any two flies: *Tabanus/ Phlebotomus/ Sarcophaga.*	D	2P
8	Study of life cycle of parasitic protozoa: *Trypanosoma* and *Leishmania*	D	1P
9	Study of life cycle of helminth parasites: *Schistosoma*, *Echinococcus*, *Ancylostoma* and *Dracunculus*.	D	2P
10	Study of Parasites from digestive tract of Cockroach /gut parasites of hen	E	1P
Section III –PSZO 244: Environmental Biology and Animal Systematics & Diversity			
1	A visit to aquatic ecosystem and methods for water and plankton collection	E	1P
2	Plankton identification and quantification from river / lake water samples.	E	1P
3	Water analysis for physico-chemical characteristics.	E	2P
4	Physico-chemical analysis of soil.	E	1P
5	Study of museum specimens and slides (invertebrates, one example from each phyla)	D	1P

6	Study of museum specimens (protochordates and chordates, one example from each phyla)	D	1P
7	Method of collection, preservation, and curetting of any insect specimen	E	2P
8	Visits to scientific institute like Zoological Survey of India and report writing		1P
E*-Experimental D*- Demonstration			

Course Articulation Matrix of PSZO 245 B: Zoology Practical-VII (Practicals Corresponding to: PSZO 241B, PSZO 242, PSZO 244)

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	2
CO2	3	2	1	1	1	1	1	1	1
CO3	3	2	1	2	2	2	1	1	2
CO4	3	2	1	2	2	3	3	3	2
CO5	3	2	1	2	1	1	1	1	1
CO6	3	1	1	1	1	1	1	1	1
CO7	3	3	1	3	3	2	3	3	3

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts physiology. For example, CO1 directly involves in-depth knowledge of biochemical pathways and analytical techniques..

PO2: Critical Thinking and Problem Solving

All of the COs are directly mapped to PO2 because they require students to apply critical thinking and problem-solving skills. For example, CO4 involves diagnosing complex life cycles, transmission pathways, and designing control measures for vector-borne diseases require critical thinking and problem-solving skills.

PO3: Social Competence

COs are indirectly mapped to PO3, but applying immunological assays might involve collaboration in research setting.

PO4: Research-related skills and Scientific temper

All of the COs are directly mapped to PO4 because they develops research skills. For example, CO5, involves collecting plankton and assessing diversity requires research skills for data collection, analysis, and interpretation of ecological relationships.

PO5: Trans-disciplinary knowledge

All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems. For example CO3, applying immunological assays might involve basic knowledge of biochemistry and immunology concepts.

PO6: Personal and professional competence

CO4 is directly mapped to PO6 because diagnosing diseases and implementing control measures can contribute to professional responsibility and ethical implications for public health..

PO7: Effective Citizenship and Ethics

COs are directly mapped to PO7 because they require students to uphold the ethical standards in toxicology. For example, CO4 directly contributes to public health and environmental citizenship by understanding of controlling and prevention of vector-borne diseases.

PO8: Environment and Sustainability

All of the COs are directly mapped to PO8. For example, CO7 involves the Assessing and maintaining ecosystem health directly contributes to environmental sustainability and conservation efforts. CO4 contributes to environmental sustainability by understanding of controlling and prevention of vector-borne diseases that impact ecosystems and wildlife.

PO9: Self-directed and Life-long learning

All of the COs are directly mapped to PO9 because they require students to develop the skills necessary for self-directed and lifelong learning. Adapting immunological assays based on new technologies and research requires self-directed learning and staying abreast of advancements in the field. Adapting ecosystem assessment methods and interpreting new data requires self-directed learning and critical thinking about evolving environmental challenges.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Zoology Practical-VII (Practicals Corresponding to: PSZO 241C, PSZO 242, PSZO 244)

Course Code: PSZO 245C

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

Course Objectives:-

- To develop the skills necessary to construct, analyze, and interpret human pedigrees for autosomal dominant, autosomal recessive, sex-linked dominant and sex-linked recessive traits.
- To develop the practical skills necessary to conduct genetic research in areas such as cytogenetic, biochemistry, molecular biology, and developmental biology.
- To develop the skills necessary to perform a variety of immunological techniques, including Ouchterlony agar gel diffusion, ELISA, and dot immunobinding assay.
- To gain practical experience in the study of the morphology and life cycles of medically important ticks, mosquitoes, flies, protozoa, and helminths.
- To develop the skills necessary to collect, identify, and quantify plankton from freshwater samples.
- To study museum specimens and methods of collecting, preserving, and curating insect specimens.
- Evaluate the physical, chemical, and biological attributes of aquatic and terrestrial ecosystems using field and laboratory techniques to assess their health and ecological balance.

Course Outcomes:-

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

CO1: construct, analyse, and interpret human pedigrees for autosomal dominant, autosomal recessive, sex-linked dominant, and sex-linked recessive traits.

CO2: develop the practical skills necessary to conduct genetic research in areas such as cytogenetic, biochemistry, molecular biology, and developmental biology.
CO3: expertly execute immunological techniques like Ouchterlony, ELISA, and dot immunobinding assays for research and diagnostic applications.
CO4: confidently identify and differentiate medically important arthropods, protozoa, and helminths based on morphology, life cycles, and public health significance.
CO5: collect, identify, and quantify plankton diversity in freshwater samples, accurately assessing ecosystem health and dynamics.
CO6: proficiently utilize museum specimens and insect collection/preservation techniques to classify and compare invertebrates and vertebrates across phyla.
CO7: integrate knowledge of physical, chemical, and biological parameters to accurately assess the health and ecological balance of aquatic and terrestrial ecosystems.

Section I –PSZO 241C: Genetics-II			
Sr. No.	**Title of the Practical**	**E/D**	**Practical weightage**
1	Methodology for constructing Human Pedigree	D	1P
2	Analysis and construction of typical pedigrees for autosomal dominant and recessive genes, sex linked dominant and recessive genes.	D	2P
3	Preparation of metaphase chromosomal spreads of one vertebrate.	E	2P
4	Enzyme polymorphism in natural population.	E	1P
5	Visit to a medical genetics laboratory for cytogenetic, biochemical and other studies		1P
6	G- banding on mouse metaphase spread	E	2P
7	In-silico design of PCR primers for a gene of interest.	D	1P
8	C banding on mouse metaphase chromosomes.	E	2P
10	Study of maternal effect mutants for genes- Bicoid and Nanos.	E	2P
11	Chromatography of Drosophila eye colour pigment	E	1P
12	To Study effect of mitogen induction on lymphocytes	E	1P
13	Concept of genetic disorder databases and demonstration of use of OMIM	D	1P
14	Dissection and Mounting of Imaginal Discs of *Drosophila*	E	1P
15	Visualization of Nucleolus in the larval salivary gland polytene nuclei in *Drosophila* melanogaster using light microscopy	E	1P
Section II –PSZO 242: Immunology and Parasitology			
1	Ouchterlony technique of agar gel diffusion	E	2P
2	Histology of Lymphoid organ- Skin, Spleen, Thymus, Ilium, Lymph node, Bone marrow	D	2P
3	Preparation of blood smear to observe blood cells	E	1P
4	Blood group analysis with reference to cross matching	E	1P
5	To perform ELISA	E	2P
6	Dot immunobinding assay to detect antibodies in the serum	E	2P
7	Study of life cycle, role as vector & control measures of: Ticks(*Argas*, *Boophilus*) Mosquito - anyone from- *Anopheles/ Aedes/ Culex* Any two flies: *Tabanus/ Phlebotomus/ Sarcophaga.*	D	2P
8	Study of life cycle of parasitic protozoa: *Trypanosoma* and *Leishmania*	D	1P
9	Study of life cycle of helminth parasites: *Schistosoma*,	D	2P

	Echinococcus, *Ancylostoma* and *Dracunculus*.		
10	Study of Parasites from digestive tract of Cockroach /gut parasites of hen	E	1P
Section III –PSZO 244: Environmental Biology and Animal Systematics & Diversity			
1	A visit to aquatic ecosystem and methods for water and plankton collection	E	1P
2	Plankton identification and quantification from river / lake water samples.	E	1P
3	Water analysis for physico-chemical characteristics.	E	2P
4	Physico-chemical analysis of soil.	E	1P
5	Study of museum specimens and slides (invertebrates, one example from each phyla)	D	1P
6	Study of museum specimens (protochordates and chordates, one example from each phyla)	D	1P
7	Method of collection, preservation, and curetting of any insect specimen	E	2P
8	Visits to scientific institute like Zoological Survey of India and report writing		1P
E*-Experimental D*- Demonstration			

While conducting practicals, guidelines of UGC on use of experimental animal will be strictly followed.

Course Articulation Matrix of PSZO 245 C: Zoology Practical-VII (Practicals Corresponding to: PSZO 241C, PSZO 242, PSZO 244)

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	2
CO2	3	2	1	1	1	1	1	1	1
CO3	3	2	1	2	2	2	1	1	2
CO4	3	2	1	2	2	3	3	3	2
CO5	3	2	1	2	1	1	1	1	1
CO6	3	1	1	1	1	1	1	1	1
CO7	3	3	1	3	3	2	3	3	3

PO1: Disciplinary Knowledge

All of the COs are directly mapped to PO1 because they require students to have strong understanding of key concepts physiology. For example, CO1 requires in-depth knowledge of genetics principles and human biology for constructing, analysing, and interpreting human pedigrees for various inheritance patterns.

PO2: Critical Thinking and Problem Solving

All of the COs are directly mapped to PO2 because they require students to apply critical thinking and problem-solving skills. For example, CO4 involves diagnosing complex life cycles, transmission pathways, and designing control measures for vector-borne diseases require critical thinking and problem-solving skills.

PO3: Social Competence

COs are indirectly mapped to PO3, but applying immunological assays might involve collaboration in research setting.

PO4: Research-related skills and Scientific temper

All of the COs are directly mapped to PO4 because they develops research skills. For example, CO5, involves collecting plankton and assessing diversity requires research skills for data collection, analysis, and interpretation of ecological relationships.

PO5: Trans-disciplinary knowledge

All of the COs are directly mapped to PO5 because they require students to apply knowledge from different disciplines to solve problems. For example CO3, applying immunological assays might involve basic knowledge of biochemistry and immunology concepts.

PO6: Personal and professional competence

CO4 is directly mapped to PO6 because diagnosing diseases and implementing control measures can contribute to professional responsibility and ethical implications for public health..

PO7: Effective Citizenship and Ethics

COs are directly mapped to PO7 because they require students to uphold the ethical standards in toxicology. For example, CO4 directly contributes to public health and environmental citizenship by understanding of controlling and prevention of vector-borne diseases.

PO8: Environment and Sustainability

All of the COs are directly mapped to PO8. For example, CO7 involves the Assessing and maintaining ecosystem health directly contributes to environmental sustainability and conservation efforts. CO4 contributes to environmental sustainability by understanding of controlling and prevention of vector-borne diseases that impact ecosystems and wildlife.

PO9: Self-directed and Life-long learning

All of the COs are directly mapped to PO9 because they require students to develop the skills necessary for self-directed and lifelong learning. Adapting immunological assays based on new technologies and research requires self-directed learning and staying abreast of advancements in the field. Adapting ecosystem assessment methods and interpreting new data requires self-directed learning and critical thinking about evolving environmental challenges.

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

Name of the Program: M.Sc. Zoology **Program Code: PSZO**

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

Course Name: Research Project **Course Code: PSZO 246**

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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