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

Principal
Tuljaram Chaturchand College
Baramati

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TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE & COMMERCE, BARAMATI.
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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	Zoology Practical-VII (Practicals Corresponding to : PSZO 241A , PSZO 242, PSZO 244)	4	I / E	40 + 60
6	PSZO 245B		Zoology Practical-VII (Practicals Corresponding to : PSZO 241B , PSZO 242, PSZO 244)	4	I / E	40 + 60
7	PSZO 245C		Zoology Practical-VII (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-41		Skill Development	2	-	-

IA* - Internal Assessment

EA*- External Assessment

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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.

UNIT	SUB UNIT	SYLLABUS	NO. OF LECTURES
1. Gametogenesis:			
	1.1	Spermatogenesis,	**08**
	1.2	Oogenesis,	
	1.3	Seminal transfer,	
	1.4	Fertilization and Oviposition.	
2. Early embryonic development in Insects			
	2.1	Cleavage and Blastoderm formation,	**22**
	2.2	Germ band formation	
	2.3	Gastrulation	
	2.4	Blastokinesis and differentiation of germ layers	
	2.5	Segmentation, appendages formation and organogenesis in brief.	
3. Post embryonic development in Insects			
	3.1	Developmental stages: Larva, nymph and pupa	**20**
	3.2	Emergence of adult from the pupa/cocoon	
	3.3	Metamorphosis in insects	

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	3.4	Growth in insects	
4. Hadorn's experiments			
	4.1	Experiments with imaginal disc	**05**
	4.2	Regeneration and Aging in insects	
5. Diapause			**05**
	5.1	Occurrence,	
	5.2	Initiation and Preparations for diapauses,	
	5.3	Diapause development and Controls.	

REFERENCES

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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.

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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.

Topics:

UNIT	SUBUNIT	SYLLABUS	NO. OF LECTURES
1. **Energy metabolism**			14
	1.1	Metabolic rate	
	1.2	Energy storage: Fat and glycogen	
	1.3	Effect of O2 concentration: acclimation to low O2 level, anaerobic metabolism, lactic acid and glycolysis	
	1.4	Problem of diving and deep sea hydro thermal vent	
	1.5	Metabolic rate and body size: mammals, birds, marsupials & monotremes	
	1.6	Energy cost of locomotion: running, swimming, flying	

	1.7	Effect of high altitude.	
2. Excretion			08
	2.1	Nitrogenous waste- ammonia and its excretion, urea, urea cycle, uric acid and its excretion, products of nucleoprotein metabolism, miscellaneous end product of nitrogen metabolism	
	2.2	Organ of excretion and urine formation	
	2.3	Renal regulation and acid –base balance	
3**. Osmoregulation: Maintaining water and electrolyte balance and its regulation in-**			07
	3.1	Fresh water: Invertebrates & vertebrates	
	3.2	Terrestrial: Moist skinned animals, arthropods & vertebrates and	
	3.3	Marine: Invertebrates & vertebrates & air breathing vertebrates	
4. Blood and blood vessels			10
	4.1	Blood composition and function, Haematopoiesis	
	4.2	Blood clotting and it's molecular mechanism	
	4.3	Blood vessels and blood pressure: Blood vessel types, Arteries, role as pressure reservoir and arterial pressure: Arteriole: role in distribution in cardiac output and maintenance of arterial blood pressure, Capillaries and its functions, veins: its role as blood reservoir and venous return	
	4.4	Blood pressure-Hypertension and Hypotension	
5. Cardiac Physiology			09
	5.1	Anatomy of heart	
	5.2	Electrical activity of the heart pace makers, spread of cardiac coupling, action potential of cardiac cells	
	5.3	Electrocardiography	
	5.4	Mechanism events of cardiac cycle, Heart sound	
	5.5	Neuronal and Hormonal control of heart	
	5.6	Cardiovascular response of exercise	
6. Neuronal Physiology			06
	6.1	Nerve cells : Structure & Function	
	6.2	Excitation and conduction of nerve fiber: Resting membrane potential, Action potential, all or none law, electronic potential, saltatory conduction	
	6.3	Ionic basis of excitation and conduction	
	6.4	Neurotransmitter types and receptors: Metabolism of neurotransmitters, Neuropeptides	
	6.5	Synapse and Neuronal integration	
	6.6	Impact of drugs and disease on synaptic transmission	
7. Sensory Physiology			06
	7.1	Receptor types, receptor potential and receptor adaptation	
	7.2	Eye-structure and physiology of vision	
	7.3	Ear-Hearing and equilibrium, sound waves and it's characters, structure of ear and physiology of hearing and equilibrium	
	7.4	Chemical senses : Taste and smell	

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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.

Topics:

UNIT	SUB UNIT	SYLLABUS	NO. OF LECTURES
1. Solving problems (Numerical Probability estimation) of Mendelian and non-Mendelian genetics.			**03**
2. Basic Human Genetics	2.1.	History of Human Genetics	
	2.2.	Pedigree- Gathering Family history, pedigree symbols, construction of pedigrees, Autosomal inheritance- Dominant & Recessive, Monogenic traits (Sex Linked inheritance, Sex	**18**

		Limited & Sex-influenced traits, mitochondrial traits), MIM (Mendelian Inheritance in Man) number	
	2.3	Complications to the basic pedigree patterns- non penetrance, variable expressivity, pleiotropy, late onset, dominance problems, genetic heterogeneity, genomic imprinting & uniparental disomy, mosaicism & chimerism, X- inactivation	
3. Clinical Genetics	**3.1**	**Monogenic diseases** (Cystic Fibrosis)	**18**
	3.2	**Triplet repeat based disorders (any one)**	
	3.3	**Inborn metabolic errors (any two for each type)**	
		3.3.1. Disorders of carbohydrate metabolism	
		3.3.2. Disorders of nucleic acid metabolism	
		3.3.3. Disorders of lipid metabolism	
		3.3.4. Lysosomal storage disorders	
		3.3.5. Peroxisomal disorders	
	3.4	**Disorders of Hematopoietic systems**	
		3.4.1. Over view of blood cell types & haemoglobin	
		3.4.2. Sickle cell anemia	
		3.4.3. Thalassemia	
	3.5	**Prenatal and pre-implantation diagnosis**	
		3.5.1Non- invasive methods	
		3.5.2. Invasive methods	
4. Physical mapping methods	**4.1**	Restriction maps, STS map, DNA sequence map.	**04**
5. Immunogenetics	**5.1**	Genetic basis of antibody diversity.	**05**
	5.2	Regeneration of TCR diversity	
	5.3	HLA polymorphism and disease association.	
6.Behavioural Genetics	**6.1**	Rothen Buhler's experiment on genetics of Bee behaviour (hygienic and unhygienic Trait).	**05**
	6.2	**Genetics of human behavioural defects- Schizophrenia.**	
7. Neurogenetics	**7.1**	Circadian rhythms	**03**
	7.2	Psychopathology- Alzheimer's disease	
8.*Drosophila* genetics	**8.1**	History of Drosophila genetics.	**04**
	8.2	Genetic basis of Sex determination and dosage compensation in Drosophila.	

REFERENCES

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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.

Topics:

UNIT	SUB UNIT	SYLLABUS	NO. OF LECTURES
1. Immune System			3
	1.1	Introduction to Immunology	

	1.2	Concept of immunity (self – non self, antigen, antibody, immune response, immunological tolerance, autoimmune disease) and active and passive immunization,	
	1.3	Primary and Secondary lymphoid organ. Tissue, cells and molecules of the human immune system.	
2. Humoral immunity, and cell mediated immunity (Role of T cell receptors)			2
3. Immediate response to infection			3
	3.1	Inflammation, cell migration,	
	3.2	Acute phase response; interferon and NK cell.	
4. Antibody			4
	4.1	Structure and types of antibodies	
5. Theories of antibody synthesis, generation of antibody diversity (molecular basis), Antibody class switching			3
6. Antigen- antibody reaction and complement fixation pathways.			2
7. Immunogenetics			5
	7.1	HLA and Disease association	
	7.2	Immune deficiencies and disorders.	
	7.3	Antigen processing and MHC	
8. Immunotechniques			5
	8.1	Hybridoma: principle and application	
	8.2	ELISA	
	8.3	Immunofluorescence and Immunoelectrophoresis	
9. Immunological Memory and Vaccination			3
10. Host- Parasite systems:			7
	10.1	Preadaptation to infectiousness	
	10.2	Myiasis: Classification, diagnostic, control method prevention, treatment	
	10.3	Transmission: Definition Types	
	10.4	Manipulation of host behaviour,	
	10.5	Parasitism & Altruism, parasites	
	10.6	Parasitic effects benefiting the host.	
11. Type study: Classification geographical distribution, morphology, life-cycle, transmission, pathogenicity, treatment and prophylaxis of:			8
	11.1	Protozoa: *Trypanosoma* sps. , *Leishmania* sps.	
	11.2	Platyhelminthes: *Schistosoma s*ps., *Echinococcus* sps.	
	11.3	Nematoda: *Ancylostoma* sps., *Dracunculus* sps.	
12. Genetics & Molecular Biology			7
	12.1	*Trypanosoma*: Diploid & Sexual stage, Molecular characteristics of surface coat, Variable surface glycoprotein (VSG) and VSG gene expression.	
	12.2	*Plasmodium*: Diploid & haploid stages, Chromosome polymorphism, gene encoding circumsporozoite protein & merozoites S- antigens, surface antigen diversity. Resistance of Malaria to drugs, its mechanism & assessment.	
	12.3	Platyhelminthes: Inseminative behaviour, parthenogenesis and polyspermy, sex determination, sex linked inheritance in Schistosomes.	

	12.4	Nematoda: chromosome germ line limited DNA & chromatin diminution in *Ascaris*.	
13. Serology & immunodiagnostic methods:			6
	13.1	Complement fixation test and latex agglutination test	
14. Prophylaxis & control of parasites: Biological, Chemical, Physical and genetical methods			2

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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

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	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	

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	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.

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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	E	3P

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	ovipositor.		
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 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 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*, *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			

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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