



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

F.Y. B.Sc. (Zoology) Semester -I

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 2023-2024

Title of the Programme: F. 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 first semester of **F. Y. 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 be 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.

Anekant Education Society's
Tuljaram Chaturchand College
of Arts, Science & Commerce, Baramati
(Autonomous)

Board of Studies (BoS) in Zoology

From 2022-23 to 2024-25

Sr. No.	Name	Designation
1.	Mr. 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. Rutuja R. Chavan	Student Representative
12.	Mr. Subodh M. Nikam	Student Representative
13.	Mr. Shubham R. Ghadage	Student Representative
14.	Ms. Tamanna S. Tamboli	Student Representative

Credit Distribution Structure for F.Y.B.Sc. -2023-2024 (Zoology)

Level	Semester	Major		Minor	GE/OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	I	ZOO-101-MJM: Animal Systematics & Diversity-I ZOO-102-MJM: Fundamentals of Cell Biology ZOO-103-MJM: Zoology Practical – I Credits-2+2+2		--	ZOO-116-OE: Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती) ZOO-117-OE: Fresh Water Fishery(Practical) गोड्या पाण्यातील मत्स्यशेती (प्रात्य क्षक) Credit- 2+2	ZOO-121-VSC:- Biological Techniques-I ZOO-126-SEC: Medical Laboratory Technology-I Credit- 2+2	ENG-131-AEC: Functional English-I ZOO-135-VEC : Environmental Science ZOO-137-IKS: Animal Diversity & Conservation in Indian Culture Credit- 2+2+2	US--CC1: NSS/NCC/Yoga/ Cultural Activity/Sports Credit- 2	22	UG Certificate 44
	II	ZOO-151-MJM: Animal Systematics & Diversity-II ZOO-152-MJM: Genetics ZOO-153-MJM: Zoology Practical – II Credits-2+2+2		Credits-2	ZOO-166-OE: Crop pests: Types & management (पकावरील कीड: प्रकार व व्यवस्थापन) ZOO-167-OE: Crop pests: Types & management (पकावरील कीड: प्रकार व व्यवस्थापन) (प्रात्य क्षक) Credit- 2+2	ZOO-171-VSC: Biological Techniques-II ZOO-176-SEC: Medical Laboratory Technology -II Credit- 2+2	ENG-181-AEC: English – II ZOO-185-VEC: Digital and Technological Solutions Credit- 2+2	US--CC2: NSS/NCC/Yoga/ Cultural Activity/Sports Credit- 2	22	
	Cum Cr.	12	-	2	8	8	10	4	44	

Course Structure for F.Y.B.Sc. Zoology (2023 Pattern)

Sem	Course Type	Course Code	Course Name	Theory / Practical	Credits
I	Major Mandatory	ZOO-101-MJM	Animal Systematics & Diversity – I	Theory	02
	Major Mandatory	ZOO-102-MJM	Fundamentals of Cell Biology	Theory	02
	Major Mandatory	ZOO-103-MJM	Zoology Practical – I	Practical	02
	Open Elective (OE)	ZOO-116-OE	Fresh Water Fishery (गोड्या पाण्यातील मत्स्य शेती)	Theory	02
	Open Elective (OE)	ZOO-117-OE	Fresh Water Fishery (Practical) गोड्या पाण्यातील मत्स्य शेती (प्रात्य क्षक)	Practical	02
	Vocational Skill Course (VSC)	ZOO-121-VSC	Biological Techniques-I	Theory	02
	Skill Enhancement Course (SEC)	ZOO-126-SEC	Medical Laboratory Technology-I	Practical	02
	Ability Enhancement Course (AEC)	ENG-131-AEC	Functional English-I	Theory	02
	Value Education Course (VEC)	ZOO-135-VEC	Environmental Science	Theory	02
	Indian Knowledge System (IKS)	ZOO-137-IKS	Animal Diversity & Conservation in Indian Culture	Theory	02
	Co-curricular Course (CC)	--	To be selected from the Basket	Theory	02
Total Credits Semester-I					22
II	Major Mandatory	ZOO-151-MJM	Animal Systematics & Diversity – II	Theory	02
	Major Mandatory	ZOO-152-MJM	Genetics	Theory	02
	Major Mandatory	ZOO-153-MJM	Zoology Practical – II	Practical	02
	Minor	ZOO-161-MN	Apiculture	Theory	02
	Open Elective (OE)	ZOO-166-OE	Crop pests: Types & management (पकावरील कीड: प्रकार व व्यवस्थापन)	Theory	02
	Open Elective (OE)	ZOO-167-OE	Crop pests: Types & management (Practical) पकावरील कीड: प्रकार व व्यवस्थापन (प्रात्य क्षक)	Practical	02
	Vocational Skill Course (VSC)	ZOO-171-VSC	Biological Techniques-I	Practical	02
	Skill Enhancement Course (SEC)	ZOO-176-SEC	Medical Laboratory Technology -II	Practical	02
	Ability Enhancement Course (AEC)	ENG-181-AEC	Functional English-II	Theory	02
	Value Education Course (VEC)	ZOO-185-VEC	Digital and Technological Solutions	Theory	02
	Co-curricular Course (CC)	--	To be selected from the Basket	Theory	02
Total Credits Semester-II					22
Cumulative Credits Semester I + Semester II					44

**SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2023)**

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: Major (Mandatory) Theory

Course Code: ZOO-101-MJM

Course Name: Animal Systematics & Diversity-I

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- Principles of systematics.
- Systems of animal classification.
- Basic characteristics of the non-chordates.
- Evolution and development of systems and animals.
- Habitat diversity of animals.
- Morphology and anatomy of non-chordate.
- Economic importance of animals.

Course Outcomes:-

Student will be able to-

CO1: Define principles of systematics

CO2: Classify animals according to different systems of classification.

CO3: Identify non-chordate animals with the help of distinguishing characters.

CO4: Explain evolution and development of animals.

CO5: Identify the habitat diversity and role of animals in ecosystem.

CO6: Explain the body plan / organization of non-chordate animals.

CO7: Explore ethical use of animal abilities for environmental sustainability own economic benefits.

TOPICS:

Unit No.	Subunit No	Details	Teaching Hours
1. Principles of animal classification	1.1	Introduction to invertebrates, Three Domain & Six kingdom classification system	06
	1.2	Importance of animal classification.	
	1.3	Systematics-Linnaean hierarchy (Phylum, Class, Order, Family, Genus and Species)	
	1.4	Taxonomy-Basic terminology and Introduction : Alpha, Beta and Gamma levels of taxonomy, Micro-taxonomy	
2.	2.1	Protozoa	06

Classification with salient features (Up to class level with minimum one example of each class)	2.2	Porifera	
	2.3	Coelenterata (Cnidaria)	
	2.4	Platyhelminthes	
	2.5	Aschelminthes	
	2.6	Annelida	
3. General topics	3.1	Porifera: Skeleton	04
	3.2	Cnidaria: Coral reefs & Its importance	
4. Type study: <i>Pheretima posthuma</i>	4.1	Systematic position, Habits and habitat	14
	4.2	Morphology & Hydrostatic skeleton	
	4.3	Digestive system	
	4.4	Circulatory system	
	4.5	Excretory system.	
	4.6	Reproductive system	
	4.7	Nervous system and sense organs.	
	4.9	Economic importance	

REFERENCES

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2. Kotpal, R. L. (1998). Zoology Phylum (Annelida, Mollusca, Arthropoda, Minor Phyla).
3. Kotpal, R. L. (2003). Zoology phylum 8, Echinodermata.
4. Kotpal, R. L. (2012). Modern text book of Zoology: Invertebrates. Rastogi Publications.
5. Jordan, E. L., & Verma, P. S. (1996). Invertebrate Zoology sixth revised and Enlarged edition. S. Chand and Company, Ltd. 857pp.
6. Harley, J. P., & Miller, S. A. (2007). Zoology. McGraw-Hill Higher Education.
7. Pechenik, J. A. (2010). Biology of the Invertebrates (No. 592 P3).
8. Bhat, J. V., & Khambata, S. R. (1959). Role of earth worms in agriculture. Indian Council of Agricultural Research.

Course Articulation Matrix of ZOO 101 MJM Animal Systematics & Diversity – 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	1	1	1	1	1	1	1	3	1	1	1	1
CO2	3	1	1	1	2	1	1	1	3	2	2	1	2
CO3	3	2	1	1	2	1	1	1	3	1	1	1	1
CO4	1	3	1	3	2	2	2	2	3	3	2	1	3
CO5	1	3	2	2	3	2	2	3	3	2	2	1	2
CO6	2	2	2	3	2	2	2	2	3	1	1	1	1
CO7	2	2	3	2	2	3	3	3	3	2	1	1	2

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 earthworm 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 F. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2023)**

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: Major (Mandatory) Theory

Course Code: ZOO-102-MJM

Course Name: Fundamentals of Cell Biology

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- Identification of cell types based on structural peculiarities.
- Comparison of structural properties of the cells.
- Functions of cell organelles.
- Facts & definitions of cytology, mitosis, meiosis, etc.
- Concept of cell division.
- Interpretation of the cell division stages with the help of pictures.
- Construction the models of types of cells, cell organelles, and stages of cell division.

Course Outcomes:-

Student will be able to-

CO1: Identify cell types based on structural peculiarities.

CO2: Compare structural properties of the cells.

CO3: Explain the functions of cell organelles.

CO4: Recall the facts & definitions of cytology, mitosis, meiosis, etc.

CO5: Explain the concept of cell division.

CO6: Interpret the stage of cell division with the help of pictures.

CO7: Create the models of types of cells, cell organelles, and stages of cell division.

TOPICS:

Unit	Subunit No	Content	Teaching Hours
01. Introduction to Cell Biology	1.1	Definition and brief history	02
	1.2	Introduction to cell theory	
02. Study of Prokaryotic cell and Eukaryotic cell	2.1	Comparative study of Prokaryotic cell and Eukaryotic cell	01
	2.2	Comparative study of plant and animal cell	
03. Structure and functions of cell membrane	3.1	Chemical composition	04
	3.2	Fluid mosaic model	
	3.3	Functions of cell membrane	

04. Cytoplasm	4.1	Physical Organization	02
	4.2	Chemical Composition & Biological Properties	
05. Study of cell organelles and their functions	5.1	Endoplasmic reticulum	10
	5.2	Golgi complex	
	5.3	Lysosomes & Peroxisomes	
	5.4	Ribosomes	
	5.5	Mitochondria	
06. Nucleus	6.1	Ultrastructure of nucleus	04
	6.2	Functions of nucleus	
07. Cell cycle	7.1	Cell cycle in brief	07
	7.2	Cell division: 1. Mitosis, 2. Meiosis	
	7.3	Significance of cell division	

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1. Powar, C. B., & Powar, C. B. (1970). Cell Biology. Himalaya Publishing House.
2. DuPraw, E. J. (1968). Cell and molecular biology (No. QH581 D83).
3. Avers, C. J. (1978). Basic cell biology.
4. Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons.
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8. Johnson, A., Lewis, J., & ALBERTS, B. (2002). Molecular biology of the cell.
9. Lohar, P. S. (2019). Cell and Molecular Biology. MJP Publisher. Chennai

Course Articulation Matrix of ZOO 102 MJM Fundamentals of Cell Biology **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	1	1	1	1	1	1	1	3	3	2	1	1
CO2	3	1	1	1	1	1	1	1	3	3	1	1	3
CO3	3	1	1	3	3	1	3	3	3	2	1	3	1
CO4	3	2	2	2	1	1	2	1	3	1	3	1	2
CO5	2	3	2	3	3	1	1	1	3	1	3	2	1
CO6	2	3	2	3	1	1	1	2	3	2	3	1	1
CO7	1	2	3	2	2	3	1	2	3	2	1	1	1

PO1: Comprehensive knowledge and understanding

CO1: Directly applies to understanding cell structure and how it relates to function.

CO2: Involves understanding the differences between various cell types.

CO3: Directly applies to understanding the roles of cell organelles.

CO4: Assesses knowledge of fundamental cytology concepts.

CO5: Requires understanding of the cell division process.

CO6: Involves knowledge of cell division stages and their characteristics.

PO2: Practical, professional, and procedural knowledge

CO7: Creating models can indirectly develop practical skills in model building and scientific visualization, potentially applicable in other scientific contexts (PO2).

PO3: Entrepreneurial mindset and knowledge (may not be directly applicable)

CO3: Understanding cell organelle function can indirectly contribute to PO3 if the course explores the applications of this knowledge in areas like biotechnology or medicine. For example, students might see how knowledge of lysosomes and their role in waste disposal could be applied to develop drugs targeting lysosomal storage diseases.

CO7: Model creation skills developed in CO7 could be indirectly applied in PO3 if students use their models to explain cellular processes to a lay audience, fostering an entrepreneurial spirit in science communication.

PO4: Specialized skills and competencies

CO1: Develops the ability to identify different cell types, a foundational skill for further biological studies (PO4).

CO3: Provides a foundational competency in cell organelle function, necessary for understanding cellular processes (PO4).

CO6: Acquires the skill of interpreting cell division stages, crucial for understanding cell growth and development (PO4).

CO7: Develops the skill of model creation for scientific visualization, a transferable skill useful in various scientific fields (PO4).

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO2: Requires applying knowledge to compare cell structures, developing analytical thinking skills (PO5).

CO3: Involves applying understanding of cell organelles to their functions, essential for problem-solving in cellular malfunctions (PO5).

CO5: Requires applying knowledge to explain the concept of cell division, fostering analytical skills in understanding biological processes (PO5).

CO6: Applies knowledge of cell division stages to interpret images, a key analytical skill in cell biology research (PO5).

PO6: Communication skills and collaboration

CO1-CO6: Discussing cell types, structures, and functions can indirectly develop communication skills through explanation and justification (PO6).

PO7: Research-related skills (may not be directly applicable)

CO1-CO6: The foundational knowledge gained in these COs can indirectly provide a basis for developing research-related skills in cell biology (PO7) if pursued further.

PO8: Learning how to learn skills

All Course Outcomes (COs) involve learning new skills and knowledge related to cell biology, fostering the ability to learn independently (PO8).

PO9: Digital and technological skills (may not be directly applicable)

CO7: Creating models might involve using digital tools in some cases, indirectly introducing basic digital skills (PO9).

PO10: Multicultural competence, inclusive spirit, and empathy

CO1-CO6: While not directly related, the knowledge and skills developed in these COs can contribute to PO10 if the course discusses the historical contributions of scientists from diverse backgrounds to the field of cell biology. This can foster an appreciation for multicultural perspectives in science.

PO11: Value inculcation and environmental awareness

CO3: Understanding the role of cell organelles in cellular processes can indirectly contribute to PO11 if the course explores how these processes are essential for maintaining environmental balance (e.g., mitochondria and cellular respiration).

PO12: Autonomy, responsibility, and accountability

CO1-CO7: Completing these COs independently can indirectly develop autonomy, responsibility, and accountability in students' learning (PO12).

PO13: Community engagement and service

Learn to cooperate with each other like that of the cells within tissues and also will try to find out the problems of society just like the immunity cells do in the body of animals.

**SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2023)**

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: Major (Mandatory) Practical

Course Code: ZOO-103-MJM

Course Name: Zoology Practical-I

Number of Credits: 02

Number of Teaching hours: 60

Course Objectives:-

- Taxonomic classification of invertebrate animals.
- Culturing of animals.
- Preparation of vermiculture unit.
- Use of dissecting instruments.
- Working of microscope.
- Mountings of prokaryotic and eukaryotic cells.
- Demonstration of mitochondria and bar body with suitable experiment.

Course Outcomes:-

Students will be able to-

CO1: Classify the invertebrate animals.

CO2: Culture the animals.

CO3: Apply known procedures to solve the problem of biodegradable waste.

CO4: Acquire the skills in handling and dissecting the earthworm.

CO5: Explain handling, principle and working of microscope.

CO6: Compare the mounting types of cells.

CO7: Plan the experiment for demonstration of mitochondria and bar body.

Sr. No.	Name of the practical	E/D	Teaching Hours
1.	Microscopy: Study of standard operating procedure of a simple and compound microscope.(Activity based)	E	04
2.	Title: Taxonomic classification up to class level 1. Phylum: Protozoa: <i>Paramecium</i> , <i>Euglena</i> 2. Phylum: Porifera: <i>Sycon</i> , <i>Euspongia</i>	D	04
3.	Title: Taxonomic classification up to class level 1. Phylum: Coelenterata: <i>Hydra</i> , Jelly fish 2. Phylum: Platyhelminthes- <i>Taenia</i> , <i>Planaria</i> .	D	04
4.	Title: Taxonomic classification up to class level 1. Phylum: Aschelminthes- <i>Ascaris</i> , <i>Wuchereria bancrofti</i> .(Filarial worm) 2. Phylum: Annelida- <i>Nereis</i> , <i>Leech</i> .	D	04
5.	Culturing of freshwater animals (<i>Acathamoeba/Hydra/Paramecium</i>)	E	04

6.	Preparation of small scale vermiculture bed (Activity based)	E	04
7.	Dissection of earthworm so as to expose its digestive system	E/D	04
8.	Dissection of earthworm so as to expose its nervous system	E/D	04
9.	Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla	D/E	04
10.	Temporary preparation of a bacterial and protozoans on a slide and its observations under the microscope.	E	04
11.	Ultrastructure study of: a. Mitochondria, b. Nucleus, c. Endoplasmic Reticulum, d. Golgi complex (With Picture/Model/Chart)	D	04
12.	Study of mitotic cell division using onion root tips	E	04
13.	Demonstration of mitochondria using Janus Green B stain	E	04
14.	Demonstration of Barr Body	E	04
15.	Study Tour: Visit to established aquatic ecosystem / functional commercial vermicompost unit and submission of detailed tour report		
E: Experimental, D: Demonstrative			

Course Articulation Matrix of ZOO 103 MJM Zoology Practical-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	1	1	1	1	1	1	1	3	1	1	3	1
CO2	3	1	3	3	1	3	1	1	3	1	1	3	2
CO3	3	3	1	2	3	2	3	3	3	1	1	3	1
CO4	1	2	3	2	2	3	2	2	3	2	2	3	3
CO5	3	1	2	3	2	2	2	1	3	2	3	3	2
CO6	3	1	1	3	1	2	2	1	3	2	2	3	1
CO7	1	3	2	1	2	1	2	1	3	3	3	3	2

PO1: Comprehensive knowledge and understanding

- CO1: Directly applies to understanding invertebrate phyla characteristics.
- CO4: Requires understanding of earthworm anatomy and function.
- CO6: Requires knowledge of mosquito morphology for identification.

PO2: Practical, professional, and procedural knowledge

- CO2: Develops practical skills in culturing microorganisms.
- CO3: Involves practical aspects of vermicomposting setup.
- CO4: Requires dissection skills, a practical biological technique.
- CO5: Develops skills in preparing and observing microscopic samples.

PO3: Entrepreneurial mindset and knowledge

- CO3: Could be relevant if the course explores the potential applications of vermicomposting.

PO4: Specialized skills and competencies

- CO1: Develops the ability to classify invertebrates.
- CO2: Acquires a skill in culturing microorganisms.
- CO3: Provides a specialized skill in setting up vermicomposting.
- CO4: Develops the skill of earthworm dissection and organ identification.
- CO5: Acquires a skill in preparing microscopic mounts.
- CO6: Develops the ability to use identification keys for mosquito differentiation.
- CO7: Provides the skill of scientific illustration and field report writing.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

- CO2: May involve problem-solving during culturing process.
- CO3: Requires applying scientific principles to vermicomposting.
- CO4: Involves analytical skills in identifying earthworm organs.
- CO5: Requires analytical skills to observe and identify microscopic structures.
- CO6: Applies knowledge to differentiate mosquito species using a key.
- CO7: Involves applying observation and analysis skills during a field trip.

PO6: Communication skills and collaboration

- CO7: Report writing can contribute to developing communication skills.

PO7: Research-related skills

- CO2: Basic culturing techniques can be a foundation for research skills.
- CO7: Field trip report writing can involve a research element.

PO8: Learning how to learn skills

- All Course Outcomes (COs) involve learning new skills and knowledge related to invertebrate biology.

PO9: Digital and technological skills

- CO7: Report writing might involve using digital tools.

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

- CO3: Vermicomposting promotes environmental awareness.

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 F. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2023)**

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: Open Elective (Theory)

Course Code: ZOO-116-OE

Course Name: Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती)

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- मत्स्यव्यवसायाची संकल्पना आणि व्याप्ती अभ्यासणे
- मत्स्यतलावाचे प्रकार अभ्यासणे
- गोड्या पाण्यातील माशांच्या विविध जाती अभ्यासणे.
- माशांसाठी अन्न तयार करण्याच्या प्रक्रिया अभ्यासणे.
- मत्स्यसंवर्धन करताना घ्यावयाच्या दक्षतांचा अभ्यास करणे.
- मासे टिकविण्याच्या विविध पद्धती अभ्यासणे.
- मत्स्य व्यवसायासाठी उपलब्ध सरकारी योजनांचा आढावा घेणे.

Course Outcomes:-

सदर वर्षयाचा अभ्यास केल्यानंतर वद्यार्थी-

CO1: मत्स्य व्यवसायातील संधींचा फायदा घेऊ शकतील.

CO2: गरजेनुसार मत्स्य तलाव बांधण्यासाठी लागणारी तयारी करू शकेल.

CO3: गोड्या पाण्यातील योग्य जातीचे मासे मत्स्य पालनासाठी निवडू शकेल.

CO4: विविध माशांना लागणारे अन्न तयार करण्याची माहिती आत्मसात करतील.

CO5: मत्स्य संवर्धनासाठी आवश्यक दक्षता घेतील.

CO6: मासे टिकविण्याच्या विविध पद्धतींचा वापर करू शकेल.

CO7: मत्स्य व्यवसायासाठी उपलब्ध सरकारी योजनांची सर्वकष माहिती घेतील.

Topics

Unit	Content	No. of Teaching hours
1	उद्दिष्टे व प्रस्तावना	02
2	मत्स्य व्यवसाय संकल्पना	02
3	मत्स्य तलाव व प्रकार	05
4	गोड्या पाण्यातील माशांच्या जाती	06

5	माशांसाठीचे अन्न	03
6	मत्स्य व्यवस्थापन आणि काळजी.	06
7	मासे टिकविण्याच्या विविध पद्धती.	04
8	मत्स्य व्यवसायासाठी असणाऱ्या सरकारी योजना.	02

संदर्भसूची

1. कोकण विभागातील मत्स्य व्यवसायाची वाटचाल. महाराष्ट्र राज्य, मुंबई, १९९४.
2. शेत तळ्यातील मत्स्य पालन. महात्मा फुले कृषि विद्यापीठ, राहुरी. २०१९.

Course Articulation Matrix of ZOO 116 OE Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती) 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	3	1	2	1	1	2	3	1	2	3	1
CO2	1	3	2	3	1	3	1	3	3	2	1	1	2
CO3	3	2	1	2	3	2	3	3	3	1	1	1	1
CO4	3	2	1	3	2	3	2	2	3	1	2	1	3
CO5	1	3	2	3	2	2	2	1	3	2	3	1	2
CO6	1	3	1	3	1	2	2	1	3	1	2	3	1
CO7	1	2	3	1	2	1	2	1	3	1	3	3	2

Program Outcome (PO)	Course Outcome (CO)	Mapping Justification
1. Comprehensive Knowledge and Understanding	CO1, CO3, CO4	These COs require knowledge of foundational concepts in fisheries management, including potential opportunities (CO1), suitable fish species (CO3), and essential food preparation for different fish (CO4).
2. Practical, Professional, and Procedural Knowledge	CO2, CO5, CO6	CO2 focuses on practical pond construction skills, CO5 emphasizes essential fish farming techniques, and CO6 deals with real-world fish preservation methods - all relevant to the fisheries profession.
3. Entrepreneurial Mindset and Knowledge	CO1, CO7	CO1 encourages identifying opportunities within the fisheries business (entrepreneurial spirit), and CO7 highlights government schemes that can benefit fisheries ventures (business knowledge).
4. Specialized Skills and	CO2, CO4,	These COs address technical skills like pond

Competencies	CO5, CO6	construction (CO2), preparing fish feed (CO4), fish farming practices (CO5), and preservation techniques (CO6).
5. Capacity for Application, Problem-Solving, and Analytical Reasoning	CO2, CO3, CO5	CO2 involves applying knowledge to prepare for pond construction, CO3 requires choosing suitable fish species based on analysis, and CO5 emphasizes applying fish farming techniques for problem-solving.
6. Communication Skills and Collaboration	(Limited Mapping)	While not a direct focus, effective communication might be required when collaborating with others in aspects like acquiring government aid (CO7).
7. Research-related Skills	(Limited Mapping)	There's no direct mapping, but research skills might be indirectly beneficial for exploring new fish farming techniques or government schemes (CO7).
8. Learning How to Learn Skills	(Implicit in all COs)	Continuous learning is essential for adapting to changes in the fisheries industry and acquiring new knowledge about fish farming techniques and government schemes (CO7).
9. Digital and Technological Skills	(Limited Mapping)	While not explicitly mentioned, some COs might involve basic digital skills for accessing information about government schemes (CO7).
10. Multicultural Competence, Inclusive Spirit, and Empathy	(Not Applicable)	This program likely focuses on technical fisheries management and may not directly involve multicultural aspects.
11. Value Inculcation and Environmental Awareness	(Implicit in all COs)	Sustainable fisheries practices likely underlie all COs, promoting responsible management of fish populations and environmental awareness.
12. Autonomy, Responsibility, and Accountability	CO2, CO5	CO2 emphasizes taking responsibility for proper pond construction, and CO5 highlights applying fish farming techniques responsibly.
13. Community Engagement and Service	(Not Directly Applicable)	The program seems focused on individual fisheries management skills, not directly on community engagement.

**SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2023)**

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: Open Elective (Practical)

Course Code: ZOO-117-OE

Course Name: Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती प्रात्यक्षिक)

Number of Credits: 02

Number of Teaching hours: 60

Course Objectives:-

- मत्स्यतलावाचे प्रकार अभ्यासणे
- मत्स्य पालनासाठी आवश्यक पाण्याची गुणवत्ता तपासणे.
- गोड्या पाण्यातील माशांच्या विविध जाती अभ्यासणे.
- माशांसाठी अन्न तयार करण्याच्या प्रक्रिया अभ्यासणे.
- मत्स्यसंवर्धन करताना घ्यावयाच्या दक्षतांचा अभ्यास करणे.
- मत्स्यपालनासाठी लागणाऱ्या साधनांचा आणि सरकारी योजनांचा अभ्यास करणे.
- मत्स्य बीज निर्मिती, पॅकिंग आणि वाहतूक यांचा अभ्यास करणे.

Course Outcomes:-

सदर विषयाचा अभ्यास केल्यानंतर विद्यार्थी-

CO1: गरजेनुसार मत्स्य तलाव बांधण्यासाठी लागणारी तयारी करू शकेल.

CO2: मत्स्य पालनासाठी आवश्यक पाण्याची गुणवत्ता तपासेल.

CO3: गोड्या पाण्यातील योग्य जातीचे मासे ओळखू आणि निवडू शकेल.

CO4: विविध माशांना लागणारे अन्न तयार करतील.

CO5: मत्स्य संवर्धनासाठी आवश्यक दक्षता घेतील आणि रोगप्रतिबंधक उपाय योजतील.

CO6: मत्स्यपालनासाठी लागणाऱ्या साधनांचा आणि सरकारी योजनांचा उपयोग करू शकेल.

CO7: मत्स्य बीज निर्मिती, पॅकिंग आणि वाहतूक यांचा अभ्यास करून स्वतःचा व्यवसाय करू शकेल.

Topics

Sr. No.	Title of Practical	E/D	Teaching Hours
1	मत्स्य तळ्याची निवड करणे	01 D	04
2	गोड्या पाण्याची मत्स्य पालना साठी गुणवत्ता व तपासणी	02 E	08
3	गोड्या पाण्यातील माशांच्या जातींचा अभ्यास करणे	02 E	08
4	माशांसाठी अन्न निर्मिती आणि साठवणूक	02 E	08
5	माशांच्या विविध रोगांचा अभ्यास करणे	02 D	08
6	मत्स्यपालनासाठी आवश्यक साधनांचा अभ्यास	01 D	04

7	मत्स्य बीज निर्मिती, पॅकिंग आणि वाहतूक	01D	04
8	मत्स्य व्यवसायासाठी सरकारी योजनाचा अभ्यास.	01D	04
9	मत्स्य व्यवसायासाठी प्रकल्प अहवाल तयार करणे	01E	04
10	मत्स्य पालन प्रकल्प भेट		08

Course Articulation Matrix of ZOO 117 OE Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती प्रात्यक्षिक) **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	1	1	3	1	3	1	1	1	1	1	1	1
CO2	3	1	1	3	1	3	1	1	1	1	1	1	1
CO3	3	1	2	2	1	3	1	1	1	1	1	1	1
CO4	3	2	3	3	1	2	1	1	1	1	1	1	1
CO5	2	3	2	3	1	3	3	3	1	1	1	1	1
CO6	3	2	3	3	1	1	2	2	3	3	3	3	1
CO7	3	2	1	1	3	1	2	2	2	2	1	1	1

Program Outcome (PO)	Course Outcome (CO)	Mapping Justification
1. Comprehensive Knowledge and Understanding	CO1, CO2, CO3	These COs require knowledge of fundamental concepts in fisheries management, including pond construction preparation (CO1), water quality assessment (CO2), and identifying suitable fish species (CO3).
2. Practical, Professional, and Procedural Knowledge	CO1, CO4, CO5, CO6	CO1 involves practical pond construction skills, CO4 emphasizes preparing fish feed, CO5 highlights essential fish farming techniques and disease prevention measures, and CO6 deals with utilizing aquaculture tools and government schemes.
3. Entrepreneurial Mindset and Knowledge	CO6, CO7	CO6 emphasizes utilizing government schemes for business growth, and CO7 focuses on starting a fish seed production, packaging, and transportation business.
4. Specialized Skills and Competencies	CO1, CO2, CO4, CO5, CO6	These COs address technical skills like pond construction (CO1), water quality assessment (CO2), preparing fish feed (CO4), fish farming practices (CO5), and utilizing aquaculture tools (CO6).
5. Capacity for Application, Problem-Solving, and Analytical Reasoning	CO1, CO2, CO3, CO5	CO1 involves applying knowledge to prepare for pond construction, CO2 requires analyzing water quality data, CO3 necessitates choosing suitable fish species based on analysis, and CO5 emphasizes applying fish farming techniques for problem-solving.
6. Communication Skills and Collaboration	CO6	While not a direct focus, effective communication might be required when collaborating with others in aspects like acquiring government aid (CO6).
7. Research-related Skills	CO6	There's no direct mapping, but research skills might be indirectly beneficial for exploring new fish farming techniques or government schemes (CO6).
8. Learning How to Learn Skills	CO6	Continuous learning is essential for adapting to changes in the fisheries industry and acquiring new knowledge about fish farming techniques and government schemes (CO6).
9. Digital and Technological	CO6	While not explicitly mentioned, some COs might involve basic digital skills for accessing information about government schemes (CO6).

Skills		
10. Multicultural Competence, Inclusive Spirit, and Empathy	(Not Applicable)	This program likely focuses on technical fisheries management and may not directly involve multicultural aspects.
11. Value Inculcation and Environmental Awareness	CO1, CO5	Sustainable fisheries practices likely underlie all COs, promoting responsible management of fish populations and environmental awareness. CO1 emphasizes proper pond construction to prevent environmental damage, and CO5 highlights responsible fish farming techniques.
12. Autonomy, Responsibility, and Accountability	CO1, CO5, CO6	CO1 emphasizes taking responsibility for proper pond construction, CO5 highlights applying fish farming techniques responsibly, and CO6 emphasizes utilizing aquaculture tools and government schemes responsibly.
13. Community Engagement and Service	(Not Directly Applicable)	The program seems focused on individual fisheries management skills, not directly on community engagement.

**SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2023)**

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: Vocational Skill Courses (Theory)

Course Code: ZOO-121-VSC

Course Name: Biological Techniques-I

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives: -

- Acquaintance with good laboratory practices.
- Working mechanism of laboratory instruments
- Instrument handling and maintenance.
- Cleaning and sterilization of glass-wares.
- Preparation of solutions.
- Principle and working of pH meter.
- Separation of biomolecules.

Course Outcomes: -

Student will be able to-

CO1: Implement good laboratory practices.

CO2: Demonstrate working mechanism of laboratory instruments.

CO3: Handle the instruments and keep its maintenance.

CO4: Clean and sterilize glass-wares for different experiments.

CO5: Prepare the solutions of different concentrations.

CO6: Measure the pH of different samples with the help of pH meter.

CO7: Separate different biomolecules.

Unit	Subunit No	Content	Teaching Hours
1. Introduction to Good Laboratory Practices	1.1	Introduction to Good Laboratory Practices	04
	1.2	History, Scope	
	1.3	Fundamental points of GLP (Resources Characterization, Rules, Results, Quality assurance)	
2. Laboratory rules and Protocols	2.1	General Rules/Protocols for Lab Safety measures	04
	2.2	Precaution and Safety in handling of chemicals	
	2.3	Laboratory tools, Glassware and instruments.	
3. Laboratory SOP	3.1	Basic SOPs for instrument	02

		handling and Maintenance	
4. Sterilization of Laboratory Glassware and Equipment	4.1	Cleaning agents for glassware, Methods of sterilization and storage of glassware	04
5. Standard system for Measurement	5.1	Units of measurements: SI system, Equivalent weight, normality, molarity	08
	5.2	Mole concept, Determination of molecular weight by gram molecular volume relationship, Calculations and related conversions of Chemical molarity, normality	
	5.3	Volumetric measure: Percent volume; ppb; ppm	
6. Microscopy	6.1	Basic understanding on principle and uses of: Simple microscope Compound microscope	04
7. Analytical technique	7.1	pH meter: principal and working of pH meter	02
8. Separation technique	8.1	Centrifugation: principal and working of Centrifugation	02

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2. Christopher.F Forster, D.A. John Wase, (1987) Environmental Biotechnology, Ellis Harwood.
3. Arms, K. (1990) Environmental Science, Saunders College Publishing
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8. Principles and Techniques of Biochemistry and Molecular Biology, 6th edition (2008), Keith Wilson and John Walker, Publisher–Cambridge University Press.

Course Articulation Matrix of ZOO-121-VSC: Biological Techniques-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	1	1	1	1	1	1	1	3	3	2	1	1
CO2	3	1	1	1	1	1	1	1	3	3	1	1	3
CO3	3	1	1	3	3	1	3	3	3	2	1	3	1
CO4	3	2	2	2	1	1	2	1	3	1	3	1	2
CO5	2	3	2	3	3	1	1	1	3	1	3	2	1
CO6	2	3	2	3	1	1	1	2	3	2	3	1	1
CO7	1	2	3	2	2	3	1	2	3	2	1	1	1

Program Outcome (PO)	Course Outcome (CO)	Justification
1. Comprehensive Knowledge and Understanding	CO3: Handle the instruments and keep its maintenance.	Understanding the principles behind laboratory instruments and their proper maintenance contributes to a broader knowledge base in zoology.
2. Practical, Professional, and Procedural Knowledge	CO1: Implement good laboratory practices, CO2: Demonstrate working mechanism of laboratory instruments, CO3: Handle the instruments and keep its maintenance, CO4: Clean and sterilize glass-wares for different experiments, CO5: Prepare the solutions of different concentrations, CO6: Measure the pH of different samples with the help of pH meter, CO7: Separate different biomolecules.	These COs directly develop practical skills essential in zoological research and professional settings.
3. Entrepreneurial Mindset and Knowledge	(Limited overlap in provided COs)	While not explicitly covered, the skills of preparing solutions, using instruments, and following protocols could be applied in settings like fish hatcheries or insect rearing for commercial purposes.
4. Specialized Skills and Competencies	CO1: Implement good laboratory practices, CO2: Demonstrate working mechanism of laboratory instruments, CO3: Handle the instruments and keep its maintenance, CO4: Clean and sterilize glass-wares for different experiments, CO5: Prepare the solutions of different concentrations, CO6: Measure the pH of different samples with the help of pH meter, CO7: Separate different biomolecules.	Mastery of these techniques translates to specialized laboratory competencies in zoological research.

5. Capacity for Application, Problem-Solving, and Analytical Reasoning	CO1: Implement good laboratory practices, CO4: Clean and sterilize glass-wares for different experiments, CO5: Prepare the solutions of different concentrations, CO6: Measure the pH of different samples with the help of pH meter, CO7: Separate different biomolecules.	Following protocols, troubleshooting issues during experiments, and applying knowledge to prepare solutions and analyze samples all involve problem-solving and analytical skills.
6. Communication Skills and Collaboration	(Limited overlap in provided COs)	Though not directly addressed, laboratory work often involves collaboration with peers and potentially requires clear communication of procedures and findings.
7. Research-related Skills	CO1: Implement good laboratory practices, CO2: Demonstrate working mechanism of laboratory instruments, CO3: Handle the instruments and keep its maintenance, CO4: Clean and sterilize glass-wares for different experiments, CO5: Prepare the solutions of different concentrations, CO6: Measure the pH of different samples with the help of pH meter, CO7: Separate different biomolecules.	These COs equip students with fundamental laboratory techniques used in zoological research.
8. Learning How to Learn Skills	CO1: Implement good laboratory practices, CO2: Demonstrate working mechanism of laboratory instruments, CO3: Handle the instruments and keep its maintenance, CO4: Clean and sterilize glass-wares for different experiments, CO5: Prepare the solutions of different concentrations, CO6: Measure the pH of different samples with the help of pH meter, CO7: Separate different biomolecules.	By mastering these laboratory techniques, students develop the ability to independently learn new procedures and adapt to different research environments.
9. Digital and Technological Skills	(Limited overlap in provided COs)	While not directly covered, some laboratory instruments might utilize digital interfaces or software. Data collected during experiments may also be analyzed with digital tools.
10. Multicultural Competence, Inclusive Spirit, and Empathy	(Limited overlap in provided COs)	The field of zoology can benefit from diverse perspectives, but these COs themselves don't directly address this.
11. Value	(Limited overlap in provided COs)	Some zoological research

Inculcation and Environmental Awareness		directly relates to environmental issues, but these COs target practical lab skills.
12. Autonomy, Responsibility, and Accountability	CO1: Implement good laboratory practices, CO3: Handle the instruments and keep its maintenance, CO4: Clean and sterilize glass-wares for different experiments, CO5: Prepare the solutions of different concentrations, CO6: Measure the pH of different samples with the help of pH meter.	Following protocols, maintaining instruments, and ensuring accurate results all require a sense of responsibility and accountability in the lab.
13. Community Engagement and Service	(Limited overlap in provided COs)	The provided COs focus on foundational laboratory skills. Community engagement might be part of other courses in the B.Sc. Zoology program.

**SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2023)**

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: Skill Enhancement Course (Practical)

Course Code: ZOO-126-SEC

Course Name: Medical Laboratory Technology-I

Number of Credits: 02

Number of Teaching hours: 60

Course Objectives:-

- Identification of glass-wares and instruments.
- Working of instruments.
- Identification of blood cells and blood groups.
- Estimation of hemoglobin.
- Counting of blood cells and its interpretation.
- Preparation of blood smear and measurement of blood pressure.
- Deproteinization of samples.

Course Outcomes:-

Student will be able to-

CO1: Distinguish glass-wares and identify instruments.

CO2: Demonstrate the working of instruments.

CO3: Distinguish blood cells based on morphology and identify blood groups.

CO4: Determine haemoglobin content.

CO5: Count blood cells and interpret obtained data.

CO6: Prepare blood smear and measure blood pressure.

CO7: Deproteinize blood samples.

Sr. No.	Title of the Practical	E/D	Teaching Hours
1.	Study of Microscope and its use.	(D)	04
2.	Glassware and equipments for Haematology	(D)	04
3.	Study of morphology of blood cells	(D)	04
4.	To perform bleeding & Clotting time	(E)	04
5.	Study of Stains used in Haematology	(E)	04
6.	Determination of Blood group	(E)	04
7.	Estimation of Haemoglobin by Sahli's method	(E)	04
8.	To perform Total WBC count by Haemocytometer	(E)	04
9.	To perform Total RBC count	(E)	04
10.	Preparation of blood films	(E)	04
11.	To perform Differential Leukocyte count	(E)	04
12.	Erythrocyte Indices- MCV, MCH and MCHC	(E)	04
13.	Deproteinization of blood sample	(E)	04
14.	To measure blood pressure	(E)	04
15.	Demonstration of ECG	(D)	04
*D- Demonstration; E- Experiment.			

Course Articulation Matrix of ZOO-126-SEC: Medical Laboratory Technology-I
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO 1	1	3	1	3	1	1	3	2	1	1	1	2	1
CO 2	1	3	1	3	1	1	3	2	1	1	1	2	1
CO 3	3	3	1	3	3	1	3	3	1	1	1	3	1
CO 4	2	3	1	3	3	1	3	2	1	1	1	3	1
CO 5	2	3	1	3	3	2	3	3	1	1	1	3	1
CO 6	1	3	1	3	2	2	3	2	1	1	1	3	1

Program Outcome (PO)	Course Outcome (CO)	Justification
1. Comprehensive Knowledge and Understanding	CO3: Distinguish blood cells based on morphology and identify blood groups.	Understanding the morphology of blood cells and blood group systems contributes to a foundational knowledge base in hematology, a subfield of zoology.
2. Practical, Professional, and Procedural Knowledge	CO1: Distinguish glass-wares and identify instruments, CO2: Demonstrate the working of instruments, CO3: Distinguish blood cells based on morphology and identify blood groups, CO4: Determine haemoglobin content, CO5: Count blood cells and interpret obtained data, CO6: Prepare blood smear and measure blood pressure.	These COs directly develop practical skills essential in clinical and research settings related to animal blood analysis.
3. Entrepreneurial Mindset and Knowledge	(Limited overlap in provided COs)	While not directly applicable, the skills of blood analysis could be relevant in fields like animal breeding or veterinary diagnostics.
4. Specialized Skills and Competencies	CO1: Distinguish glass-wares and identify instruments, CO2: Demonstrate the working of instruments, CO3: Distinguish blood cells based on morphology and identify blood groups, CO4: Determine haemoglobin content, CO5: Count blood cells and interpret obtained data, CO6: Prepare blood smear and measure blood pressure.	Mastery of these techniques translates to specialized laboratory competencies in animal blood analysis.
5. Capacity for Application,	CO3: Distinguish blood cells based on morphology and identify blood	Analyzing blood cell morphology, interpreting blood

Problem-Solving, and Analytical Reasoning	groups, CO4: Determine haemoglobin content, CO5: Count blood cells and interpret obtained data, CO6: Prepare blood smear and measure blood pressure.	test results, and troubleshooting issues during procedures all involve problem-solving and analytical skills.
6. Communication Skills and Collaboration	(Limited overlap in provided COs)	Though not directly addressed, laboratory work often involves collaboration with peers and potentially requires clear communication of findings. Communicating blood test results to veterinarians or researchers could also be important.
7. Research-related Skills	CO1: Distinguish glass-wares and identify instruments, CO2: Demonstrate the working of instruments, CO3: Distinguish blood cells based on morphology and identify blood groups, CO4: Determine haemoglobin content, CO5: Count blood cells and interpret obtained data, CO6: Prepare blood smear and measure blood pressure.	These COs equip students with fundamental laboratory techniques used in animal blood analysis research.
8. Learning How to Learn Skills	CO1: Distinguish glass-wares and identify instruments, CO2: Demonstrate the working of instruments, CO3: Distinguish blood cells based on morphology and identify blood groups, CO4: Determine haemoglobin content, CO5: Count blood cells and interpret obtained data, CO6: Prepare blood smear and measure blood pressure.	By mastering these blood analysis techniques, students develop the ability to independently learn new procedures used in animal health and research.
9. Digital and Technological Skills	(Limited overlap in provided COs)	Some blood analysis instruments might utilize digital interfaces or software. Data collected during blood tests may also be analyzed with digital tools.
10. Multicultural Competence, Inclusive Spirit, and Empathy	(Limited overlap in provided COs)	The field of veterinary medicine can benefit from diverse perspectives, but these COs themselves don't directly address this.
11. Value Inculcation and Environmental Awareness	(Limited overlap in provided COs)	While animal health can be indirectly linked to environmental factors, these COs target practical blood analysis

		skills.
12. Autonomy, Responsibility, and Accountability	CO1: Distinguish glass-wares and identify instruments, CO2: Demonstrate the working of instruments, CO3: Distinguish blood cells based on morphology and identify blood groups, CO4: Determine haemoglobin content, CO5: Count blood cells and interpret obtained data, CO6: Prepare blood smear and measure blood pressure.	Following protocols, using instruments correctly, and ensuring accurate blood test results all require a sense of responsibility and accountability in the lab.
13. Community Engagement and Service	(Limited overlap in provided COs)	The provided COs focus on foundational blood analysis skills. Community engagement might be part of other courses in the B.Sc. Zoology program.

SYLLABUS (CBCS) FOR F. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2023)

Name of the Program: B.Sc. Zoology

Program Code: ZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: Indian Knowledge System (Theory)

Course Code: ZOO-137-IKS

Course Name: Animal Diversity & Conservation in Indian Culture

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- Basic information on animals in Indian culture.
- Classification of some animals by Indian ascetics.
- Habitat and behavioral diversity of animals in perspective of Indian culture.
- Correlation between Indian culture and animal conservation.
- Role of animals in ecosystem.
- Domestication of animals
- Animal taming in Indian culture.

Course Outcomes:-

Student will be able to-

CO1: Recall facts about animals in Indian culture.

CO2: Classify animals as per Indian tradition.

CO3: Compare habitat and behavioral diversity of animals.

CO4: Analyze role of Indian culture in animal conservation.

CO5: Explain role of animals in ecosystem.

CO6: Predicts correlation between Indian culture and animal domestication.

CO7: Explain the concept of animal taming in Indian culture

TOPICS:

Unit No.	Subunit No	Details	Teaching Hours
1. Sacred Animals of India (Non-chordates)	1.1	Introduction	06
	1.2	Ants & Bees	
	1.3	Praying Mantis	
	1.4	Butterflies	
	1.5	Spider	
2. Sacred Animals of India (Chordates)	2.1	Fish	12
	2.2	Frog	
	2.3	Tortoise & Snakes	
	2.4	Eagle, Peacock, Owl	
	2.5	Cow, Elephant, Horse	
3. Introduction to Animal Classification in Ancient India	3.1	Eagle	12
	3.2	Owl	
	3.3	Crow	
	3.4	Cow	
	3.5	Buffalo	
	3.6	Horse	

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3. Majupuria, T.C., (2000). Sacred Animals of Nepal and India, Gwalior.
4. Ramanujam, Geetha, (2006). Environmental Awareness in Jainism, Department of Jainology, University of Madras, Chennai.
5. Chitampalli M., and Bhatkhande N., (1993). Hansadev Virachit Mriga Pakshi Shastra, Maharashtra Rajya Sahitya Aani Sanskruti Mandal, GoM, Mumbai.

Course Articulation Matrix of ZOO-137-IKS: Animal Diversity & Conservation in Indian Culture

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

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

Program Outcome (PO)	Course Outcome (CO)	Justification
1. Comprehensive Knowledge and Understanding	CO1: Recall facts about animals in Indian culture.	This CO requires students to remember factual information about animals within the specific context of Indian culture, which contributes to their overall knowledge base.
1. Comprehensive Knowledge and Understanding	CO7: Explain the concept of animal taming in Indian culture.	This CO builds understanding of a specific aspect of human-animal interaction within Indian culture, fostering both knowledge and appreciation for different cultural perspectives.
2. Practical, Professional, and Procedural Knowledge	Not directly applicable	The course focuses on cultural understanding and animal diversity, not directly equipping students with practical skills for specific professions.
3. Entrepreneurial	Not directly applicable	The course doesn't have an entrepreneurial

Mindset and Knowledge		focus, though it might indirectly foster creative thinking through analyzing cultural practices.
4. Specialized Skills and Competencies	CO2: Classify animals as per Indian tradition.	Classifying animals based on traditional knowledge systems falls under specialized skills relevant to understanding Indian cultural perspectives on the natural world.
4. Specialized Skills and Competencies	CO4: Analyze role of Indian culture in animal conservation.	This CO combines understanding traditional practices with environmental awareness, fostering specialized skills in analyzing cultural influences on conservation.
5. Capacity for Application, Problem-Solving, and Analytical Reasoning	CO3: Compare habitat and behavioral diversity of animals.	Students will be applying their knowledge to compare habitat and behavior across different animal groups, demonstrating analytical thinking skills.
5. Capacity for Application, Problem-Solving, and Analytical Reasoning	CO5: Explain role of animals in ecosystem.	Explaining the ecological role of animals demonstrates understanding of interconnectedness within ecosystems and reinforces environmental awareness.
5. Capacity for Application, Problem-Solving, and Analytical Reasoning	CO6: Predicts correlation between Indian culture and animal domestication.	Predicting correlations necessitates applying knowledge of both animal domestication and Indian cultural practices, demonstrating analytical reasoning.
6. Communication Skills and Collaboration	Not directly applicable	The course doesn't have a strong focus on developing communication or collaboration skills, though discussions might be present.
7. Research-related Skills	Not directly applicable	The course doesn't have a primary focus on conducting research, although students might be exposed to research findings on animal diversity and conservation.
8. Learning How to Learn Skills	Indirectly applicable	By critically analyzing cultural perspectives on animals, students might develop self-directed learning skills.
9. Digital and Technological Skills	Not directly applicable	The course doesn't have a focus on using digital tools or technologies.
10. Multicultural Competence, Inclusive Spirit, and Empathy	CO7: Explain the concept of animal taming in Indian culture.	This CO builds understanding of a specific aspect of human-animal interaction within Indian culture, fostering both knowledge and appreciation for different cultural perspectives.
11. Value Inculcation and Environmental Awareness	Not directly applicable (already included in PO 5)	Understanding the role of animals in ecosystems and the relationship between Indian culture and animal conservation inherently fosters environmental

		awareness.
12. Autonomy, Responsibility, and Accountability	Not directly applicable	The course doesn't have a focus on developing these traits in a professional context.
13. Community Engagement and Service	Not directly applicable	The course doesn't have a service-learning component or focus on community engagement.