Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science & Commerce, Baramati

(Autonomous)

Four Year B.Sc. Degree Program in Zoology

(Faculty of Science & Technology)

CBCS Syllabus

S.Y. B.Sc. (Zoology) Semester -III

For 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 Program: S Y. B. 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 learning. 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 learning 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 third semester (Second year) of **B. 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 B.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 analyzing 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. B.Sc. Zoology graduates 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 B.Sc, M.Sc and Ph.D. in 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 Cell Biology, Genetics, Taxonomy, Physiology, Biochemistry, Molecular Biology, Embryology, Developmental Biology, Immunology, Ecology 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 interpret the pathogen based upon symptoms of disease.

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.

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(Autonomous)

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**	Invitee member
9.	**Mr. Mayur S. Shitole**	Invitee member
10.	**Mr. Bipin B. Jagtap**	Meritorious Alumni
11.	**Ms. Sana J. Sayyad**	Student Representative
12.	**Mr. Subodh M. Nikam**	Student Representative

Course & Credit Distribution Structure for S.Y.B.Sc. –From A.Y. 2024-2025 (Zoology)

Sem	Course Category	Course Code	Course Title	Theory / Practical	Credits
III	Major mandatory	ZOO-201-MJM	Animal Systematics & Diversity-III	T	2
	Major mandatory	ZOO-202-MJM	Applied Zoology-I	T	2
	Major mandatory	ZOO-203-MJM	Ecology	T	2
	Major mandatory	ZOO-204-MJM	Zoology Practical-III	**P**	2
	Minor	ZOO-211-MN	Sericulture	T	2
	Minor	ZOO-212-MN	Sericulture Lab	**P**	2
	Open Elective	ZOO-216-OE	मधमाशापालन	T	2
	Vocational Skill Course (VEC)	ZOO-221-VSC	Toxicology	T	2
	Ability Enhancement Course (AEC)	MAR/HIN/SAN-231-AEC	भाषिक उपयोजन व लेखन कौशल्ये हिंदी भाषा : सृजन कौशल प्राथमिक संभाषणकौशल्यम्	T	2
	Field Project	ZOO-235-FP	Field Project	**P**	2
	Co-curricular course (CC)	YOG/PES/CUL/NSS/NCC-239-CC	To be selected from basket	T	2
	Generic IKS	GEN-245-IKS		T	2
			Total Credits (Semester-III)		24
IV					
	Major mandatory	ZOO-251-MJM	Animal Systematics & Diversity-IV	T	2
	Major mandatory	ZOO-252-MJM	Applied Zoology- II	T	2
	Major mandatory	ZOO-253-MJM	Environmental Biology	T	2
	Major mandatory	ZOO-254-MJM	Zoology Practical-IV	**P**	2
	Minor	ZOO-261-MN	Dairy Science	T	2
	Minor	ZOO-262-MN	Dairy Science Lab	**P**	2
	Open Elective	ZOO-266-OE	मधुमक्षिका पालन प्रात्यक्षिक	T	2
	Skill Enhancement Course (SEC)	ZOO-276-SEC	Toxicology Lab	P	2
	Ability Enhancement Course (AEC)	MAR/HIN/SAN-281-AEC	लेखन निर्मिती व परीक्षण कौशल्ये हिंदी भाषा : संप्रेषण कौशल प्रगत संभाषणकौशल्यम्	T	2
	Community Engagement Project	ZOO-285-CEP	Community Engagement Project	**P**	2
	Co-curricular course (CC)	YOG/PES/CUL/NSS/NCC-289-CC	To be selected from basket	T	2
			Total Credits (Semester-IV)		22
			Cumulative Credits- Semester III + IV		46

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

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: S.Y. B.Sc.

Semester: III

Course Type: Major (Mandatory) Theory

Course Code: ZOO-201-MJM

Course Name: Animal Systematics & Diversity-III

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:

- Distinguish between different classes with highlighting distinct characteristics.
- Assessment of special biological processes in organisms.
- Examination of cockroach anatomy and physiology.
- Assess the ecological roles and economic importance of the studied invertebrates.
- Acquire taxonomic knowledge to identify and classify unknown invertebrates.
- Assess the evolutionary adaptations and biological strategies displayed by different invertebrate groups.
- Explore the behavioral patterns in organisms.

Course Outcomes:

Student will be able to-

CO1: distinguish distinct characteristics of various invertebrate classes, facilitating precise classification and identification.
CO2: assess and analyze specific biological phenomena in invertebrates.
CO3: comprehensively examine the anatomy and functionality of cockroach systems.
CO4: critically evaluate the ecological roles of studied invertebrates.
CO5: acquire taxonomic knowledge essential for identifying and classifying unknown invertebrates.
CO6: evaluate and interpret the evolutionary adaptations and biological strategies exhibited by diverse invertebrate groups.
CO7: explore and analyze behavioral patterns in various invertebrate species.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1. Salient features and classification upto classes of the following: (any one example from each class)			**(09 L)**
	1.1	Arthropoda: - Crustacea, Arachnida, Insecta, Myriapoda and Onychophora.	03
	1.2	Mollusca: - Aplacophora, Gastropoda, Scaphopoda, Pelecypoda, and Cephalopoda	03
	1.3	Echinodermata:- Asteroidea, Ophuroidea, Holothuria, Echinoidea, and Crinoidea	03
2. General topics:			**(09 L)**
	2.1	Insects: Metamorphosis, Mouthpart, Mimicry, Bioluminescence	05

	2.2	Mollusca: Shell (Structure, diversity and uses)	02
	2.3	Echinoderms: Autotomy and regeneration	02
3. Biology of cockroach			**(12 L)**
	3.1	Systematic position, habit and habitat	01
	3.2	External morphology and sexual dimorphism	01
	3.3	Digestive system	01
	3.4	Circulatory system	02
	3.5	Respiratory system	01
	3.6	Reproductive system: Male & Female	02
	3.6	Nervous system	02
	3.7	Sense organs	02

REFERENCES

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Course Articulation Matrix of ZOO-201-MJM: Animal Systematics & Diversity-III
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	2	1	1	1	1	1	1	1	1
CO2	3	2	2	2	3	1	3	2	1	1	2	2	1
CO3	3	2	1	2	1	1	2	2	1	1	1	1	1
CO4	3	1	2	2	3	2	2	2	1	1	3	2	1
CO5	3	2	1	3	2	1	2	3	1	1	2	2	1
CO6	3	1	1	2	3	2	3	3	1	1	1	1	1
CO7	2	2	1	1	2	2	2	2	1	1	2	1	1

PO1: Comprehensive knowledge and understanding
CO5 directly mapped to PO5 because; a strong understanding of invertebrate characteristics is necessary to distinguish between different classes.

PO2: Practical, professional, and procedural knowledge
CO3 and 5 are directly mapped to PO2 because; practical knowledge in anatomy and functionality aids in conducting comprehensive examinations of cockroach systems.

PO3: Entrepreneurial mindset and knowledge
CO4 is directly mapped to PO3 because understanding economic importance can be relevant to an entrepreneurial mindset.

PO4: Specialized skills and competencies
CO6 is directly mapped to PO4 because evaluation and interpretation of evolutionary adaptations and biological strategies exhibited by diverse invertebrate groups requires analysis skills.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO6 is directly mapped to PO5 because critical thinking and analysis are essential for interpretation of evolutionary adaptations

PO6: Communication skills and collaboration
CO7 is directly mapped to PO6 because communication skills and collaboration are essential for presenting findings evaluations and interpretations.

PO7: Research-related skills
CO6 is directly mapped to PO7 because research-related skills are crucial for evaluation and interpretation of evolutionary adaptations and biological strategies exhibited by diverse invertebrate groups.

PO8: Learning how to learn skills
CO6 is directly mapped to PO8 because learning about evolution and biological strategies is part of learning how to learn about invertebrates.

PO9: Digital and technological skills
CO6 is directly mapped to PO9 because digital and technological skills are directly involved in accessing relevant research and data.

PO10: Multicultural competence, inclusive spirit, and empathy
All of the COs are indirectly mapped to PO10 because, Multicultural competence, inclusive spirit, and empathy may indirectly contribute to understanding diverse perspectives on invertebrate ecological roles.

PO11: Value inculcation and environmental awareness
All Cos are strongly mapped to PO11 because; Value inculcation and environmental awareness motivate the study and acquisition of taxonomic knowledge for conservation purposes.

PO12: Autonomy, responsibility, and accountability
CO4 is moderately mapped to PO12 because; Autonomy, responsibility, and accountability are necessary for conducting independent evaluations.

PO13: Community engagement and service
All of the COs are partially mapped to PO13 because; community engagement and service may involve sharing findings about invertebrate ecological roles, biological phenomena with the community.

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

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: S.Y. B.Sc.

Semester: III

Course Type: Major (Mandatory) Theory

Course Code: ZOO-202-MJM

Course Name: Applied Zoology-I

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- Understand the fundamentals of fisheries and aquaculture.
- Gain comprehensive knowledge of freshwater pearl culture.
- Develop an understanding of Lamellidans spp. morphology, anatomy, and their role in pearl formation.
- Master the different implantation techniques in pearl culture.
- Gain knowledge of post-operative care and marketing in pearl culture.
- Develop an understanding of fish preservation techniques.
- Gain knowledge of fishery ponds

Course Outcomes:-

Student will be able to-

CO1: demonstrate comprehensive knowledge of the foundational principles and practices in fisheries and aquaculture.
CO2: attain mastery in freshwater pearl culture techniques.
CO3: develop a comprehensive understanding of *Lamellidans* spp., exploring their morphology, anatomy, and their pivotal role in the formation of pearls.
CO4: acquire proficiency in various implantation methods used in pearl culture.
CO5: gain an understanding of post-operative care for molluscs post-implantation and knowledge of marketing strategies for cultured pearls.
CO6: develop comprehensive understanding fish preservation techniques.
CO7: attain proficiency and comprehensive knowledge in aquaculture ponds.

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1. Fisheries:			**(12 L)**
	1.1	Introduction to fisheries	2
	1.2	Different types of ponds used in fish farming: nursery pond, rearing pond and grow out ponds	2
	1.3	Introduction to composite fish farming of Indian major carps (Biology of fish (Rohu, Catla and Mrigal), seed rearing, nutrition and feeding habits)	6

	1.4	**Fish transport and preservation:** a) Salting b) Chilling (Use of insulated containers, etc.) c) Freezing d) Canning	2
2. Freshwater Pearl Culture:			**(18 L)**
	2.1	**Introduction to pearl culture** • Global and national status of pearl culture • Significance of pearl culture	3
	2.2	**Morphology and biology of *Lamellidans* spp.** • Morphology • Anatomy: Alimentary canal and associated structures	4
	2.3	Formulation and preparation of artificial feeds for larval rearing	2
	2.4	**Implantation techniques in Pearl Culture** • Surgical procedures in pearl culture • Beads insertion • Nucleus implantation • Graft tissue preparation	4
	2.5	**Post-operative care and marketing** • Post-operative care. Precautionary measures of pearl culture • Quality improvement • Caring of implanted bivalve • Harvesting of pearl • Sorting of pearl • Marketing and economics concerned with pearl culture	5

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8. Pedigo, L. P., Rice, M. E., &Krell, R. K. (2021). Entomology and pest management. Waveland Press.

Course Articulation Matrix of ZOO-202-MJM Applied Zoology-I
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	1	3	3	3	3	3	2	1	3	3	2
CO2	3	3	1	3	3	3	3	3	2	1	3	3	2
CO3	3	3	1	3	3	3	3	3	2	1	3	3	2
CO4	3	3	1	3	3	3	3	3	2	1	3	3	2
CO5	3	3	1	3	3	3	3	3	2	1	3	3	2
CO6	3	3	1	3	3	3	3	3	2	1	3	3	2
CO7	3	3	1	3	3	3	3	3	2	1	3	3	2

PO1: Comprehensive knowledge and understanding
All of the course outcomes (COs) are directly mapped to PO1. For example CO1 aims to demonstrate comprehensive knowledge of fisheries and aquaculture principles and practices, which directly aligns with the goal of PO1, which emphasizes the acquisition of comprehensive knowledge and understanding in various domains.

PO2: Practical, professional, and procedural knowledge
All of the course outcomes (COs) are directly mapped to PO2. For example CO2 aims to attaining mastery in freshwater pearl culture techniques necessitates practical, professional, and procedural knowledge, which directly aligns with the objective of PO2.

PO3: Entrepreneurial mindset and knowledge
All of the course outcomes (COs) are indirectly mapped to PO3. For example, the primary focus of CO2 is on mastering specific techniques rather than fostering an entrepreneurial mindset while proficiency in pearl culture techniques may indirectly relate to identifying entrepreneurial opportunities.

PO4: Specialized skills and competencies
All of the course outcomes (COs) are directly mapped to PO4. For example; CO2 aims to develop specialized skills and competencies in freshwater pearl culture, directly aligning with the objective of PO4, which emphasizes the acquisition of specialized skills in specific areas.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO3 is directly mapped to PO5 because; capacity for application, problem-solving, and analytical reasoning are necessary for studying *Lamellidans* spp.

PO6: Communication skills and collaboration
CO3 is directly mapped to PO6 because; communication skills and collaboration are necessary for sharing and applying knowledge about *Lamellidans* spp.

PO7: Research-related skills
CO4 is directly mapped to PO7 because; research-related skills are crucial for acquiring proficiency in implantation methods.

PO8: Learning how to learn skills
CO4 directly mapped to PO8 because; learning how to learn skills aid in acquiring and updating knowledge in pearl culture practices.

PO9: Digital and technological skills
CO4 directly mapped to PO9 because; digital and technological skills may support data management and analysis in marketing strategies.

PO10: Multicultural competence, inclusive spirit, and empathy
All of the COs are indirectly mapped to PO10 because, multicultural competence, inclusive spirit, and empathy may indirectly relate to understanding diverse perspectives in aquaculture pond management.

PO11: Value inculcation and environmental awareness
All of the CO's are directly mapped to PO10. For example; CO1 aims to understand and apply sustainable practices in fisheries and aquaculture, aligning directly with the objective of PO11, which emphasizes the inculcation of values and environmental awareness.

PO12: Autonomy, responsibility, and accountability
All of the CO's are directly mapped to PO10. For example; CO1 involves independent practice and decision-making in fisheries and aquaculture contexts, which directly aligns with the objective of PO12, emphasizing the development of autonomy, responsibility, and accountability.

PO13: Community engagement and service
All of the CO's are moderately mapped to PO10. For example; while sharing knowledge and practices with the community may involve aspects of fisheries and aquaculture, CO1 primarily focuses on individual competence rather than community engagement and service, hence the moderate relation.

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

Name of the Program: B.Sc. Zoology
Program Code: ZOO
Class: S.Y. B.Sc.
Semester: III
Course Type: Major (Mandatory) Theory
Course Code: ZOO-203-MJM
Course Name: Ecology
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Fundamental principles and scope of ecology.
- Basic concepts in ecology.
- Explore the concept and types of niche.
- Examine ecosystem structure, function, and diversity.
- Analyze energy flow and biogeochemical cycles.
- Understand population dynamics and growth.
- Explore community dynamics and interactions.

Course Outcomes:-

Student will -

CO1: grasp the basic concepts of ecology, including its definition, principles, and the interrelationships between organisms and their environments.

CO2: explain key ecological terms such as autecology, synecology, ecozones, landscape, habitat, biosphere, ecosystem, and niche, and understand their significance within ecological studies.

CO3: gain knowledge of niche theory, including its conceptual framework and the different types of niches, and appreciate the ecological implications of niche differentiation and partitioning.

CO4: comprehend the concept, structure, and functions of ecosystems, and classify different ecosystem types such as forests, grasslands, aquatic environments, deserts, and wetlands based on their characteristics.

CO5: investigate energy flow within ecosystems through food chains and food webs, and explore the dynamics of biogeochemical cycles, including hydrological, carbon, nitrogen, phosphorus, and sulfur cycles.

CO6: analyze population characteristics such as density, dispersion, natality, mortality, survivorship curves, and age structure.

CO7: examine community ecology, focusing on keystone species, ecotones, edge effects, and various species interactions and ecological succession processes.

TOPICS:

Unit No.	Subunit No	Details	Teaching Hours
1. Introduction to Ecology	1.1	Basic concept, principles, & scope of ecology	06
	1.2	Definitions: Ecology, autecology, synecology, ecozones, landscape, habitat, biosphere & ecosystem	
	1.3	Concept and types of niche	
2. Ecosystem	2.1	Concept, structure and functions of ecosystem	14
	2.2	Types of ecosystem: Forest, grassland, aquatic, desert	

		& wetlands	
	2.3	Energy flow in ecosystem: Food chain & food web	
	2.4	Ecological pyramids	
	2.5	Ecosystem metabolism- primary production, secondary production, GPP, NPP and trophic efficiency	
	2.6	Biogeochemical cycles- Hydrological, carbon, nitrogen, phosphorous & sulphur cycle	
3. Population Ecology	3.1	Concept of population & meta population, r- & k-selection	05
	3.2	Characteristics of population: Density, dispersion, natality, mortality, survivorship curves & age structure	
	3.3	Population growth: Introduction to geometric, exponential & logistic growth curves.	
4. Community Ecology	4.1	Community Characteristics: keystone species, ecotone and edge effect	05
	4.2	Species interactions: Mutualism, commensalism, amensalism, predation, competition, parasitism, mimicry, herbivory.	
	4.3	Ecological succession: Primary and secondary successions, stages of succession, examples of succession	

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Course Articulation Matrix of ZOO-203-MJM: Ecology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	1	3	3	1	2	2	1	1	3	1	1
CO2	3	3	1	3	3	1	2	2	1	1	3	1	1
CO3	1	1	3	1	1	1	2	2	1	1	3	1	1
CO4	3	3	1	3	3	1	2	2	1	1	3	1	1
CO5	3	3	1	3	3	1	2	2	1	1	3	1	1
CO6	1	1	1	1	1	2	3	2	1	1	1	1	1
CO7	1	1	2	1	2	2	3	2	1	1	2	2	1

PO1: Comprehensive knowledge and understanding
All of the course outcomes (COs) are directly mapped to PO1; for example, CO4 requires students to have comprehensive knowledge to understand the ecosystem.

PO2: Practical, professional, and procedural knowledge
All of the course outcomes (COs) are directly mapped to PO2; for example CO1, understanding key ecological terms is crucial for practical, professional, and procedural knowledge in ecological studies.

PO3: Entrepreneurial mindset and knowledge
CO3 and 4 are directly mapped to PO3 because they focus on Niche theory and ecological implications which directly contribute to entrepreneurial mindset and knowledge.

PO4: Specialized skills and competencies
CO4 and 5 are directly mapped to PO4 because they involve investigation of energy flow within ecology which contributes to development of specialized skills and competencies.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO5 directly mapped to PO5 because investigating energy flow contributes to specialized skills and competencies within ecology.

PO6: Communication skills and collaboration
CO 6 and 7 are directly mapped to PO6 because communication skills and collaboration are essential for examining community ecology, especially in understanding species interactions and ecosystem dynamics.

PO7: Research-related skills
All Cos are strongly mapped to PO7 because research-related skills are crucial for examining ecosystem, community ecology, including data collection, analysis, and interpretation.

PO8: Learning how to learn skills
All Cos are moderately mapped to PO8 because learning how to learn skills are engaged in examining community ecology, especially in acquiring new knowledge and methodologies.

PO9: Digital and technological skills
All of the COs are partially mapped to PO9 because digital and technological skills are directly involved in examining community ecology, but they can aid in data analysis and presentation.

PO10: Multicultural competence, inclusive spirit, and empathy
All of the COs are indirectly mapped to PO10 because, multicultural competence, inclusive spirit, and empathy may not be directly involved in comprehending ecosystems.

PO11: Value inculcation and environmental awareness
All Cos are strongly mapped to PO11 because;, value inculcation and environmental awareness are closely tied to understanding key ecological terms, basic ecological concepts, niche theory and comprehending ecosystems.

PO12: Autonomy, responsibility, and accountability
CO7 is moderately mapped to PO12 because; autonomy, responsibility, and accountability are engaged in examining community ecology, especially in designing and conducting research projects.

PO13: Community engagement and service
All of the COs are partially mapped to PO13 because; community engagement and service activities, such as participatory research and conservation initiatives, complement research-related skills in examining community ecology enhance practical applications of ecological knowledge and foster collaboration between researchers and community stakeholders.

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

Name of the Program: B.Sc. Zoology
Program Code: ZOO
Class: S.Y. B.Sc.

Semester: III

Course Type: Major (Mandatory) Practical

Course Code: ZOO-204-MJM

Course Name: Zoology Practical - III

Number of Credits: 02

Number of Teaching hours: 60

Course Objectives:-

- Develop the ability to classify organisms to their respective class based on specific characteristics.
- Gain in-depth knowledge of morphology, anatomy and physiology of cockroach through practical study and analysis.
- Acquire practical skills in temporary and permanent mountings of insects.
- Develop expertise in taxonomic identification, feeding habits, and economic importance of specific fish.
- Estimate the major biochemical components (protein, lipid, and carbohydrate) present in fish tissue.
- Apply ecological principles to determine stocking density and feed requirements in a fishery setting.
- Investigate aquatic ecosystems through various methods, including primary productivity estimation, zooplankton diversity analysis, and phoretic association studies.

Course Outcomes:-

Student will be able to-

CO1: identify and classify organisms to their respective classes based on key morphological characteristics.
CO2: explain the anatomical structures and physiological processes of the cockroach.
CO3: skillfully master temporary and permanent mounting techniques for preparing insect specimens for preservation and identification.
CO4: accurately identify common fish species based on their taxonomic characteristics.
CO5: utilize appropriate laboratory techniques to extract and quantify protein, lipid, and carbohydrate content in fish tissue samples.
CO6: evaluate the nutritional needs of different fish species and design feeding strategies based on stocking density and ecological principles.
CO7: employ the light and dark bottle method to estimate primary productivity in a water body, utilize appropriate techniques to collect and identify zooplankton species.

Sr. No.	Title of the Practical	E/D
1	Classification of following taxa to their 'class level' with reason: Phylum Arthropoda (Crab and Scorpion) Phylum Mollusca (*Pila* and *Octopus*) Phylum Echinodermata (Sea star and Feather star)	(D)
2	Study of morphology, sexual dimorphism and digestive system of cockroach	(E)

3	Study of nervous system of cockroach	(E)
4	Study of reproductive system of cockroach	(E)
5	Temporary / Permanent mountings of a) Cornea b) Thoracic spiracles c) Gizzard	(E)
6.	Taxonomic identification, feeding habit and economic importance of following fish: a) Rohu b) Catla c) Mrigal	(D)
7.	Estimation of Protein / Lipid / Carbohydrate in Fish.	(E)
8.	Determination of stocking density and feed assessment in fishery.	(D / E)
9.	Study of morphology and digestive system of mussel	(D / E)
10.	Estimation of primary productivity in aquatic ecosystem by using light and dark bottle method	(E)
11.	Determination of frequency, density & abundance of insects by quadrate method.	(E)
12	Study of phoretic association of the species from surrounding area.	(D)
13	To study the zooplankton diversity in a fresh water ecosystem	(E)
14	Visit to a forest / grassland / aquatic ecosystem / Aquaculture and submission of report	(E)
15	Submission of short project report on Economics of Aquaculture /Pearl culture/ (Activity based practical)	
***D- Demonstration; E- Experiment.**		

Course Articulation Matrix of ZOO-204-MJM: Zoology Practical-III
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	1	3	3	2	3	3	1	1	3	3	2
CO2	3	3	1	3	3	2	3	3	1	1	3	3	2
CO3	3	3	1	3	3	2	3	3	1	1	3	3	2
CO4	3	3	1	3	3	2	3	3	1	1	3	3	2
CO5	3	3	1	3	3	2	3	3	3	1	3	3	2
CO6	3	3	2	3	3	3	3	3	1	1	3	3	2
CO7	3	3	1	3	3	3	3	3	1	1	3	3	3

PO1: Comprehensive knowledge and understanding
All of the course outcomes (COs) are directly mapped to PO1 because each CO contributes directly to building comprehensive knowledge and understanding in their respective fields of study.

PO2: Practical, professional, and procedural knowledge
All of the course outcomes (COs) are directly mapped to PO2 because; all COs involve the acquisition and

application of practical skills, professional knowledge, and procedural techniques essential for success in various fields.

PO3: Entrepreneurial mindset and knowledge
CO6 is moderately mapped to PO3 because an entrepreneurial mindset may lead to innovative approaches in designing feeding strategies.

PO4: Specialized skills and competencies
All of the course outcomes (COs) are directly mapped to PO4. For example; CO7 requires specialized skills in aquatic ecology and limnology.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
All of the course outcomes (COs) are directly mapped to PO5. For example; in CO7 analytical reasoning is involved in interpreting primary productivity data and identifying zooplankton species

PO6: Communication skills and collaboration
CO 6 and 7 are directly mapped to PO6 because; effective communication and collaboration are essential for conducting fieldwork and sharing research findings.

PO7: Research-related skills
All Cos are strongly mapped to PO7 because research skills are crucial for fish identification and classification, conducting primary productivity studies and zooplankton surveys.

PO8: Learning how to learn skills
All Cos are moderately mapped to PO8 because; each CO encourages students to reflect on their learning process, seek out new information, and refine their skills over time, aligning closely with the objectives of PO8.

PO9: Digital and technological skills
All of the COs are partially mapped to PO9 because digital skills may be necessary for data analysis and interpretation in laboratory work.

PO10: Multicultural competence, inclusive spirit, and empathy
All of the COs are indirectly mapped to PO10 because, they indirectly contribute to fostering an inclusive and empathetic mindset. Understanding diverse perspectives and respecting cultural differences are essential components of effective collaboration and communication, which are integral to many of the COs.

PO11: Value inculcation and environmental awareness
All Cos are strongly mapped to PO11. For example, in CO7 understanding aquatic ecosystems contributes to environmental awareness and conservation efforts.

PO12: Autonomy, responsibility, and accountability
CO7 is moderately mapped to PO12 because; autonomy, responsibility, and accountability are engaged in examining aquatic ecosystems, especially in designing, conducting surveys and research projects.

PO13: Community engagement and service
All of the COs are moderately mapped to PO13 because; they indirectly contribute to community engagement through potential applications in research, conservation efforts, or educational outreach activities. All COs offers opportunities for students to apply their skills and knowledge for the betterment of communities and ecosystems, thus warranting a moderate level of relationship with PO13.

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

Name of the Program: B.Sc. Zoology
Program Code: ZOO
Class: S.Y. B.Sc.

Semester: III

Course Type: Minor Theory

Course Code: ZOO-211-MN

Course Name: Sericulture

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- Develop a comprehensive understanding of the diversity of silk moths, their distribution patterns, and the varieties of silk
- Describe the external morphology and life cycle of Bombyx mori (silkworm) to facilitate effective management practices during its different developmental stages.
- Gain practical knowledge of moriculture techniques
- Acquire proficiency in silkworm rearing, encompassing various rearing methods, management of rearing houses, techniques for bed cleaning, mounting, and harvesting.
- Identify and assess the management strategies for prevalent diseases and pests affecting sericulture, ensuring effective disease and pest control measures.
- Learn the post-harvest processing procedures for cocoons.
- Explore the utilization of by-products generated in the sericulture industry and their diverse applications.

Course Outcomes:-

Student will be able to-

CO1: develop a comprehensive understanding of the diversity of silk moths, their distribution patterns, and the varieties of silk, enhancing knowledge of sericulture practices and silk production.

CO2: describe the external morphology and life cycle of Bombyx mori (silkworm), enabling effective management strategies at different developmental stages to optimize silk production.

CO3: gain practical knowledge of moriculture techniques, including mulberry cultivation and maintenance, fertilization schedules, and harvesting methods, fostering competency in sericulture practices.

CO4: acquire proficiency in silkworm rearing, encompassing various rearing methods, maintenance of rearing houses, and efficient techniques for bed cleaning, mounting, and harvesting, ensuring successful silk production.

CO5: identify and assess management strategies for prevalent diseases and pests affecting sericulture, enabling implementation of effective disease and pest control measures to safeguard silk production.

CO6: learn post-harvest processing procedures for cocoons, including harvesting techniques and processing methods such as stiffling, sorting, and reeling, ensuring quality silk production and processing.

CO7: explore the utilization of by-products generated in the sericulture industry and their diverse applications, enhancing understanding of the economic and environmental aspects of sericulture practices and by-product utilization.

Topics:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1. Introduction and types of Silk moths	1.1	An Introduction and its scope	01
	1.2	Study of different types of silk moths, their distribution and varieties of silk produced by Mulberry, Tassar, Eri and Muga silk worms in India	02
2. Life cycle of *B. mori*	2.1	External morphology	01
	2.2	Life cycle of *Bombyx mori.*	02
3. Moriculture	3.1	Cultivation of mulberry: a) Varieties for cultivation, b) Rainfed and irrigated mulberry cultivation – Fertilize schedule, Prunning.	04
	3.2	Harvesting of mulberry : Introduction and types - a) Leaf plucking b)Branch cutting c) Whole shoot cutting.	02
4. Silkworm rearing	4.1	Silk worm rearing: a) Types of rearing b) Rearing house c) Rearing techniques d) Bed cleaning e) Mounting and harvesting	03
	4.2	Quality of silk, factors influencing the quality of silk, market value, commercial aspects	05
5. Important diseases and pests.	5.1	Protozoan, fungal, bacterial and viral diseases (each one)	03
	5.2	Pests: a) Dermestid beetles b) Uzi-fly	02
6. Post-harvest processing of cocoons	6.1	Post-harvest processing of cocoons: a) Harvesting and preparation of cocoons for marketing b) Stiffling, sorting, storage, deflossing and riddling c) Cocoon cooking, reeling and rereeling, washing and polishing.	03
7. By-products and applications of sericulture	7.1	By-products of sericulture industry and their applications.	02

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Course Articulation Matrix of ZOO-211-MN: Sericulture
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	3	2	2	2	2	2	3	2	3
CO2	3	3	1	3	3	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	2	3	2	2	3	3	3
CO4	3	3	2	3	3	3	2	3	2	2	3	3	3
CO5	3	3	1	3	3	3	3	3	2	2	3	3	3
CO6	3	3	1	3	3	3	2	3	2	2	3	3	3
CO7	3	3	1	3	3	3	2	3	2	2	3	3	3

PO1: Comprehensive knowledge and understanding
All of the course outcomes (COs) are directly mapped to PO1 because; each CO provides specific knowledge and skills that contribute to a holistic understanding of sericulture

PO2: Practical, professional, and procedural knowledge
All of the course outcomes (COs) are directly mapped to PO2 because; each CO offers specific skills and competencies required for various aspects of sericulture, such as cultivation, rearing, disease management, post-harvest processing, and by-product utilization.

PO3: Entrepreneurial mindset and knowledge
All of the course outcomes (COs) are indirectly mapped to PO3 because each CO contributes to building skills and knowledge essential for sericulture, which could be applied in entrepreneurial endeavors within the industry. For instance, CO4 and CO5 provide proficiency in silkworm rearing and disease management, crucial for successful sericulture businesses.

PO4: Specialized skills and competencies
All of the course outcomes (COs) are directly mapped to PO4 as they collectively contribute to the development of specialized skills and competencies essential for sericulture.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
All of the course outcomes (COs) are directly mapped to PO5 All COs correlate strongly with PO5 as they collectively contribute to enhancing the capacity for application, problem-solving, and analytical reasoning in the context of sericulture.

PO6: Communication skills and collaboration
All of the course outcomes (COs) are directly mapped to PO6 as they collectively contribute to developing communication skills and fostering collaboration within the context of sericulture..

PO7: Research-related skills
All Cos are indirectly mapped to PO7 as each CO indirectly supports the development of research-related skills within the context of sericulture. For instance, CO1 enhances understanding of silk moth diversity, which could lay the groundwork for conducting research on silk moth behavior or genetics.

PO8: Learning how to learn skills
All Cos are directly mapped to PO8 as they collectively contribute to the development of adaptive learning abilities within the context of sericulture.

PO9: Digital and technological skills
All of the COs are mapped to PO9 as they collectively contribute to the integration of technology and digital tools within the context of sericulture practices. For instance, CO1 enhances understanding of silk moth diversity, which could involve utilizing digital resources such as databases or online platforms for species identification and research.

PO10: Multicultural competence, inclusive spirit, and empathy
All of the COs are directly mapped to PO10 as they collectively contribute to fostering understanding and collaboration within diverse cultural contexts in the field of sericulture.

PO11: Value inculcation and environmental awareness
All COs are strongly mapped to PO11 which focuses on value inculcation and environmental awareness, as they collectively contribute to promoting sustainable practices and environmental stewardship within the field of sericulture.

PO12: Autonomy, responsibility, and accountability
All COs are strongly mapped to PO12 which emphasizes autonomy, responsibility, and accountability, as they collectively contribute to fostering independent decision-making, accountability for actions, and responsible stewardship within the field of sericulture.

PO13: Community engagement and service
All of the COs are mapped to PO13 which focuses on community engagement and service, as they collectively contribute to fostering community involvement and addressing societal needs within the field of sericulture.

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

Name of the Program: B.Sc. Zoology
Program Code: ZOO
Class: S.Y. B.Sc.

Semester: III

Course Type: Minor Practical

Course Code: ZOO-212-MN

Course Name: Sericulture Lab

Number of Credits: 02

Number of Teaching hours: 60

Course Objectives:-

- Develop proficiency in identifying different types of raw silk produced by various silk moth species, their characteristics and applications in sericulture practices.
- Gain practical knowledge and comprehension of the life cycle of *Bombyx mori*, to facilitate effective management and rearing techniques in sericulture.
- Acquire skills in sex separation techniques for silkworm larvae, pupae, and adults, enabling the identification and selection of desired sexes for controlled breeding and improved silk production.
- Develop competency in temporary mountings of silkworm larval structures
- Understand the characteristics of cocoon structures in popular uni-, bi-, and multivoltine races of silkworms
- Familiarize with different types of rearing houses used in sericulture to comprehend their design, functionality, and suitability for silk production.
- Learn methods for determining the percentage of good and defective cocoons, enabling assessment of cocoon quality and production efficiency in sericulture practices.

Course Outcomes:-

Student will be able to-

CO1: demonstrate proficiency in accurately identifying and distinguishing different types of raw silk produced, along with an understanding of their unique characteristics and applications within sericulture practices.

CO2: acquire practical knowledge and comprehension of the complete life cycle of Bombyx mori, enabling the effective implementation of management and rearing techniques essential for successful sericulture operations.

CO3: develop skills in employing sex separation techniques for silkworm larvae, pupae, and adults

CO4: attain competency in performing temporary mountings of silkworm larval structures, enhancing understanding of their morphology and functional significance in silk production processes.

CO5: explain distinct characteristics of cocoon structures present in popular uni-, bi-, and multivoltine races of silkworms.

CO6: familiarize oneself with the various types of rearing houses utilized in sericulture, including their design, functionality, and suitability for silk production, to effectively manage and optimize rearing environments.

CO7: apply methods for accurately determining the percentage of good and defective cocoons, facilitating the assessment of cocoon quality and overall production efficiency within sericulture practices.

Practicals:

Sr. No.	Title of the Practical	E/D
1	Identification of Mulberry, Tassar, Eri and Muga raw silk	(D)
2	Study of life cycle of *Bombyx mori*.	(D)
3	Study of sex separation in larva, pupa and adult of silkworm *Bombyx mori*	(E/D)
4	Temporary mountings of larva: a) Mouth parts b) Spiracles c) Silk gland	(E/D)
5	Study of cocoon characters of popular uni-, bi- and multivoltine races	(D)
6.	Study of rearing houses: Model rearing house and low-cost rearing house	(D)
7.	Determination of good cocoon and defective cocoon percentage	(E)
8.	Determination of soil pH and water holding capacity for mulberry cultivation	(E)
9.	Study of morphology of haemocytes in silkworm	(E)
10.	Study of various diseases in silkworm	(D)
11.	Study of pests in sericulture: Dermestid beetle and Uzi fly	(D)
12	Study of any five equipments in sericulture	(D)
13	Study of handicrafts made from cocoons	(E)
14	Submission of short project report on Economics of sericulture (Activity based practical) (With necessary pictures).	(E)
15	Visit to sericulture farm and submission of report.	(E)
***D- Demonstration; E- Experiment.**		

Course Articulation Matrix of ZOO-212-MN: Sericulture Lab
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	2	1	2	1	1	1	1	1	1
CO2	3	3	1	3	3	1	2	2	2	1	2	2	1
CO3	2	3	1	3	3	1	2	2	1	1	2	2	1
CO4	2	3	1	3	3	1	2	2	1	1	2	2	1
CO5	2	3	1	3	3	1	2	2	1	1	2	2	1
CO6	2	3	1	3	3	1	2	2	1	1	2	2	1
CO7	2	3	1	3	3	1	2	2	1	1	2	2	2

PO1: Comprehensive knowledge and understanding
All of the course outcomes (COs) are directly mapped to PO1 because; because the objectives of each practical exercise focus on developing a deep understanding of various aspects related to sericulture.

PO2: Practical, professional, and procedural knowledge
All of the course outcomes (COs) are directly mapped to PO2 because; because the practical exercises are designed to impart hands-on skills and procedural knowledge essential for sericulture practices.

PO3: Entrepreneurial mindset and knowledge
All of the course outcomes (COs) are mapped to PO3 because the practical exercises in sericulture involve aspects of entrepreneurship such as understanding market value, assessing quality factors influencing silk, and exploring commercial aspects.

PO4: Specialized skills and competencies
All of the course outcomes (COs) are directly mapped to PO4 because the practical exercises are specifically designed to develop specialized skills and competencies relevant to sericulture.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
All of the course outcomes (COs) are directly mapped to PO5 because the practical exercises in sericulture require students to apply their knowledge and problem-solving skills to various real-world scenarios.

PO6: Communication skills and collaboration
All of the course outcomes (COs) are directly mapped to PO6 because the practical exercises in sericulture often involve collaborative learning environments where students work together to achieve common objectives.

PO7: Research-related skills
All Cos are indirectly mapped to PO7 because the practical exercises in sericulture involve elements of research methodology and data analysis. Activities like studying diseases and pests in sericulture and exploring by-products often involve researching relevant literature to understand underlying concepts and mechanisms.

PO8: Learning how to learn skills
All Cos are directly mapped to PO8 because the practical exercises in sericulture are designed to enhance students' ability to learn independently and adapt to new challenges.

PO9: Digital and technological skills
All of the COs are mapped to PO9 because the practical exercises in sericulture often involve the use of digital tools and technologies. Students may utilize digital resources for researching silk moth species, accessing online databases for information on sericulture practices, and employing technological devices for data collection and analysis during field visits or laboratory experiments.

PO10: Multicultural competence, inclusive spirit, and empathy
All of the COs are directly mapped to PO10 because the practical exercises in sericulture often involve interactions with diverse stakeholders, including farmers, researchers, and industry professionals from different cultural backgrounds.

PO11: Value inculcation and environmental awareness
All COs are strongly mapped to PO11 because the practical exercises in sericulture involve understanding the importance of environmental sustainability and ethical practices in silk production.

PO12: Autonomy, responsibility, and accountability
All COs are strongly mapped to PO12 which emphasizes autonomy, responsibility, and accountability, as they collectively contribute to fostering independent decision-making, accountability for actions, and responsible stewardship within the field of sericulture.

PO13: Community engagement and service
All of the COs are mapped to PO13 because the practical exercises in sericulture often involve engaging with various stakeholders within the community, such as local farmers, researchers, and industry professionals. By participating in activities, students contribute to the broader community by sharing knowledge and expertise in sericulture practices.

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

Name of the Program: B.Sc. Zoology
Program Code: ZOO
Class: S.Y. B.Sc.
Semester: III
Course Type: Open Elective
Theory Course Code: ZOO-216-OE
Course Name: मधमाशापालन
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:

- मधमाशापालनाची ओळख आणि महत्त्व समजून घेणे.
- आग्या (एपीस डोर्साटा), सातेरी (एपीस इंडिका), फुलोरी (एपीस फ्लोरिया) आणि युरोपीय (एपीस मेलिफेरा) या प्रजातींची सवय, अधिवास आणि पोळे बांधणीची पद्धत शिकणे.
- मधमाशी वसाहतीची रचना, श्रमविभागणी, बहुरूपता आणि मधमाश्यांच्या संवादाच्या पद्धती यांचे ज्ञान प्राप्त करणे.
- मध काढणी यंत्र, धूरयंत्र आणि इतर उपकरणांचा वापर आणि देखभाल शिकणे.
- मध, मेण, मधमाशी विष, रोंगण (प्रोपोलिस), राजान्न (रॉयल जेली) आणि परागकण यांच्या संग्रह पद्धती आणि उपयोग शिकणे.
- मधमाशी पालन व्यवसायाची योजना तयार करणे आणि अर्थव्यवस्था समजून घेणे.
- मधमाश्यांच्या प्रमुख रोगांची कारणे, लक्षणे आणि प्रतिबंधात्मक उपाय शिकणे.

Course Outcomes:

या अभ्यासक्रमाद्वारे -

CO1 :विद्यार्थ्यांना मधमाशीपालनाची ओळख, इतिहास, महत्त्व आणि सामाजिक-आर्थिक परिणाम यांची माहिती मिळेल.

CO2: मधमाशी पालनाचे विविध प्रकार, मधमाशी प्रजाती आणि त्यांची निवड यांविषयी माहिती सांगू शकतील.

CO3: मधमाश्यांच्या वर्तणुकीचे विविध पैलू, संवाद आणि नृत्य भाषेचे अर्थ सांगू शकतील.

CO4: मधमाशी पालनातील नवीनतम तंत्रज्ञान आणि प्रगतीची माहिती विषद करतील.

CO5: मध, मेण, मधमाशी विष, रोंगण) प्रोपोलिस(, राजान्न) रॉयल जेली (आणि परागकण यांच्या संग्रह, प्रक्रिया आणि उपयोग यांविषयी माहिती सांगू शकतील.

CO6 :मधमाश्यांच्या प्रमुख रोगांची कारणे, लक्षणे, निदान आणि प्रतिबंधात्मक उपाय यांविषयी माहिती सांगू शकतील.

CO:7 प्राप्त झालेल्या ज्ञान आणि कौशल्यांचा उपयोग करून विद्यार्थी यशस्वी मधमाशी पालन व्यवसाय सुरू करू शकतील आणि पर्यावरणाचे रक्षण करण्यात योगदान देऊ शकतील.

TOPICS:

Unit No.	Subunit No.	Details	Teaching Hours
1.किटकशास्त्रातील मधमाशांचे स्थान व जाती	1.1	मधमाशीपालनाचा परिचय	**04**
	1.2	आग्या (एपीस डोर्साटा), सातेरी (एपीस इंडिका), फुलोरी (एपीस फ्लोरिया) आणि युरोपीय (एपीस मेलिफेरा) *यांच्या सवयी, अधिवास आणि* पोळे बांधणीचा अभ्यास	
2. वसाहतीचा जीवनक्रम आणि वसाहतीची वाढ	2.1	मधमाश्यांचे जीवनचक्र	**05**
	2.2	वसाहतीच्या अस्तित्वासाठी केली जाणारी सामूहिक कार्ये	
	2.3	खाद्याचा शोध- गोल नृत्य व इंग्रजी आठ आकडी नृत्य	
	2.4	वसाहतीची वाढ व पुनरुत्पती	
3. मधमाशीपालनाचे तंत्रज्ञान व अवजारे	3.1	मधमाशांची पेटी,	**04**
	3.2	मधयंत्र	
	3.3	धूरयंत्र	
	3.4	मधमाशीपासून संरक्षण करणारा बुरखा	
	3.5	हातमोजे	
	3.6	पटाशी	
	3.7	सूरी व कुंचा	
	3.8	मेणपत्रे	
4. मधमाशी उत्पादने **(**संग्रह पद्धती, रचना आणि उपयोग**)**	4.1	मध	**05**
	4.2	मेण	
	4.3	पराग	
	4.4	मधमाशी विष	
	4.5	राजान्न	
	4.6	रोंगण	
5.मधमाश्यांचे रोग आणि शत्रू	5.1	मधमाशी रोग - आदिजीव, जीवाणू, बुरशीजन्य	**05**
	5.2	मधमाशी कीटक – मेणपतंग, परजीवी माईट, अंजनमाशी	
	5.3	मधमाशी शत्रू - मधमाशी भक्षक पक्षी, अस्वल, मानव	
6.वसाहतीची देखभाल	6.1	वसाहतीची सर्वसाधारण तपासणी	**05**
	6.2	वसाहतीची विशिष्ट देखभाल	
	6.3	वसाहतीची मौसमी देखभाल	
7. मधमाशीपालन-व्यवस्थापन			**02**

REFERENCES

1. मधमाशापालन एक नमूनेदार ग्रामोद्योग- महाराष्ट्र राज्य खादी ग्रामोद्योग मंडळ महाबळेश्वर
2. भारतीय मधमाशा आणि मधमाशापालन- डॉ.र.पु. फडके
3. मधमाशापालन:कृषिपुरक जैवतंत्रज्ञान-डॉ. तुकाराम निकम
4. मधमाशापालन पुस्तिका- महाराष्ट्र राज्य खादी ग्रामोद्योग मंडळ मध संचालनालय महाबळेश्वर

Course Articulation Matrix of ZOO-216-OE मधमाशापालन
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	1	1	1	1	1	1	1	1	1	1
CO2	3	1	1	1	1	1	1	1	2	1	2	1	1
CO3	2	2	1	2	1	3	1	1	1	1	1	1	1
CO4	3	3	1	1	1	1	3	1	3	1	2	1	1
CO5	3	3	1	2	1	1	3	1	3	1	1	1	2
CO6	3	3	1	1	3	2	3	1	3	1	1	1	1
CO7	3	3	3	3	1	1	1	3	3	3	1	3	3

PO1: Comprehensive Knowledge and Understanding
CO1, CO2, CO3, CO4, CO5& CO6 These outcomes cover various aspects of knowledge and understanding related to beekeeping, including history, types, behaviors, technological advancements, health issues, and products.

PO2: Practical, Professional, and Procedural Knowledge
CO5, CO6 & CO7 These outcomes focus on practical aspects such as the process of beekeeping, identification and management of diseases, and utilizing knowledge and skills for starting a successful beekeeping business.

PO3: Entrepreneurial Mindset and Knowledge
CO7 This outcome emphasizes using acquired knowledge and skills to initiate and manage a successful beekeeping enterprise, contributing to environmental conservation efforts.

PO4: Specialized Skills and Competencies
CO5& CO6 These outcomes entail acquiring specific skills and competencies related to beekeeping, such as handling bee products and identifying and addressing bee health issues.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO6 & CO7 These outcomes involve applying knowledge to diagnose and solve problems related to bee health, as well as using analytical reasoning to start and manage a beekeeping business effectively.

PO6: Communication Skills and Collaboration
CO3, CO7 involve communicating effectively with others in the beekeeping community and collaborating to implement successful beekeeping practices and business ventures.

PO7: Research-related Skills
CO1, CO4: These outcomes require conducting research to gain a deeper understanding of beekeeping history, advancements, and technological innovations, contributing to knowledge enhancement in the field.

PO8: Learning How to Learn Skills
CO1, CO4, CO7 This mapping focuses on instilling in students the ability to continuously learn and adapt by

providing them with foundational knowledge about beekeeping, exposure to emerging technologies, and encouraging self-directed learning through entrepreneurial endeavors.

PO9: Digital and Technological Skills
CO4 involves staying updated with the latest technological advancements in beekeeping, contributing to the integration of digital tools for better management practices.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy
CO5, CO10 This mapping underscores the development of multicultural competence, inclusive spirit, and empathy among students by engaging with diverse cultural perspectives related to beekeeping and fostering inclusive practices within the beekeeping community.

PO11: Value Inculcation and Environmental Awareness
CO7 involves understanding the value of beekeeping in environmental conservation efforts, aligning with the goal of preserving ecosystems and biodiversity.

PO12: Autonomy, Responsibility, and Accountability
CO7 emphasizes taking responsibility for managing beekeeping operations ethically and accountably, ensuring the well-being of the environment and the community.

PO13: Community Engagement and Service
CO7 involves engaging with the community through beekeeping initiatives, such as education programs or environmental conservation projects, contributing to societal welfare.

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

Name of the Program: B.Sc. Zoology
Program Code: ZOO
Class: S.Y. B.Sc.
Semester: III
Course Type: Vocational Skill Course
Course Code: ZOO-221-VSC
Course Name: Toxicology
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Understand the fundamental concepts of toxicology, including the definitions of toxicology, toxin, poison, and venom, as well as their distinctions and common examples.
- Explore the scope, goals, and various branches of toxicology, including ecotoxicology, to comprehend its applications in environmental and human health assessment.
- Gain insight into ecotoxicology, its definition, and examples, to grasp the impact of toxins on ecosystems and the environment.
- Identify the basic divisions of toxicology and their relevance in studying the effects of toxicants on living organisms and ecosystems.
- Define toxicants and toxicity, exploring the different types of toxicants and factors influencing toxicity such as pH, temperature, reproductive status, age, and physiological state.
- Understand the concepts of dose, effect, and response, including the determination and interpretation of LD50 and LC50 values, to evaluate the toxicological effects of substances.
- Explore various categories of environmental contaminants, including pesticides, heavy metals, fertilizers, food additives, radioactive substances, and their biological effects.

Course Outcomes:-

Student will be able to-

CO1: demonstrate a comprehensive understanding of the fundamental principles and terminology of toxicology, and provide examples illustrating their applications in various contexts.

CO2: evaluate the scope, objectives, and interdisciplinary nature of toxicology, and apply this knowledge to analyze the impacts of toxins on both environmental and human health.

CO3: assess the significance of ecotoxicology in understanding the effects of contaminants on ecosystems, identify common examples of environmental toxins, and propose strategies for mitigating their adverse effects on the environment.

CO4: apply knowledge of the basic divisions of toxicology to analyze the effects of toxicants on living organisms and ecosystems, and interpret how these divisions contribute to the field's overall understanding of toxicity.

CO5: define toxicants and toxicity, classify different types of toxicants, and analyze the influence of various factors such as pH, temperature, and physiological state on toxicity outcomes.

CO6: utilize concepts of dose, effect, and response to interpret LD50 and LC50 values, and critically evaluate toxicological data to assess the potential risks associated with exposure to harmful substances.

CO7: evaluate the biological effects of various environmental contaminants, including pesticides, heavy metals, and radioactive substances, and propose sustainable solutions such as toxin-

free farming practices and the use of biofertilizers and bio-pesticides.

TOPICS:

Unit No.	Subunit No	Details	Teaching Hours
1. Introduction to Toxicology	1.1	Definition of toxicology, toxin, poison and venom	04
	1.2	Scope, goals and branches of toxicology	
	1.3	Ecotoxicology- Definition & examples	
	1.4	Basic divisions of toxicology	
2. Toxicants and Toxicity	2.1	Definition of Toxicants and Toxicity	08
	2.2	Types of toxicants	
	2.3	Factors influencing toxicity (pH, temperature, reproductive status, age, physiological state)	
	2.4	Dose, effect and response	
	2.5	LD_{50} & LC_{50}	
3. Toxicants of Public Health and Hazards	3.1	Pesticides, heavy metals, fertilizers, food additives and radioactive substances, biological effect of radiations	06
	3.2	Toxin free farming, biofertilizers and bio-pesticides	
4. Xenobiotics	4.1	Introduction to Xenobiotics	08
	4.2	Absorption, translocation & accumulation of Xenobiotics	
	4.3	Excretion of Xenobiotics	
5. Biomonitoring	5.1	Introduction to biomonitoring	04
	5.2	Bioindicators and environmental Monitoring	
	5.3	Biomonitoring in microbial system and animal system	

REFERENCES

1. Sharma, P. D. (2013). Environmental Biology and Toxicology Rastogi Publications. *Meerut, India*.
2. Murray, L., Armstrong, J., Cadogan, M., & Pascu, O. (2011). *Toxicology handbook*. Elsevier Australia.
3. Timbrell, J., & Barile, F. A. (2023). *Introduction to toxicology*. CRC Press.
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5. Hayes, A. W., & Kobets, T. (Eds.). (2023). *Hayes' principles and methods of toxicology*. Crc Press.
6. Kent, C. (1998). *Basics of toxicology* (Vol. 3). John Wiley & Sons.

Course Articulation Matrix of ZOO-216-VSC Toxicology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	2	3	1	3	1	2	2	3	2
CO2	3	3	2	2	3	3	2	2	1	1	2	2	1
CO3	3	3	2	1	3	2	2	1	1	1	3	2	3
CO4	3	3	2	3	2	3	2	3	1	1	2	3	2
CO5	3	2	1	3	2	2	1	3	2	1	1	2	1
CO6	3	3	2	3	3	3	2	3	2	1	2	3	1
CO7	3	3	2	3	3	3	3	3	2	2	3	3	2

PO1: Comprehensive Knowledge and Understanding
This course lays the groundwork for understanding toxicology principles, terminology, and applications across various contexts (CO1). It also explores the scope and objectives of toxicology and its interdisciplinary nature (CO2). Students gain knowledge of environmental contaminants and their impacts (CO3, CO7).

PO2: Practical, Professional, and Procedural Knowledge
CO6 directly addresses this PO by equipping students with the ability to interpret dose-response data (LD50, LC50) and critically evaluate toxicological data for risk assessment.

PO3: Entrepreneurial Mindset and Knowledge
CO3 encourages students to explore sustainable solutions for mitigating environmental damage caused by toxins, fostering an entrepreneurial mindset. Similarly, CO7 explores sustainable alternatives like biofertilizers (PO3).

PO4: Specialized Skills and Competencies
This course develops specialized skills in toxicology through CO1 (classification of toxins), CO3 (ecotoxicology), CO4 (applying toxicological divisions), CO5 (classification of toxicants), and CO7 (analyzing xenobiotics).

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
Students apply toxicological knowledge to analyze the effects of toxins on living systems (CO2, CO3, CO4, CO7). They interpret data (CO6) and propose solutions for environmental issues (CO3, CO7).

PO6: Communication Skills and Collaboration
Toxicology involves research, risk communication, and collaboration with diverse stakeholders. The COs equip students with the knowledge base (CO1-CO7) necessary to communicate effectively in these contexts.

PO7: Research-related Skills

CO7 (potential): Analyzing xenobiotic behavior might involve research skills depending on the depth of analysis required. The extent of research involvement can vary depending on the course design.

PO8: Learning How to Learn Skills

Toxicology is a constantly evolving field. The COs require students to critically evaluate data (CO6), analyze complex topics (CO3, CO7), and propose solutions (CO7). These skills foster lifelong learning.

PO9: Digital and Technological Skills

These POs are not directly addressed by the provided COs. While the course may indirectly contribute to some of these skills (e.g., encouraging independent learning through CO8), a stronger justification would require incorporating activities or assessments that specifically target these areas.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy: Toxicology impacts people and ecosystems globally. Understanding different cultures and perspectives is crucial for effective communication, collaboration, and addressing toxicological issues worldwide.

PO11: Value Inculcation and Environmental Awareness

CO2, CO3, CO7: These COs introduce ecotoxicology (CO2) and emphasize its importance (CO3), raising awareness (PO11) of environmental impact caused by toxins. CO7 further promotes environmental awareness (PO11) by proposing sustainable solutions.

PO12: Autonomy, Responsibility, and Accountability: Toxicologists work independently and collaboratively. This PO emphasizes the importance of taking responsibility for judgments and actions related to toxicological assessments and recommendations.

PO13: Community Engagement and Service: Toxicologists play a vital role in protecting public health and the environment. This PO encourages engagement with communities to raise awareness and implement solutions to toxicological challenges.