Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science & Commerce, Baramati

(Autonomous)

Two Year M.Sc. Degree Program in Zoology

(Faculty of Science & Technology)

CBCS Syllabus

M.Sc. (Zoology) Semester -IV

For P.G. Department of Zoology

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati

Choice Based Credit System Syllabus (2023 Pattern) (As Per NEP 2020)

To be implemented from Academic Year 2024-2025

Title of the Programme: M. Sc. (Zoology)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential Course. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and Course based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Zoology and related subjects, the Board of Studies in Zoology at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the first semester of M. Sc. Zoology, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

After completion of M.Sc. in Zoology, enrolled students will acquire complete disciplinary knowledge as well as allied branches of Zoology. At the end of programme, students may possess expertise which will provide them competitive advantage in pursuing higher studies within India or abroad; and seek jobs in academia, civil administration, research or industries. Students will be able to define and explain major concepts in the biological sciences. They will be able to correctly use biological instrumentation and proper laboratory techniques; to communicate biological knowledge in oral and written form; to identify the relationship between structure and function at all levels: molecular, cellular, tissue, organ, system and organismal.

Students should be able to identify, classify and differentiate diverse non-chordates and chordates based on their basic morphological, anatomical biochemical and molecular characters. They will also be able to describe economic, ecological and medical significance of various animals in human life. This programme will create a curiosity and awareness among students to explore the animal diversity and take up wild life photography or wild life exploration as a career option. The procedural knowledge about identification and classification of animals will provide students professional advantages in seeking the jobs in fields of teaching, research and taxonomy in various private & public organizations; including Zoological Survey of India and

National Parks/Sanctuaries. Students will be able to apply the scientific methods to answer questions in biology by formulating testable hypotheses, gathering data that address these hypotheses, and analysing those data to assess the degree to which their scientific work supports their hypotheses. Students will be able to present scientific hypotheses and data both orally and in writing in the conventional formats that are in practice. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works. Acquired practical skills in biotechnology, biostatistics, bioinformatics and molecular biology can be used to pursue career as a scientist in drug development industry in India or abroad. The students will be acquiring basic experimental skills in various techniques in the fields of genetics; molecular biology; biotechnology; entomology, physiology, qualitative and quantitative microscopy; and analytical biochemistry. These methodologies will provide an extra edge to our students, who wish to undertake higher studies.

Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped animal morphology, physiology, life history, and behaviour. Students will be able to explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behaviour of different animals. Students will be able to analyse the ecological relationships of life on earth by tracing energy and nutrient flows through the ecosystems. They will be able to establish the relationship between the physical features of the environment and the structure of populations, communities, and ecosystems. Students undertaking skill enhancement courses like aquaculture, sericulture and apiculture will inculcate skills involved in rearing fish, bees and silk moth which would help them to generate self-employment making them successful entrepreneurs. Acquired skills in diagnostic testing, haematology, histopathology, staining procedures etc. used in clinical and research laboratories will make them eligible to work in diagnostic or research laboratories. M.Sc. Zoology candidates will find opportunities in public services departments, NGOs, environmental agencies, universities, colleges, biotechnological, pharmaceutical, environmental / ecological fields. There are numerous career opportunities for candidates completing their M.Sc. Zoology in public and private sector. Candidates may find jobs as Animal Behaviourist, Conservationist, Wildlife Biologist, Zoo Curator, Wildlife Educator, Zoology teacher, Forensic experts, Lab technicians, Veterinarians, etc.

Overall, revising the Zoology syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Programme Specific Outcomes (PSOs)

PSO1. Disciplinary Knowledge: Understand the basic concepts of various branches of Zoology like Entomology, Physiology, Genetics, Cell Biology, Taxonomy, Biochemistry & Bioenergetics, Molecular Biology, Embryology, Developmental Biology, Immunology, Ecology, Ichthyology, Fresh Water Zoology, and Applied Zoology.

PSO2. Critical thinking and problem solving: Analyse the relationships of animals with abiotic factors and different biotic factors like plants and microbes. They will able to identify the species based on molecular taxonomy.

PSO3. Individual and Teamwork: Sets up the experiments and performs the same as per laboratory standards in different fields of Zoology like Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Entomology, Nematology, Sericulture, Biochemistry, Ichthyology, Animal biotechnology, Immunology, Physiology and research methodology.

PSO4. Research related skills and scientific temper: Propose hypothesis, formulate tests, use various modern instruments for biological analysis, data collection and field surveys and interprets the data and find answers.

PSO5. Critical Thinking: Recognizes the relationships between structure and functions at different levels of biological organization (e.g., molecules, cells, organs, organisms, populations, and species) for animals.

PSO6. Development of Observation Skills: Distinguishes different ecosystems (e.g., terrestrial, freshwater, marine) based on biological, chemical, and physical features; Correlates the morphology, physiology, behaviour with the properties of habitat.

PSO7. Ethics and Effective Citizenship: Contributes the knowledge for sustainable development and nation building.

PSO8. Management Skills: Exhibits management skills in applied branches of Zoology like Apiculture, Sericulture, Aquaculture and Agriculture.

PSO9. Environmental Ethics and Sustainability: Explains the broad understanding of ecosystems, biodiversity and their conservation.

PSO10. Identification of critical problems and issues: Detect the causes and consequences of biodiversity depletion.

Anekant Education Society's
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Board of Studies (BoS) in Zoology

From 2022-23 to 2024-25

Sr. No.	Name	Designation
1.	Dr. Sandip P. Chordiya	Chairman
2.	Dr. Vitthal B. Nale	Member
3.	Dr. Deepali M. Sangale	Member
4.	Dr. Sunil N. Pokale	Vice-Chancellor Nominee
5.	Dr. Gulab D. Khedkar	Expert from other University
6.	Dr. Sanjay K. Gaikwad	Expert from other University
7.	Dr. Yogesh A. Karpe	Industry Expert
8.	Mr. Kishor U. More	Member
9.	Dr. Sameer S. Jadhav	Member
10.	Miss. Sharvari S. Shah	Invitee member
11.	Miss. Shaheen M. Shaikh	Invitee member
12.	Mr. Bipin B. Jagtap	Meritorious Alumni
13.	Mr. Subodh M. Nikam	Student Representative
14.	Ms. Sana J. Sayyad	Student Representative

Course & Credit Structure for M.Sc. Zoology (2023 Pattern)

Sem.	Course Category	Course Code	Course Title	Theory / Practical	Credits
III	Major mandatory	ZOO-601-MJM	Histology, Histo-chemistry & Reproductive Physiology of Mammals	**T**	4
	Major mandatory	ZOO-602-MJM	Systematics & Economic Zoology	**T**	4
	Major mandatory	ZOO-603-MJM	Zoology Practical-V	**P**	2
	Major mandatory	ZOO-604-MJM	Zoology Practical-VI	**P**	2
	Major Elective	ZOO-611-MJE (A)	Ichthyology	**T**	2
		ZOO-611-MJE (B)	Comparative Animal Physiology	**T**	2
	Major Elective	ZOO-612-MJE (A)	Ichthyology Lab	**P**	2
	Major Elective	ZOO-612-MJE (B)	Comparative Animal Physiology Lab	**P**	2
	Research project	ZOO-621-RP	Research Project	**P**	4
	Skill Development	ZOO-631-SDC	Skill Development Course		2
			Total Credits (Semester-III)		**22**
IV	Major Mandatory	ZOO-651-MJM	Immunology and Parasitology	**T**	4
	Major Mandatory	ZOO-652-MJM	Physiology, Biochemistry & Ecology of Insects	**T**	4
	Major Mandatory	ZOO-653-MJM	Zoology Practical-VII	**P**	2
	Major Elective	ZOO-661-MJE (A)	Entomology-II	**T**	2
		ZOO-661-MJE (B)	Animal Physiology-II	**T**	2
		ZOO-661-MJE (C)	Genetics-II	**T**	2
	Major Elective	ZOO-662-MJE (A)	Entomology-II Lab	**P**	2
		ZOO-662-MJE (B)	Animal Physiology-II Lab	**P**	2
		ZOO-662-MJE (C)	Genetics-II Lab	**P**	2
	Research Project	ZOO-681-RP	Research Project	**P**	6
	Skill Development	ZOO-691-SDC	Skill Development Course		2
			Total Credits (Semester-IV)		**22**
			Cumulative Credits (Semester-III & IV)		**44**

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2024)

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Course Type: Major Theory
Course Code: ZOO-651-MJM
Course Name: Immunology and Parasitology
Number of Credits: 04
Number of Teaching hours: 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 defence.

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 defence.

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			
	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	3
	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			
	3.1	Inflammation, cell migration	3
	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			
	7.1	HLA and Disease association	5
	7.2	Immune deficiencies and disorders	
	7.3	Antigen processing and MHC	
8. Immunotechniques			
	8.1	Hybridoma: principle and application	5
	8.2	ELISA	
	8.3	Immunofluorescence and Immunoelectrophoresis	
9. Immunological Memory and Vaccination			3
10. Host- Parasite systems:			
	10.1	Preadaptation to infectiousness	
	10.2	Myiasis: Classification, diagnostic, control method prevention, treatment	
	10.3	Transmission: Definition & types	7
	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:			
	11.1	Protozoa: *Trypanosoma* sps. , *Leishmania* sps.	
	11.2	Platyhelminthes: *Schistosoma* sps., *Echinococcus* sps.	10
	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	
	12.4	Nematoda: chromosome germ line limited DNA & chromatin diminution in *Ascaris*	
13. Serology & immunodiagnostic methods:			4
	13.1	Complement fixation test and latex agglutination test	
14. Prophylaxis & control of parasites: Biological, Chemical, Physical and genetical methods			2

REFERENCES

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2. Roitt, I. V. (2001). Immunology (6th ed.). Butterworth Heinemann.
3. Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. (2007). Kuby immunology (6th ed.). W.H. Freeman.
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7. Melhorn, H. (Ed.). (1986). Parasitology in focus: Facts & trends. Springer-Verlag.
8. Piakarsky, G. L. (1983). Medical parasitology. Springer-Verlag.
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Course Articulation Matrix of: ZOO-651-MJM Immunology and Parasitology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	3	3	1	1	1	3	1
CO2	3	3	1	3	3	1	1	1	3	1
CO3	3	3	1	3	2	1	1	1	3	1
CO4	3	3	1	3	2	1	1	1	3	1
CO5	3	2	1	3	3	1	1	1	3	1
CO6	3	2	1	3	3	1	1	1	3	1
CO7	1	2	3	3	2	2	1	2	3	1

PO1: Comprehensive Knowledge and Understanding:

CO1: Involves foundational knowledge of antibody structure and immunization strategies.
CO2: Requires understanding of key concepts in humoral and cell-mediated immunity.
CO3: Covers fundamental concepts of the inflammatory response.
CO4: Includes understanding of immunoglobulin diversity and antibody gene rearrangement.
CO5: Encompasses foundational knowledge of antigen-antibody interactions and complement activation.
CO6: Requires understanding of HLA polymorphism, antigen presentation, and disease susceptibility.

PO2: Practical, Professional, and Procedural Knowledge:

CO1: Practical knowledge of immunization strategies is critical for real-world medical applications.
CO2: Essential for understanding and applying immune response mechanisms.
CO4: Involves practical understanding of molecular mechanisms for professional application.
CO5: Practical knowledge of antigen-antibody interactions is necessary for medical applications.
CO7: Knowledge of hybridoma technology, ELISA, and immunofluorescence is crucial for immunological research and diagnostics.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding

CO7: Indirectly mapped as the development and application of immunological techniques (e.g., hybridoma technology, ELISA) can foster innovation and have commercial and entrepreneurial implications in biotechnology and diagnostic sectors**.**

PO4: Specialized Skills, Critical Thinking, and Problem-Solving

CO2: Requires critical analysis of immune mechanisms.
CO3: Involves critical thinking in analyzing the inflammatory response.
CO4: Requires specialized skills for understanding molecular mechanisms of immunoglobulins.
CO5: Involves problem-solving in evaluating antigen-antibody interactions.
CO6: Requires advanced analytical skills to analyze HLA polymorphism and immune deficiencies.
CO7: Involves critical evaluation of immunological techniques and technologies.

PO5: Research, Analytical Reasoning, and Ethical Conduct.

CO3: Analyzing the inflammatory response involves research and analytical reasoning.
CO7: Conducting research with hybridoma technology, ELISA, and immunofluorescence requires adherence to ethical standards and analytical reasoning.

PO6: Communication, Collaboration, and Leadership

CO7: Indirectly mapped as mastering and applying advanced immunological techniques (like ELISA) involves collaboration in research settings and effective communication of complex data in diagnostic and research environments.

PO7: Digital Proficiency and Technological Skills

CO7: Indirectly mapped as mastering techniques like ELISA, hybridoma technology, and immunofluorescence involves the use of advanced digital tools and technology, enhancing digital proficiency.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy

CO6: Indirectly mapped as understanding immune deficiencies and disease susceptibility (linked to HLA polymorphism) requires an appreciation of genetic diversity, which can be related to multicultural competence and empathy for different populations.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices

CO1: Ethical considerations in immunization strategies are linked to responsible citizenship.

CO6: Understanding the ethical implications of immune deficiencies and disease susceptibility is crucial for ethical practices.

PO10: Autonomy, Responsibility, and Accountability

CO3: Indirectly mapped as research into the inflammatory response requires autonomy and accountability in conducting experiments.

CO6: Analyzing HLA polymorphism and its implications demands responsibility in research and application.

CO7: Performing and interpreting advanced immunological techniques like ELISA and hybridoma technology requires a high degree of professional responsibility and accountability.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2024)

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Course Type: Major Theory
Course Code: ZOO-652-MJM
Course Name: Physiology, Biochemistry & Ecology of Insects
Number of Credits: 04
Number of Teaching hours: 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-

CO 1: gain insights of insect physiology and biochemistry.
CO 2: gain knowledge of insect population dynamics and behavioural adaptations.
CO 3: explain 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.

TOPICS:

UNIT	SUB UNIT	SYLLABUS	NO. OF LECTURES
1. Integument:			04
	1.1	Structure and chemistry of integument	
	1.2	Sclerotization	
	1.3	Functions of integument	
	1.4	Pigmentation in insects	
2. Digestion and absorption:			04
	2.1	Carbohydrates	
	2.2	Lipids	
	2.3	Proteins	
3. Fat body:			04
	3.1	Structure, physiology and functions	
	3.2	Integration of carbohydrate, fat and amino acid metabolism	
4. Ventilatory mechanisms and their control:			03
5. Haemolymph:			04

	5.1	Physico-chemical characteristics of plasma	
	5.2	Haemocytes: Structure, types and functions	
	5.3	Physiology of circulatory system	
6. Muscles:			03
	6.1	Structure, physiology and biochemistry of flight muscles	
7. Osmoregulation and excretion			04
	7.1	Structure and function of Malpighian tubules	
	7.2	Mechanism of osmoregulation and nitrogen excretion.	
8. Insecticide degradation and resistance			03
	8.1	Role of microsomal and extramicrosomal enzymes in degradation	
9. Moulting: Mechanism and regulation			03
10. Insect Ecology			15
	10.1	Insect and Climate: Temperature, photoperiod, rainfall, wind and climate change	
	10.2	Insect Herbivores: Leaf shredding insects and insect defoliators; Feeding strategies of herbivorous insects; Plant defense mechanisms	
11. Natural enemies and insect population dynamics			08
	11.1	Natural enemies	
	11.2	Impact of enemies on insect populations	
	11.3	Concept of niche & competition among insect Lotka-Volterra model	
12. Insect conservation			05
	12.1	Threats to insects	
	12.2	Conservation and restoration, prospects for insect conservation	
	12.3	Artificial breeding techniques	

REFERENCES

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Course Articulation Matrix of ZOO-652-MJM Physiology, Biochemistry & Ecology of Insects

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	1	1	3	3	1
CO2	3	3	1	3	3	3	3	1	3	3
CO3	3	2	1	3	1	1	1	3	3	1
CO4	3	2	1	3	1	1	1	1	3	3
CO5	3	3	3	3	3	3	1	1	3	1
CO6	3	1	2	3	1	1	1	1	3	3
CO7	3	3	1	3	3	1	1	1	1	1

PO1: Comprehensive Knowledge and Understanding:

CO1: Requires a deep understanding of insect physiology and biochemistry, key components of entomological studies.

CO2: Involves knowledge of population dynamics and behavioral adaptations, foundational for insect ecology.

CO3: Covers the importance of anatomy and physiology, essential for understanding insect biology.

CO4: Requires comprehension of the structure, modification, and physiology of various systems in insects.

CO5: Involves understanding how climatic factors interact with insects, a crucial part of ecological studies.

CO6: Covers the understanding of feeding strategies of herbivorous insects, essential for ecological and agricultural studies.

CO7: Involves the detailed study of plant defense mechanisms, a key concept in entomology and plant-insect interactions.

PO2: Practical, Professional, and Procedural Knowledge:

CO1: Practical application in studying insect physiology and biochemistry is crucial for professional work in entomology.

CO2: Understanding insect population dynamics and behavioral adaptations is essential for real-world ecological applications.

CO4: Practical knowledge of insect structure and physiology is necessary for professional tasks in entomology.

CO5: Interaction with climatic factors is essential for ecological and environmental applications.

CO6: Practical understanding of herbivorous insect feeding strategies is key for agricultural applications.

CO7: Knowledge of plant defense mechanisms is crucial for practical applications in pest management.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding:

CO7: Indirectly mapped as understanding plant defense mechanisms can lead to innovative approaches in pest control and agricultural biotechnology, fostering entrepreneurial opportunities.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving:

CO1: Requires critical thinking to understand complex physiological and biochemical processes in insects.
CO2: Involves problem-solving in analyzing population dynamics and behavioral adaptations.
CO4: Requires specialized skills to understand and describe insect systems.
CO5: Critical thinking is needed to understand how climatic factors influence insect behavior and population.
CO6: Involves problem-solving in analyzing the feeding strategies of herbivorous insects.
CO7: Requires critical evaluation of plant defense mechanisms against insects.

PO5: Research, Analytical Reasoning, and Ethical Conduct

CO2: Analyzing population dynamics involves research and analytical reasoning.
CO5: Researching the interaction of climatic factors with insects requires strong analytical reasoning.
CO7: Detailed study of plant defense mechanisms involves ethical research practices and analytical reasoning.

PO6: Communication, Collaboration, and Leadership

CO1**:** Indirectly mapped as studying insect physiology and biochemistry often involves collaborative research efforts and communication of complex data.
CO7**:** Effective communication and collaboration are required when applying knowledge of plant defense mechanisms in pest management and agricultural practices.

PO7: Digital Proficiency and Technological Skills

CO1**:** Indirectly mapped as studying insect physiology and biochemistry may require the use of digital tools and technology, such as molecular analysis software.
CO2**:** Population dynamics studies often involve statistical and simulation software, requiring digital proficiency.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy

CO2: Indirectly mapped as understanding insect population dynamics and behavioral adaptations can involve working in diverse ecological settings, fostering multicultural competence and empathy for different ecological perspectives.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices

CO2: Understanding insect population dynamics involves recognizing the ecological balance and ethical considerations in pest control.
CO5: Describing the interaction of climatic factors with insects involves environmental awareness.
CO7: Understanding plant defense mechanisms requires ethical considerations in the use of biotechnology and pest management strategies.

PO10: Autonomy, Responsibility, and Accountability

CO1: Indirectly mapped as researching insect physiology and biochemistry requires autonomy and accountability in laboratory settings.
CO5: Studying climatic interactions with insects requires responsible and accountable research practices.
CO7: Applying knowledge of plant defense mechanisms in real-world scenarios requires a high degree of responsibility and accountability.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2024)

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Couse Type: Major (Elective) Practical
Course Code: ZOO-653-MJM
Course Name: Zoology Practical VII
Number of Credits: 02
Number of Practicals: 15

Course Objectives: -

- To develop a comprehensive understanding of the structure, function, and interactions of various biological systems, including lymphoid organs, blood cells, and parasites.
- To acquire proficiency in laboratory techniques for the preparation, analysis, and identification of biological specimens.
- To gain expertise in the study of arthropod biology, including their life cycles, roles as vectors, and control measures.
- To develop a deep understanding of the biology and pathogenesis of parasitic organisms, including protozoa and helminths.
- To acquire the ability to identify and analyze parasites found in different hosts and environments.
- To develop a strong foundation in physiological measurements and data analysis.
- To apply scientific principles and methodologies to investigate biological phenomena and solve real-world problems.

Course Outcomes: -

After completion of this course Students will be able to -

CO1: demonstrate a comprehensive understanding of the structure, function, and interactions of biological systems, including lymphoid organs, blood cells, and parasites.
CO2: acquire proficiency in laboratory techniques for the preparation, analysis, and identification of biological specimens, such as blood smears, parasites, and insect tissues.
CO3: gain expertise in the study of arthropod biology, including their life cycles, roles as vectors, and control measures.
CO4: develop a deep understanding of the biology and pathogenesis of parasitic organisms, including protozoa and helminths.
CO5: acquire the ability to identify and analyze parasites found in different hosts and environments.
CO6: develop a strong foundation in physiological measurements and data analysis, including the study of oxygen consumption, enzyme activity, and water loss in insects.
CO7: apply scientific principles and methodologies to investigate biological phenomena and solve real-world problems, such as the control of vector-borne diseases and the management of parasitic infections.

Practical No.	Title of the practical	E/D	Teaching Hours
	Section I Any-7		
1	Study of histology of Lymphoid organ- Skin, Spleen, Thymus, Ilium, Lymph node, Bone marrow	D	4
2	Preparation of blood smear to observe blood cells	E	4

3	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	4
4	Study of life cycle of parasitic protozoa: *Trypanosoma* and *Leishmania*	D	4
5	Study of life cycle of helminth parasites: *Schistosoma, Echinococcus, Ancylostoma* and *Dracunculus*.	D	8
6	Study of Parasites from digestive tract of Cockroach /gut parasites of hen	E	4
	Section II-Any- 8		
7	Estimation of oxygen consumption in dragon fly nymph	E	4
8	Study of heart and haemocytes of cockroach	E	4
9	Estimation of the trehalase activity in haemolymph of any insect	E	4
10	Determination of amino acid in haemolymph of any insect by chromatographic technique	E	4
11	Study of effect of temperature on water loss in cockroach	E	4
12	Study of Von Wisselinghs test for presence of chitin in insect cuticle	E	4
13	Study of insect population by quadrate method	E	4
14	Detection of waxy components in insect cuticle	E	4
15	Detection of uric acid in a given insects	E	4
16	Observe anatomical details of Malpighian tubules in cockroach	E	4
17	Demonstration of uptake of dye by Malpighian tubules in a given insect	E	4
18	Determination of chitin content in insect cuticle	E	4
19	Qualitative count of haemocytes in a given insect	E	4

Course Articulation Matrix of ZOO-653-MJM Zoology Practical VII
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**3**	**1**	**1**	**3**	**1**	**1**	**1**	**3**	**3**	**1**
CO2	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**1**	**3**	**3**
CO3	**3**	**3**	**1**	**3**	**3**	**1**	**1**	**3**	**3**	**1**
CO4	**3**	**3**	**1**	**3**	**3**	**1**	**1**	**1**	**3**	**1**
CO5	**3**	**3**	**1**	**3**	**3**	**3**	**1**	**1**	**3**	**1**
CO6	**3**	**3**	**1**	**3**	**1**	**1**	**1**	**1**	**3**	**1**
CO7	**3**	**3**	**1**	**3**	**3**	**1**	**1**	**1**	**3**	**1**

PO1: Comprehensive Knowledge and Understanding

CO1: Involves a deep understanding of biological systems and their interactions, crucial for mastering the field of biology.

CO4: Requires knowledge of parasitic organisms and their pathogenesis, a core part of biological sciences.

PO2: Practical, Professional, and Procedural Knowledge

CO2: Involves proficiency in laboratory techniques, essential for professional tasks in biological sciences.

CO3: Requires expertise in the study of arthropods, including practical applications in vector control.

CO6: Involves the practical application of physiological measurements and data analysis, critical for professional work in biology.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding

CO6: Indirectly mapped as applying scientific principles to solve real-world problems, such as disease control, can lead to innovative solutions and entrepreneurial opportunities.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving

CO1: Involves critical thinking to understand complex biological systems.

CO3: Requires problem-solving skills in managing arthropods and their roles as vectors.

CO4: Involves specialized knowledge of parasitic organisms and critical analysis of their biology.

PO5: Research, Analytical Reasoning, and Ethical Conduct

CO2: Involves research and analytical skills in the preparation and analysis of biological specimens.

CO5: Requires ethical research practices in identifying and analyzing parasites.

PO6: Communication, Collaboration, and Leadership

CO1: Indirectly mapped as understanding biological systems often involves collaborative research and effective communication.

CO3: Effective communication and collaboration are required when managing arthropods and their role in disease transmission.

CO6: Involves teamwork and communication in solving real-world biological problems.

PO7: Digital Proficiency and Technological Skills

CO2: Indirectly mapped as laboratory techniques often require the use of digital tools and technology for analysis.

CO6: Involves the use of digital tools in data analysis and applying scientific principles to biological research.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy.

CO3: Indirectly mapped as the study of arthropod biology and their control measures may involve working in diverse ecological and cultural settings.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices

CO3: Understanding the environmental impact of arthropods and their control measures requires environmental awareness.

CO5: Involves ethical considerations in identifying and analyzing parasites.

CO6: Applying scientific principles to control vector-borne diseases involves ethical practices and environmental consciousness.

PO10: Autonomy, Responsibility, and Accountability

CO2: Indirectly mapped as laboratory work requires autonomy and responsibility.

CO4: Involves accountability in researching and analyzing parasitic organisms.

CO6: Requires autonomy and responsibility in applying scientific methods to real-world problems.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Course Type: Major Elective) Theory
Course Code: ZOO-661-MJE (A)
Course Name: Entomology-II
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives: -

- Comprehend processes of gametogenesis, fertilization, and oviposition.
- Gain insights of early embryonic development in insect.
- Give a brief overview of segmentation, appendage formation, and organogenesis.
- Explore post-embryonic insect development.
- Explore strategies of emergence of adults from pupae or cocoons.
- Analyse Hadorn's experiments, specifically focusing on imaginal disc experiments.
- Gaining a precise understanding of diapause in insects and control mechanisms.

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.

TOPICS:

UNIT	SUB UNIT	SYLLABUS	NO. OF LECTURES
1. Gametogenesis:			
	1.1	Spermatogenesis,	**06**
	1.2	Oogenesis	
	1.3	Seminal transfer	
	1.4	Fertilization and Oviposition.	
2. Early embryonic development in Insects			
	2.1	Cleavage and Blastoderm formation	**10**
	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	**10**
	3.2	Emergence of adult from the pupa/cocoon	
	3.3	Metamorphosis in insects	
	3.4	Growth in insects	
4. Hadorn's experiments			
	4.1	Experiments with imaginal disc	**02**
5. Diapause			**02**
	5.1	Occurrence, Initiation and Preparations for diapauses,	
	5.2	Diapause development and Controls.	

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Course Articulation Matrix of ZOO-661-MJE (A) Entomology-II
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	1	1	3	3	1
CO2	3	3	1	3	3	3	3	1	3	3
CO3	3	2	1	3	1	1	1	3	3	1
CO4	3	2	1	3	1	1	1	1	3	3
CO5	3	3	3	3	3	3	1	1	3	1
CO6	3	1	2	3	1	1	1	1	3	3
CO7	3	3	1	3	3	1	1	1	1	1

PO1: Comprehensive Knowledge and Understanding

CO1: Understanding gametogenesis and fertilization provides foundational knowledge essential for studying insect biology.
Early embryonic development is critical to grasping developmental biology concepts. **(CO2)**
Knowledge of post-embryonic development enhances understanding of lifecycle stages. **(CO4)**
Understanding diapause contributes to a comprehensive knowledge of insect biology. **(CO7)**

PO2: Practical, Professional, and Procedural Knowledge
The practical aspect is important for applying this knowledge in lab settings. **(CO1)**

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding
Understanding adult emergence can lead to innovative approaches in pest management or biological control. **(CO5)**

PO4: Specialized Skills, Critical Thinking, and Problem-Solving
Understanding organogenesis involves critical thinking and problem-solving. **(CO3)**
Analyzing and applying knowledge of post-embryonic development requires specialized skills and problem-solving abilities. **(CO4)**

PO5: Research, Analytical Reasoning, and Ethical Conduct
Research methodologies related to embryonic development align with analytical reasoning and ethics in research. **(CO2)**
Analyzing organogenesis requires analytical skills and adherence to ethical standards. **(CO3)**
Analyzing Hadorn's experiments cultivates research skills and analytical reasoning. **(CO6)**

PO6: Communication, Collaboration, and Leadership
Discussing findings fosters communication and collaboration among peers. **(CO6)**

PO7: Digital Proficiency and Technological Skills
Analyzing experiments requires proficiency in data analysis software and digital tools. **(CO6)**

PO8: Multicultural Competence, Inclusive Spirit, and Empathy
Understanding various reproductive strategies in insects can foster appreciation for biodiversity and different cultural perspectives in research. **(CO1)**
Recognizing diverse developmental processes enhances inclusivity in understanding insect biology. **(CO4)**

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices
Awareness of diapause's ecological implications relates to sustainability and ethical practices. **(CO7)**

PO10: Autonomy, Responsibility, and Accountability
Students will take responsibility for their learning and research in understanding insect reproductive processes. **(CO1)**
Analyzing experiments independently fosters a sense of accountability and ownership of research outcomes. (CO6)

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Course Type: Major Elective) Theory
Course Code: ZOO-661-MJE (B)
Course Name: Animal Physiology-II
Number of Credits: 02
Number of Teaching hours: 30

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	SUB UNIT	SYLLABUS	NO. OF LECTURES
1. Energy metabolism			07
	1.1	Metabolic rate	
	1.2	Energy storage: Fat and glycogen	

	1.3	Effect of O_2 concentration: acclimatization to low O_2 level, anaerobic metabolism- Glycolysis and lactic acid fermentation	
	1.4	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-			06
	3.1	Fresh water: Invertebrates & vertebrates	
	3.2	Terrestrial: Arthropods & vertebrates	
	3.3	Marine: Invertebrates & vertebrates	
4. Cardiac Physiology			04
	4.1	Cardiac cycle	
	4.2	Electrical activity of the heart	
	4.3	Neuronal and Hormonal control of heart	
	4.4	Cardiovascular response of exercise	
5. Neuronal Physiology			05
	5.1	Nerve impulse: Generation and conduction	
	5.2	Synaptic conduction: Types of Neurotransmitters, Metabolism of neurotransmitters	
	5.3	Neuronal integration	
	5.4	Impact of drugs and disease on synaptic transmission	

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Course Articulation Matrix of ZOO-661-MJE (B) Animal Physiology-II
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	1	1	1	3	1
CO2	3	3	1	3	3	1	1	3	3	3
CO3	3	2	1	3	3	1	1	3	3	1
CO4	3	2	1	3	3	1	1	1	3	1
CO5	3	3	3	3	3	1	1	1	3	1
CO6	3	1	2	3	1	3	1	3	3	3
CO7	3	3	1	3	3	1	1	1	1	1

PO1: Comprehensive Knowledge and Understanding
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly due to the focus on detailed understanding of physiological processes like energy metabolism, oxygen response, excretion, osmoregulation, blood functions, and cardiac physiology. Mastery of these biological systems requires comprehensive knowledge.

PO2: Practical, Professional, and Procedural Knowledge
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 map moderately to strongly as they involve practical application of physiological knowledge. For instance, explaining responses to varying oxygen levels and understanding blood regulation is vital in professional settings like medical and environmental biology.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding
CO1, CO3 and CO5 contribute moderately to strongly as they might involve innovative applications of understanding biological mechanisms like energy metabolism, excretion processes, and osmoregulation. These areas could be leveraged in health technology, environmental solutions, or new biological products.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly due to the need for critical thinking and problem-solving in understanding energy metabolism, physiological responses to oxygen, excretion regulation, osmoregulation, blood pressure control, and cardiac physiology. These require specialized skills to analyse and solve complex biological challenges.

PO5: Research, Analytical Reasoning, and Ethical Conduct
CO1, CO2, CO4, CO5 and CO7 maps strongly as they involve a focus on research and analysis of physiological processes like metabolism, oxygen adaptation, osmoregulation, and cardiac function. These areas are rich for research, demanding strong ethical reasoning and analytical skills.

PO6: Communication, Collaboration, and Leadership
CO3, CO4 and CO6 maps moderately as explaining biological concepts like excretion regulation, osmoregulation, and blood function enhances communication and teamwork in health and scientific environments. Collaboration and leadership are important in these contexts, especially in professional and clinical settings.

PO7: Digital Proficiency and Technological Skills
CO2 maps strongly as the study of physiological responses to oxygen variations, particularly in extreme environments, involves the use of digital tools and technology to monitor and analyze data. Other COs like CO1, CO3, CO4 involve limited technological engagement but still benefit from digital proficiency for data analysis in biology.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy
CO2 maps strongly as understanding physiological responses to varying oxygen levels in different environments (like deep-sea or high-altitude regions) promotes multicultural competence by appreciating the diversity of life in extreme conditions.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices
CO1, CO4, CO5, CO6 maps strongly as understanding energy metabolism, osmoregulation, and cardiovascular functions fosters environmental awareness and highlights ethical practices in physiology and healthcare.

PO10: Autonomy, Responsibility, and Accountability
CO2, CO3, CO5 and CO6 maps strongly as they demand a high level of personal responsibility and accountability in understanding physiological processes. Autonomy is crucial in applying this knowledge in professional and research settings, such as managing oxygen adaptation or blood pressure regulation.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Course Type: Major Elective) Theory
Course Code: ZOO-661-MJE (C)
Course Name: Genetics-II
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives: -

- Apply principles of probability and statistics to solve problems in 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.
- 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 analyze a family pedigree to identify the mode of inheritance (autosomal, sex-linked, and 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	SUBUNIT	SYLLABUS	NO. OF LECTURES
1. Solving problems (Numerical Probability estimation) of Mendelian genetics.			**02**

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 Limited & Sex-influenced traits, mitochondrial traits), MIM (Mendelian Inheritance in Man) number	**12**
	2.3	Complications to the basic pedigree patterns include dominance**,** non-penetrance, variable expressivity, pleiotropy, late-onset, genomic imprinting & uniparental disomy, mosaicism & chimerism, X-inactivation	
3. Clinical Genetics	**3.1**	**Monogenic diseases** (Cystic Fibrosis)	**12**
	3.2	**Triplet repeat-based disorders (anyone)**	
	3.3	**Inborn metabolic errors (any two for each type)**	
		Disorders of carbohydrate metabolism	
		Disorders of nucleic acid metabolism	
		Disorders of lipid metabolism	
		Lysosomal storage disorders	
		Peroxisomal disorders	
	3.4	**Disorders of Hematopoietic Systems**	
		Overview of blood cell types & haemoglobin	
		Sickle cell anemia	
		Thalassemia	
	3.5	**Prenatal and pre-implantation diagnosis**	
		Non- invasive methods	
		Invasive methods	
4. Neurogenetics	**4.1**	Circadian rhythms	**02**
	4.2	Psychopathology- Alzheimer's disease	
5. *Drosophila* genetics	**5.1**	History of *Drosophila* genetics.	**02**
	5.2	Genetic basis of Sex determination and dosage compensation in *Drosophila*.	

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Course Articulation Matrix of ZOO-661-MJE (C) Genetics - II
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	1	3	3	1	1	1	1	1
CO2	3	3	1	3	3	2	3	1	1	3
CO3	3	2	1	3	3	1	2	1	1	1
CO4	3	3	2	3	3	2	3	1	1	3
CO5	3	3	3	3	3	2	3	3	3	3
CO6	2	2	1	2	2	1	2	1	2	1
CO7	3	3	2	3	3	1	3	1	1	1

PO1: Comprehensive Knowledge and Understanding
CO1, CO2, CO3, CO4, CO5 and CO7 maps strongly due to their focus on the detailed understanding of genetic principles, inheritance, molecular mechanisms, and polygenic traits. These topics require comprehensive knowledge of complex genetic processes and disorders.

PO2: Practical, Professional, and Procedural Knowledge
CO1, CO2, CO4, CO5 and CO7 maps strongly, as they involve practical tasks like calculating genetic probabilities, constructing pedigrees, diagnosing genetic disorders, and evaluating diagnostic methods. These COs develop professional competence in real-world genetic practices.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding
CO4, CO5 and CO7 maps moderately as they might involve innovative approaches in diagnosing genetic disorders, using advanced diagnostic methods, and understanding the genetic basis of complex traits. These areas could be applied in biotechnology and personalized medicine industries.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving
CO1, CO2, CO3, CO4, CO5 and CO7 maps strongly as they require specialized genetic skills, critical thinking, and problem-solving to interpret genetic data, diagnose genetic disorders, and navigate complex genotype-phenotype relationships.

PO5: Research, Analytical Reasoning, and Ethical Conduct
CO1, CO2, CO3, CO4, CO5 and CO7 maps strongly due to their emphasis on research and analytical reasoning in genetic diagnosis, pedigree analysis, and evaluating diagnostic techniques. Ethical considerations are especially important in prenatal testing and genetic disorders.

PO6: Communication, Collaboration, and Leadership
CO2, CO4 and CO5 maps moderately as they involve collaborative efforts in healthcare and research, requiring clear communication in constructing pedigrees, diagnosing conditions, and discussing diagnostic methods.

PO7: Digital Proficiency and Technological Skills
CO2, CO4, CO5 and CO7 maps strongly as these COs require proficiency in using digital tools and software for pedigree analysis, genetic diagnostics, and investigating gene-disease associations. Mastery of digital technologies is essential for modern genetic research.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy
CO5 maps moderately, as understanding and evaluating prenatal diagnostic methods requires sensitivity to cultural perspectives and ethical dilemmas. Inclusivity in the genetic counseling process is crucial.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices
CO5 and CO6 maps strongly as they involve ethical practices in prenatal diagnostics and understanding the environmental influence on polygenic traits. These COs encourage ethical thinking and environmental awareness in the study of genetics.

PO10: Autonomy, Responsibility, and Accountability
CO2, CO4 and CO5 maps strongly, as constructing pedigrees, diagnosing genetic disorders, and evaluating diagnostic methods demand high levels of responsibility, autonomy, and accountability, especially in clinical settings.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2024)

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Couse Type: Major (Elective) Practical
Course Code: ZOO-662-MJE (A)
Course Name: Entomology-II Lab
Number of Credits: 02
Number of Practicals: 15

Course Objectives: -

- Develop the ability to identify and classify different types of insect eggs, larvae, nymphs, pupae, and their anatomical modifications.
- Understand the structural adaptations and modifications of insect antennae, legs, and wings in relation to their environmental and functional roles.
- Gain practical skills in culturing insects such as houseflies, *Drosophila*, or cockroaches and develop competency in rearing them on artificial diets.
- Acquire hands-on experience in the dissection and study of key anatomical systems in insects, including the digestive, nervous, and reproductive systems.
- Master techniques for temporary mounting and microscopic analysis of insect anatomical parts, such as antennae, wings, and legs.
- Investigate the respiratory structures and other physiological adaptations in insects, correlating them to environmental factors.
- Analyze the effects of environmental factors on insect development, enhancing understanding of insect growth and developmental biology.

Course Outcomes: -

After completion of this course, students will-

CO1: accurately identify and classify various types of insect eggs, larvae, nymphs, pupae, and their anatomical modifications through observation and practical analysis.

CO2: explain the structural adaptations and modifications of insect antennae, legs, and wings, and relate these to the insects' ecological roles and environmental interactions.

CO3: successfully culture and rear insects like houseflies, *Drosophila*, or cockroaches, demonstrating competency in maintaining them on different types of artificial diets.

CO4: perform detailed dissections of the digestive, nervous, and reproductive systems in insects, demonstrating a thorough understanding of their internal anatomy and functionality.

CO5: prepare and analyze temporary mounts of insect anatomical parts (antennae, wings, and legs), demonstrating proficiency in microscopic examination techniques.

CO6: describe and analyze the respiratory structures of insects and other physiological adaptations, linking them to the environmental conditions that affect insect survival and performance.

CO7: evaluate the effects of environmental factors on insect development, providing insights into how such factors influence growth stages and life cycles in various insect species.

Practicals:

Practical No.	Name of the practical	E/D	Teaching Hours
1	Study of different types of insect eggs	**D**	**4**
2	Study of types of larvae in insects	**D**	**4**
3	Study of types of nymph and pupa in insects	**D**	**4**
4	Study of typical insect antenna and its modifications	**E**	**4**
5	Study of typical insect leg and its modifications	**E**	**4**
6	Study of insect wing modifications	**E**	**4**
7	Study of different types of artificial diet for insect rearing	**D**	**4**
8	Culturing of housefly / *Drosophila* / cockroach	**E**	**8**
9	Temporary mountings of antenna, wing and leg in laboratory cultured insect.	**E**	**4**
10	Dissection of digestive system in laboratory cultured insect	**E**	**4**
11	Dissection of nervous system in laboratory cultured insect	**E**	**4**
12	Dissection of reproductive system in laboratory cultured insect	**E**	**4**
13	Study of respiratory structures in insect	**D**	**4**
14	Study of effect of environmental factors on insect development	**D**	**4**

*E- Experiment D-Demonstration

Course Articulation Matrix of ZOO-662-MJE (A) Entomology-II Lab
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	1	3	3	2	2	1	1	2
CO2	3	3	1	3	2	2	2	1	1	1
CO3	3	3	2	3	3	1	2	1	1	2
CO4	3	3	1	3	3	2	2	1	1	1
CO5	3	3	2	3	2	2	3	1	1	2
CO6	3	3	1	3	3	1	2	1	2	1
CO7	3	3	1	3	3	2	2	1	3	3

PO1: Comprehensive Knowledge and Understanding
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly due to their focus on a thorough understanding of insect anatomy, physiology, and environmental adaptations. These COs build a comprehensive knowledge base of insect biology and ecological roles.

PO2: Practical, Professional, and Procedural Knowledge
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly as they involve practical aspects like identifying insect structures, dissection, culturing insects, and performing microscopic examinations. These COs foster professional competency in insect biology.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding
CO3 and CO5 maps moderately as culturing insects and preparing mounts could have applications in commercial sectors like biotechnology, pest management, and research, fostering innovation and business potential in these fields.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving
CO1, CO2, CO3, CO4, CO5, CO6, and CO7 maps strongly due to the need for specialized biological skills, critical thinking, and problem-solving in identifying insect structures, performing dissections, and analyzing physiological adaptations in relation to environmental factors.

PO5: Research, Analytical Reasoning, and Ethical Conduct
CO1, CO3, CO4, CO6, and CO7 maps strongly due to their emphasis on observation, analysis of insect development, and understanding physiological adaptations. Ethical conduct is important in maintaining cultures and conducting dissections, and research skills are honed through detailed observations and dissections.

PO6: Communication, Collaboration, and Leadership
CO1, CO2, CO4, CO5, and CO7 maps moderately as they involve presenting findings from dissections, microscopic analysis, and environmental assessments of insects, which fosters teamwork and communication in group research or practical sessions.

PO7: Digital Proficiency and Technological Skills
CO1, CO3 and CO5 maps strongly as they require proficiency in using digital tools for microscopy, maintaining insect cultures, and documenting observations. CO7 also involves assessing environmental factors, which may require data collection and analysis technologies.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy
CO5 maps moderately as the ability to analyze insect mounts and appreciate different techniques from varied ecological and cultural contexts promotes inclusivity in learning. Understanding the ecological roles of insects fosters empathy toward environmental diversity.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices
CO6, CO7 contribute strongly as they deal with insect survival and the effects of environmental factors, emphasizing the importance of ethical and sustainable practices in handling living organisms and understanding their roles in the ecosystem.

PO10: Autonomy, Responsibility, and Accountability
CO1, CO3, CO5, and CO7 maps strongly as tasks like identifying insect anatomy, culturing insects, preparing mounts, and evaluating environmental effects on insects require responsibility and accountability. Practical lab work, dissections, and culturing insects demand autonomy in handling living organisms and experimental setups.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2024)

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Couse Type: Major (Elective) Practical
Course Code: ZOO-662-MJE (B)
Course Name: Animal Physiology-II Lab
Number of Credits: 02
Number of Practicals: 15

Course Objectives: -

- Analyze cellular responses to osmotic stress and volume changes in erythrocytes, earthworms, and cockroaches.
- Detect metabolic byproducts such as allantoin, creatinine, and nitrogenous waste, understanding their relevance in physiological health.
- Estimate biochemical markers like alkaline and acid phosphatases, serum urea, proteins, and glucose from human and animal samples.
- Explore the effects of exercise on breathing rate, pulse rate, and blood lactate levels, and understand the link between physical exertion and metabolic changes.
- Study glycerinated muscle fibres, different heart types (myogenic and neurogenic), and blood pigments to understand muscle contraction and heart function.
- Evaluate the effects of environmental temperature on water loss in cockroaches, connecting physiological responses to environmental stress.
- Determine bleeding and clotting times to gain insights into the physiological processes of homeostasis.

Course Outcomes: -

After completion of this course, students will-

CO1: analyze and interpret cellular responses to osmotic stress and volume changes in erythrocytes, earthworms, and cockroaches under different environmental conditions.
CO2: detect and quantify metabolic byproducts such as allantoin, creatinine, and nitrogenous wastes in urine samples, demonstrating an understanding of their significance in physiological health.
CO3: accurately estimate biochemical markers including alkaline and acid phosphatases, serum urea, proteins, and glucose from human and animal samples, and interpret their relevance in diagnostic contexts.
CO4: evaluate the physiological effects of exercise on breathing rate, pulse rate, and blood lactate levels, linking metabolic changes to physical activity in humans.
CO5: demonstrate proficiency in studying glycerinated muscle fibres, analysing different heart types and assessing blood pigments to gain a comprehensive understanding of muscle and cardiovascular physiology.
CO6: analyze the impact of environmental temperature on water loss in cockroaches, correlating physiological adaptations to environmental stress and survival strategies.
CO7: perform accurate determinations of bleeding and clotting times, developing an understanding of homeostatic mechanisms and their role in maintaining vascular stability.

PRACTICALS:

Sr. No.	Title of the Practical	E/D	No. of Hours
1	Study of Osmotic stress and volume change in erythrocytes	E	4
2	Detection of allantoin in mammalian urine	E	4
3	Estimation of creatinine from urine / serum sample	E	4
4	Estimation of alkaline & acid phosphatases in blood	E	4
5	Effect of exercise on breathing rate, pulse rate and blood lactate of man	E	4
6	Study of glycerinated muscles fibers	D / E	4
7	Osmotic stress and volume change in earthworm / Cockroach.	E	4
8	Effect of temperature on water loss in cockroach.	E	4
9	Study of Types of heart (Myogenic and Neurogenic)	D	4
10	Study of nitrogenous waste products of animals from different habitat	E	4
11	Determination of protein from human urine sample	E	4
12	Determination of glucose from human urine sample	E	4
13	Estimation of serum urea from suitable mammalian blood sample	E	4
14	Absorption spectra of blood pigment	E	4
15	Determination of bleeding and clotting time	E	4
E*-Experimental D*- Demonstration			

Course Articulation Matrix of ZOO-662-MJE (B) Animal Physiology-II Lab
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	1	3	3	2	2	1	1	2
CO2	3	3	1	3	2	2	2	1	1	1
CO3	3	3	2	3	3	1	2	1	1	2
CO4	3	3	1	3	3	2	2	1	1	1
CO5	3	3	2	3	2	2	3	1	1	2
CO6	3	3	1	3	3	1	2	1	2	1
CO7	3	3	1	3	3	2	2	1	3	3

PO1: Comprehensive Knowledge and Understanding
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly due to the emphasis on understanding complex biological systems and physiological processes, demonstrating a deep comprehension of the subject matter.

PO2: Practical, Professional, and Procedural Knowledge
CO1, CO2, CO3, CO4, CO5, CO6, and CO7 maps strongly as they involve hands-on experience and the application of biological techniques in laboratory settings, ensuring students gain practical skills essential for professional contexts.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding
CO2, CO4, and C57 maps moderately as they can lead to innovations in health diagnostics and fitness industries, relevant for entrepreneurial applications in biology and fostering a mindset geared towards practical applications.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving
CO1, CO2, CO4, and CO6 maps strongly due to the need for specialized knowledge in analyzing and solving complex biological issues, emphasizing critical thinking in experimental design and data interpretation.

PO5: Research, Analytical Reasoning, and Ethical Conduct
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly as they involve critical evaluation and analysis of data and ethical considerations in biological research, promoting integrity and rigor in scientific inquiry.

PO6: Communication, Collaboration, and Leadership
CO4, CO5, and CO6 maps moderately as they involve discussing findings and collaborating on practical tasks, enhancing communication skills and the ability to work effectively in teams.

PO7: Digital Proficiency and Technological Skills
CO3, CO4, and CO5 maps moderately as they may involve using digital tools for data analysis and interpretation in laboratory practices, helping students develop relevant technological skills.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy
CO2, and CO3 maps moderately, as understanding the significance of metabolic byproducts can foster empathy in healthcare contexts, encouraging students to appreciate diverse biological perspectives.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices
CO6 contributes strongly as it relates to understanding environmental impacts on physiological processes, fostering ecological awareness and ethical considerations in biological research.

PO10: Autonomy, Responsibility, and Accountability
CO1, CO4, CO5, and CO7 maps moderately as they promote individual responsibility in conducting experiments and reporting findings, ensuring accountability in scientific practices.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2024)

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Couse Type: Major (Elective) Practical
Course Code: ZOO-662-MJE (C)
Course Name: Genetics-II Lab
Number of Credits: 02
Number of Practicals: 15

Course Objectives: -

- Learn how to construct and analyze typical human pedigrees for autosomal dominant, autosomal recessive, sex-linked dominant, and sex-linked recessive traits..
- Develop skills in preparing metaphase chromosomal spreads and visualizing chromosomal features using light microscopy
- Design and optimize PCR primers for amplifying specific genes of interest, and perform genetic analyses using in-silico tools
- Investigate genetic mutants in Drosophila melanogaster, including dominant, recessive, autosomal, sex-linked, and multiple mutations, as well as using balancers.
- Understand and use genetic disorder databases like OMIM, and perform sequence similarity searches using tools such as BLASTN and BLASTP.
- Conduct chromatography to analyze Drosophila eye color pigments and assess the impact of metals on bacterial growth through oligodynamic action.
- Study qualitative and quantitative traits in humans and model organisms, and understand the influence of genetic and environmental factors on these traits.

Course Outcomes: -

After completion of this course, students will-

CO1: construct accurate pedigrees and analyze inheritance patterns for different genetic traits, applying principles of Mendelian and non-Mendelian genetics..
CO2: effectively prepare and analyze metaphase chromosomal spreads, and visualize key chromosomal structures such as the nucleolus and polytene chromosomes
CO3: design functional PCR primers, perform amplification, and use bioinformatics tools for gene and protein sequence analysis, demonstrating proficiency in molecular biology techniques.
CO4: identify and characterize genetic mutants in Drosophila melanogaster, understanding the implications of various genetic mutations on phenotype.
CO5: navigate genetic databases and use bioinformatics tools to retrieve, annotate, and compare nucleotide and protein sequences, demonstrating the ability to interpret complex genetic data.
CO6: perform chromatography experiments to analyze pigment composition and assess the effects of metals on bacterial growth, gaining practical experience in biochemical techniques.
CO7: analyze qualitative and quantitative traits in humans and model organisms, understanding how genetic and environmental factors contribute to phenotypic variation.

PRACTICALS:

Sr. No.	Title of the Practical	E/D	No. of Hours
1	Methodology for constructing human pedigree	D	1
2	Analysis and construction of typical pedigrees for autosomal dominant and recessive genes, sex-linked dominant and recessive genes.	D	2
3	Preparation of metaphase chromosomal spreads of one vertebrate.	E	2
4	Visit a medical genetics laboratory for cytogenetic, biochemical, and other studies	E	1
5	*In-silico* design of PCR primers for a gene of interest.	D	1
6	Chromatography of *Drosophila* eye color pigment	E	1
7	Concept of genetic disorder databases and demonstration of the use of OMIM	D	1
8	Dissection and Mounting of Imaginal Discs of *Drosophila*	E	1
9	Visualization of Nucleolus in the larval salivary gland polytene nuclei in *Drosophila* melanogaster using light microscopy	E	1
10	Induction of puffing in polytene chromosome by heat shocks.	E	1
11	Study of mutants of *Drosophila* melanogaster- Dominant, Recessive, Autosomal, Sex-linked and Multiple mutations, Balancers.	D	1
12	Problems based on sex-linked inheritance	D	1
13	Oligodynamic action of metals on bacteria	E	1
14	Study of some of the qualitative and quantitative traits in humans	D	1
15	Species identification through the genital plate and sex comb for (a) *D. melanogaster*. (b) *D. nasuta k* (C) *D. raiasekarii*	D	1
16	pH profile of the gastrointestinal tract in *Drosophila melanogaster* larvae	E	1
17	Retrieval of Nucleotide sequence from GenBank, annotation and Sequence Similarity Search using BLASTN	E	1
18	Retrieval of Protein sequence from GenBank and Sequence Similarity Search using BLASTP	E	1
19	Predicting physiochemical properties of protein sequence	E	1
E*-Experimental D*- Demonstration			

Course Articulation Matrix of ZOO-662-MJE (C) Genetics-II Lab
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	1	2	3	1	2	1	1	2
CO2	3	3	1	2	2	1	1	1	1	1
CO3	3	3	2	3	3	2	2	1	1	2
CO4	3	3	1	2	3	1	1	1	1	1
CO5	3	3	1	3	3	2	2	1	1	2
CO6	2	3	1	2	2	3	2	1	1	1
CO7	3	3	1	3	3	1	2	1	1	2

PO1: Comprehensive Knowledge and Understanding
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly as they emphasize a thorough grasp of genetic principles, molecular techniques, and experimental procedures in genetics.

PO2: Practical, Professional, and Procedural Knowledge
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly as they involve hands-on laboratory skills, including pedigree construction, chromosomal analysis, PCR, and chromatography, fostering professional competency in genetics.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding
CO3, and CO4 maps moderately, as techniques like PCR and analyzing genetic mutations have potential applications in biotechnology, innovation, and business ventures related to genetic research.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving
CO1, CO3, CO5, CO6, and CO7 maps strongly due to the need for specialized knowledge in genetics, critical analysis of data, and problem-solving in experimental contexts.

PO5: Research, Analytical Reasoning, and Ethical Conduct
CO1, CO3, CO4, CO5, and CO7 maps strongly, as they involve designing experiments, analyzing genetic data, and understanding the ethical implications of genetic research.

PO6: Communication, Collaboration, and Leadership
CO1, CO3, and CO4 maps moderately as these outcomes require presenting and discussing genetic findings, enhancing collaboration in lab settings.

PO7: Digital Proficiency and Technological Skills
CO3, and CO5 maps strongly as they involve using bioinformatics tools and digital technologies for genetic analysis and data interpretation.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy
CO6 maps moderately, as understanding the effects of environmental factors on genetic traits promotes inclusivity and empathy in biological research.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices
CO6 maps moderately, as it emphasizes the importance of ethical practices in genetic research and understanding environmental impacts on organisms.

PO10: Autonomy, Responsibility, and Accountability
CO1, CO3, CO5, and CO7 maps strongly as they require responsibility in conducting experiments, data interpretation, and presenting findings, highlighting accountability in research practices.

SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2024)

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Couse Type: Research Project
Course Code: ZOO-681-RP
Course Name: Research Project
Number of Credits: 06
Number of Teaching hours: 90

The research project course would involve:

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 45 practicals in the semester.

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SYLLABUS (CBCS) FOR M. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2024)

Name of the Program: M.Sc. Zoology
Program Code: ZOO
Class: M. Sc. II
Semester: IV
Couse Type: Skill Development
Course Code: ZOO-691-SDC
Course Name: Skill Development Course
Number of Credits: 02
Number of Teaching hours: 30 (12- Theory + 18-Practical)

Course Objectives: -

- Analyze the diversity of insects and their terrestrial relatives using the quadrate method, understanding their ecological roles and adaptations.
- Identify different species of honey bees, explore their ecological significance, and discuss their uses in agriculture and industry.
- Examine various beekeeping equipment and techniques, understanding their applications in honey production and pollination services.
- Investigate two diseases caused by insects, analyzing their impact on human health and agriculture, and discussing prevention strategies.
- Study the life cycles of key pollinator insects, emphasizing their role in ecosystems and agricultural productivity.
- Evaluate various biological control strategies and chemical control methods for managing insect pests, understanding their advantages and limitations.
- Discuss the importance of insect conservation and sustainable practices, analyzing cultural attitudes toward insects in human society.

Course Outcomes: -

After completion of this course, students will-

CO1: Demonstrate the ability to analyze and interpret data on insect diversity using the quadrate method, effectively assessing their ecological roles and adaptations in different environments.
CO2: Identify and classify different species of honey bees, explaining their ecological importance and articulating their contributions to agriculture and industry.
CO3: Demonstrate proficiency in the use of various beekeeping equipment and techniques, applying knowledge to optimize honey production and enhance pollination services.
CO4: Analyze and evaluate the impact of insect-borne diseases on human health and agriculture, proposing effective prevention and management strategies.
CO5: Describe the life cycles of key pollinator insects, articulating their ecological roles and significance in enhancing agricultural productivity and biodiversity.
CO6: Critically evaluate the effectiveness of biological control strategies and chemical control methods in managing insect pests, discussing their environmental implications and sustainability.
CO7: Articulate the importance of insect conservation and sustainable practices, demonstrating an understanding of cultural attitudes toward insects and their roles in human society.

CONTENT:

UNIT NO.	SYLLABUS	NO. OF LECTURES
	Theory	
1	Introduction to insects and their terrestrial relatives	2

2	Beneficial and harmful insects	1
3	Insects as a decomposer and food	2
4	Pollination and bee keeping	2
5	Insects and diseases	2
6	Insects in human culture	1
7	Insect conservation	1
8	Biological and cultural control strategies of insects	1
Practicals		
Sr. No.	**Name of the practical**	**No. of teaching hours**
1	To study the diversity of insects by using quadrate method	**3**
2	Identification of honey bee species and their uses	**3**
3	To study various bee keeping equipment and their applications	**3**
4	To study any two diseases causes due to insects.	**3**
5	To study the different pollinator insects and their life cycle.	**3**
6	To study the various bio-control and chemical control methods of insect pests.	**3**

REFERENCES

1. Morris, B. (2004). Insects and Human Life (1st ed.). Routledge, United Kingdom.
2. Govorushko, S. (2017). Human-Insect Interactions (1st ed.). CRC Press, United States.

Course Articulation Matrix of ZOO-691-SDC Skill Development Course
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	1	2	2	2	1	1	1	2
CO2	3	3	1	2	2	1	1	1	1	1
CO3	3	3	1	3	2	1	1	1	1	2
CO4	3	3	1	3	3	2	1	1	1	1
CO5	3	2	1	2	1	1	1	1	1	1
CO6	3	3	1	3	3	2	1	1	1	1
CO7	3	3	1	2	2	1	1	1	3	2

PO1: Comprehensive Knowledge and Understanding
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly due to their emphasis on understanding insect diversity, ecological roles, and conservation strategies. These COs build a comprehensive knowledge base of entomology and its relevance to various fields.

PO2: Practical, Professional, and Procedural Knowledge
CO1, CO2, CO3, CO4, CO5, CO6 and CO7 maps strongly as they involve practical skills such as data analysis, species identification, and application of beekeeping techniques. These COs foster professional competency in entomology.

PO3: Entrepreneurial Mindset, Innovation, and Business Understanding
CO3 maps moderately, as the knowledge of beekeeping techniques can lead to antrepreneurial opportunities in honey production and pollination services.

PO4: Specialized Skills, Critical Thinking, and Problem-Solving
CO1, CO4 and CO6 maps strongly due to the need for specialized skills and critical thinking in analyzing ecological roles, disease impacts, and pest management strategies.

PO5: Research, Analytical Reasoning, and Ethical Conduct
CO4, CO6, and CO7 maps strongly due to their emphasis on evaluating disease impacts, pest management methods, and the importance of conservation, integrating research and ethical considerations.

PO6: Communication, Collaboration, and Leadership
CO1, CO2, and CO4 maps moderately as they involve presenting findings, discussing ecological significance, and proposing management strategies, which fosters teamwork and communication in research contexts.

PO7: Digital Proficiency and Technological Skills
CO1, and CO3 maps moderately as they require proficiency in data analysis and the use of technology in beekeeping and ecological assessments.

PO8: Multicultural Competence, Inclusive Spirit, and Empathy
CO7 maps strongly as it addresses the cultural attitudes toward insects and their roles in human society, promoting inclusivity and understanding.

PO9: Value Inculcation, Environmental Awareness, and Ethical Practices
CO7 maps strongly as it emphasizes the importance of insect conservation and sustainable practices, fostering environmental awareness.

PO10: Autonomy, Responsibility, and Accountability
CO1, CO4, and CO6 maps moderately as tasks like analyzing insect diversity, evaluating disease impacts, and assessing pest management strategies require autonomy and accountability in practical work.