Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati

(Autonomous)

Three/Four Year Honours/Honours with Research B.Sc. Degree

Program in Zoology

(Faculty of Science)

CBCS Syllabus

FYBSc (Zoology)

For Department of Zoology

NEP-2.0

Choice Based Credit System Syllabus

(2024 Pattern)

(As Per NEP-2020)

To be implemented from Academic Year 2024-2025

Title of the Programme: FYBSc (Zoology)

Preamble

AES's Tuljaram Chaturchand College has decided to change the syllabus of various faculties from June, 2023 by taking into consideration the guidelines and provisions given 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 outcomes for the development of the students. The credit structure and the courses framework provided in the NEP are nationally accepted and internationally comparable.

The rapid changes in science and technology and new approaches in different areas of Zoology and related subjects, Board of Studies in Zoology of Tuljaram Chaturchand College, Baramati - Pune has prepared the syllabus of FYBSc Zoology Semester - I under the Choice Based Credit System (CBCS) by following the guidelines of NEP 2020, NCrF, NHEQF, Prof. R.D. Kulkarni's Report, GR of Gov. of Maharashtra dated 20th April, 16th May 2023 and 13th March, 2024 and Circular of SPPU, Pune dated 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 toapply 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 academicand 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 consequencesof biodiversity depletion.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(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 Sayyad**	Student Representative
12.	**Mr. Subodh M. Nikam**	Student Representative

Course and Credit Distribution Structure for B.Sc. (Zoology) 2024-2025

Level/ Difficulty	Sem	Subject DSC-1				Subject DSC-2	Subject DSC-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2(P)				2(T)+2(P)	2(T)+ 2(P)	2(T)	2 (T/P)	2(T) (Generic)	2(T)	2(T)	--	22
	II	2(T)+2(P)				2(T)+2(P)	2(T)+2(P)	2(P)	2 (T/P)	--	2(T)	2(T)	2(T)	22
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and other as minor and third subject will be dropped.														
Level/ Difficulty	**Sem**	**Credits Related to Major**				**Minor**	--	**GE/OE**	**SEC**	**IKS**	**AEC**	**VEC**	**CC**	**Total**
		Major Core	**Major Elective**	**VSC**	**FP/OJT/CEP/RP**									
5.0/200	III	4(T)+2(P)	--	2 (T/P)	2(FP)	2(T)+2(P)	--	2(T)	--	2(T)	2(T)	--	2(T)	22
	IV	4(T)+2(P)	--	2 (T/P)	2(CEP)	2(T)+2(P)	--	2(P)	2 (T/P)	--	2(T)	--	2(T)	22
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2(P)	2 (T/P)	2(FP/CEP)	2(T)	--	--	--	--	--	--	--	22
	VI	8(T)+4(P)	2(T)+2(P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 3Years		**44**	**8**	**8**	**10**	**18**	**8**	**8**	**6**	**4**	**8**	**4**	**6**	**132**
Exit option: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4(P)	2(T)+2 (T/P)	--	4(RP)	4(RM)(T)	--	--	--	--	--	--	--	22
	VIII	6(T)+4(P)	2(T)+2 (T/P)	--	6(RP)	--	--	--	--	--	--	--	--	22
Total 4Years		**64**	**16**	**8**	**22**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours with Research Degree** in Major and Minor with 176 credits														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	--	--	4(RM) (T)	--	--	--	--	--	--	--	22
	VIII	10(T)+4(P)	2(T)+2 (T/P)	--	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 4Years		**72**	**16**	**8**	**14**	**22**	**8**	8	**6**	**4**	**8**	**4**	**6**	**176**
Four Year **UG Honours Degree** in Major and Minor with 176 credits														

*** T = Theory** *** P = Practical** *** DSC = Discipline Specific Course**

*** OE = Open Elective** *** SEC = Skill Enhancement Course** *** IKS = Indian Knowledge System**

*** AEC = Ability Enhancement Course** *** VEC = Value Education Course** *** CC = Co-curricular Courses**

***VSC= Vocational Skill Course** ***OJT = On Job Training** ***CEP = Community Engagement Project**

***FP = Field Project** ***RP = Research Project**

F.Y.B.Sc. Zoology NEP-2.0

Course Structure for F.Y.B.Sc. Zoology (2024 Pattern)

Sem	Course Type	Course Code	Course Title	Theory / Practical	Credits
	DSC-I (General)	ZOO-101-GEN	Non-chordates	T	02
		ZOO-102-GEN	Zoology Practical-I	P	02
	DSC-II (General)	-101-GEN		T	02
		-102-GEN		P	02
	DSC-III (General)	-101-GEN		T	02
		-102-GEN		P	02
	Open Elective (OE)	ZOO-103-OE	Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती)	T	02
	Skill Enhancement Course (SEC)	ZOO-104-SEC	Medical Laboratory Technology-I	P	02
	Ability Enhancement Course (AEC)	ENG-104-AEC		T	02
	Value Education Course (VEC)	ENV-105-VEC		T	02
	Generic Indian Knowledge System (GIKS)	GEN-106-IKS		T	02
				Total Credits Semester-I	**22**
II	DSC-I (General)	ZOO-151-GEN	Fundamentals of Cell Biology	T	02
		ZOO-152-GEN	Zoology Practical-II	P	02
	DSC-II (General)	-151-GEN		T	02
		-152-GEN		P	02
	DSC-III (General)	-151-GEN		T	02
		-152-GEN		P	02
	Open Elective (OE)	ZOO-153-OE	Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती- प्रात्यक्षिक)	P	02
	Skill Enhancement Course (SEC)	ZOO-154-SEC	Medical Laboratory Technology-II	P	02
	Ability Enhancement Course (AEC)	ENG-154-AEC		T	02
	Value Education Course (VEC)	COS-155-VEC		T	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/NCC-156-CC	To be selected from the CC Basket	T	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, 2024)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: DSC- I General (Theory)

Course Code: ZOO-101-GEN

Course Title: Non-chordates

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

CO3: Classify non-chordate animals according to different systems of classification.

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.

Unit No.	Subunit No	Details	Teaching Hours
1. Principles of animal classification	1.1	Introduction to invertebrates Three Domain & Six kingdom classification system	05
	1.2	Importance of animal classification.	
	1.3	Systematics-Linnaean hierarchy (Phylum, Class, Order, Family, Genus and Species)	
2. Classification with salient features (Up to class level with minimum one example of each class)	2.1	Protozoa	15
	2.2	Porifera	
	2.3	Coelenterata (Cnidaria)	
	2.4	Platyhelminthes	
	2.5	Aschelminthes	
	2.6	Annelida	
	2.7	Arthropoda	
	2.8	Mollusca	
	2.9	Echinodermata	

3. Type study: *Pheretima posthuma*	3.1	Systematic position, Habits and habitat	10
	3.2	Morphology	
	3.3	Digestive system	
	3.4	Excretory system.	
	3.5	Reproductive system	
	3.6	Nervous system and sense organs.	
	3.7	Economic importance	

REFERENCES

1. Kotpal, R. L. (2022). Modern Textbook of Zoology II Invertebrates.
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-GEN: Non-chordates
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, 2024)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: F.Y. B.Sc.
Semester: I
Course Type: DSC-I-General (Practical)
Course Code: ZOO-102-GEN
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: identify and classify major invertebrate phyla (Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata) based on external characteristics.
CO2: set up and maintain a simple culture of freshwater organisms (e.g., Amoeba, Hydra, Paramecium) and observe them under a microscope.
CO3: design and construct a small-scale vermiculture bed and explain the scientific principles behind vermicomposting.
CO4: dissect an earthworm to identify and explain the function of its major organ systems (digestive & nervous systems).
CO5: prepare temporary mounts of earthworm structures (setae, nephridia, gizzard) and observe them under a microscope for identification.
CO6: utilize identification keys to differentiate between different mosquito species.
CO7: create scientific drawings of various invertebrate specimens and generate a detailed report from a field trip to an aquatic ecosystem or a vermicomposting facility.

Sr. No.	Name of the practical	E/D	Teaching Hours
1.	Title: Taxonomic classification up to class level 1. Phylum: Protozoa: *Paramoecium, Euglena* 2. Phylum: Porifera: *Sycon, Euspongia*	D	04
2.	Title: Taxonomic classification up to class level 1. Phylum: Coelenterata: *Hydra*, Jelly fish 2. Phylum: Platyhelminthes-*Taenia, Planaria.*	D	04
3.	Title: Taxonomic classification up to class level 1. Phylum: Aschelminthes- *Ascaris, Wuchereria bancrofti.(Filarial worm)* 2. Phylum: Annelida-*Nereis, Leech.*	D	04

4.	Title: Taxonomic classification up to class level 1. Phylum Arthropoda (Centipede, Cockroach, Crab, and Scorpion)	D	04
5.	Title: Taxonomic classification up to class level 1. Phylum Mollusca (*Pila* and *Octopus*) 2. Phylum Echinodermata (Sea star and Feather star)	D	04
6.	Culturing of freshwater animals (*Acathamoeba*/*Hydra*/*Paramoecium*)	E	04
7.	Temporary preparation of protozoans on a slide and its observations under the microscope.		
8.	Preparation of small scale vermiculture bed (Activity based)	E	04
9.	Study of external characters of Earthworm.	E/D	04
10.	Dissection of earthworm so as to expose its digestive system	E/D	04
11.	Dissection of earthworm so as to expose its nervous system	D/E	04
12.	Temporary mountings of: Setae, septal nephridia & gizzard of earthworm.	E	04
13.	Identification of mosquitos with the help of an identification key.	D	04
14.	Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla	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-102-GEN 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: USZOO
Class: F.Y. B.Sc.
Semester: I
Course Type: Open Elective (Theory)
Course Code: ZOO-103-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 वषयाचा 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 सर्वंकष 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-103-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 Competencies	CO2, CO4, CO5, CO6	These COs address technical skills like pond construction (CO2), preparing fish feed (CO4), fish farming practices (CO5), and preservation techniques (CO6).
5. Capacity for Application, Problem-Solving, and Analytical	CO2, CO3, CO5	CO2 involves applying knowledge to prepare for pond construction, CO3 requires choosing suitable fish species based on analysis, and CO5

Reasoning		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, 2024)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: F.Y. B.Sc.

Semester: I

Course Type: Skill Enhancement Course (Practical)

Course Code: ZOO-104-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-104-SEC: Medical Laboratory Technology-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	2	1	2	1	3	3	1	1	1	3
CO2	3	3	1	2	1	2	1	1	3	1	3	1	1
CO3	3	3	3	2	3	2	3	1	3	3	3	3	1
CO4	3	2	3	2	3	2	1	1	3	1	2	3	1
CO5	3	3	2	2	3	2	2	1	3	2	3	2	1
CO6	3	3	3	2	3	2	3	2	3	3	3	3	2
CO7	3	3	2	2	3	2	2	2	3	2	3	2	2

PO 1: Comprehensive Knowledge and Understanding

Understanding the purpose and principles behind the lab procedures in CO1-CO6 (e.g., why we differentiate blood cells, how blood pressure readings work) could contribute to a broader foundational knowledge in Biology or Medical Laboratory Science. This knowledge becomes a building block for understanding more complex topics later in the program.

PO 2: Practical, Professional, and Procedural Knowledge

The skills developed in CO1-CO6 (using instruments, blood analysis) could be foundational for future courses that introduce industry standards, best practices, and regulations. Mastering these basic lab techniques prepares students for applying them in a professional setting with specific protocols.

PO 3: Entrepreneurial Mindset and Knowledge & PO 4: Specialized Skills and Competencies

CO1-CO3 directly assess identifying instruments and their workings, a core technical skill. CO4-CO6 involve applying those skills in blood analysis procedures, demonstrating proficiency in relevant lab techniques.

PO 5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO4-CO6 involve applying knowledge to blood analysis tasks and interpreting data (e.g., identifying abnormal blood cell morphology). This demonstrates some problem-solving and analytical skills in a controlled lab setting. These skills can be further developed to tackle more complex problems in later coursework and real-world scenarios.

PO 6: Communication Skills and Collaboration

The skills developed in performing these COs (e.g., following protocols, recording data) could be used in future courses that involve lab reports, presentations, or collaborating with other students on research projects.

PO 7: Research-related Skills

The foundation of data collection and analysis established in CO4-CO6 (e.g., counting blood cells, interpreting results) could be applied in future courses that introduce research methodologies.

PO 8: Learning How to Learn Skills

Successfully performing the COs requires following instructions, understanding the purpose of each step, and potentially troubleshooting issues. This lays the groundwork for independent learning in future courses where students need to find information and apply it to new situations.

PO 9: Digital and Technological Skills

CO7 mentions deproteinizing blood samples, which might involve using specific equipment. Depending on the process, this could relate to using digital tools or software. These basic skills can be expanded upon in future courses to encompass a wider range of digital technologies used in the field.

PO 10: Multicultural Competence, Inclusive Spirit, and Empathy & PO 11: Value Inculcation and Environmental Awareness

The knowledge gained in these COs could be relevant to future courses that discuss the ethical implications of medical testing or the environmental impact of certain laboratory practices.

PO 12: Autonomy, Responsibility, and Accountability

Successfully completing the COs requires following protocols carefully and achieving accurate results. This instills a sense of responsibility and accountability that can be applied in future courses and professional settings.

PO 13: Community Engagement and Service

The skills developed in these COs (e.g., blood analysis) are foundational for many medical laboratory professions that directly serve the community. These basic skills are a stepping stone towards future work that contributes to public health and well-being.

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

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: F.Y. B.Sc.
Semester: II
Course Type: DSC-I General (Theory)
Course Code: ZOO-151-GEN
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	5.1	Endoplasmic reticulum	10

organelles and their functions	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	

REFERENCES

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3. Avers, C. J. (1978). Basic cell biology.
4. Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons.
5. Cooper, G. M., Hausman, R. E., &Hausman, R. E. (2007). The cell: a molecular approach (Vol. 4, pp. 649-656). Washington, DC: ASM press.
6. Cell Biology by Arumugamm Saras Publication.
7. Gupta, P. K. (2005). Cytology Genetics and Evolution. Rastogi Publications.
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-151-GEN: 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, 2024)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: F.Y. B.Sc.
Semester: II
Course Type: DSC-I General (Practical)
Course Code: ZOO-152-GEN
Course Name: Zoology Practical-II
Number of Credits: 02
Number of Teaching hours: 60

Course Objectives:-

- Demonstrating & following the safe laboratory practices
- Use of microscopes effectively
- Utilization of stains and dyes for cell analysis
- Preparation & observation of microscopic samples
- Identification of sub-cellular ultrastructure
- Analysis of cell behavior and characteristics
- Exploring the cell division and chromosome structure
- Appreciation of the contributions of cell biologists

Course Outcomes:-

Students will be able to-
CO1: Explain handling, principle and working of the microscope, use proper stains
CO2: Culture the protozoan animals.
CO3: identify the cell organelles using electron micrographs.
CO4: use micrometry to measure the microscopic dimensions.
CO5: prepare the slides of chromosomes with proper cell material, staining technique
CO6: Compare the mounting types of cells.
CO7: identify the stages of cell division.

Sr. No.	Name of the practical	E/D	Teaching Hours
1.	Study of safety measures in biological laboratory.	D	04
2.	Microscopy: Study of standard operating procedure of a simple and compound microscope.(Activity based)	E	04
3.	Study of stains & dyes in cell biology	D	04
4.	Temporary preparation of a bacterial and protozoans on a slide and its observations under the microscope.	E	04
5.	Ultrastructure study of: a. Mitochondria, b. Nucleus, c. Endoplasmic Reticulum, d. Golgi complex (With electron micrographs)	D	04
6.	Study of mitochondria using Janus Green B stain	E	
7.	Study of Barr Body	E	04
8.	Study of micrometry	E	04
9.	Study of cell viability	E	04
10.	Study of mitosis with the help of permanent slides.	D	04

11.	Study of meiosis with the help of permanent slides.	D	04
12.	Study of cyclosis in *Paramoecium*	E	04
13.	Study of polytene chromosomes	E	04
14.	Study of lampbrush chromosomes	E	04
15.	Preparation of profile of any five scientists from the field of cell biology (Activity based)	--	04
16.	Visit to Cell Biology Laboratory	--	04
E: Experimental, D: Demonstrative			

Course Articulation Matrix of ZOO-152-GEN: Zoology Practical-II
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	2	1	1
CO2	3	1	3	3	1	3	1	1	3	1	1	1	1
CO3	3	3	1	2	3	2	3	3	3	3	1	1	1
CO4	1	2	3	2	2	3	2	2	3	2	3	1	1
CO5	3	1	2	3	2	2	2	1	3	1	2	3	1
CO6	3	1	1	3	1	2	2	1	3	1	1	1	1
CO7	1	3	2	1	2	1	2	1	3	1	1	1	3

PO1: Comprehensive knowledge and understanding

- CO1: Explains handling, principle and working of the microscope - Applies to understanding a fundamental scientific tool in cell biology.
- CO3: Identifies the cell organelles using electron micrographs - Requires knowledge of cell structure.
- CO5: Prepares slides of chromosomes with proper cell material, staining technique - Understands chromosome structure and staining methods.
- CO7: Identifies the stages of cell division - Requires knowledge of the cell cycle process.

PO2: Practical, professional, and procedural knowledge

- CO1: Explains handling, principle and working of the microscope - Involves proper usage of a scientific instrument.
- CO2: Cultures protozoan animals - Develops practical skills in cell culture.
- CO4: Uses micrometry to measure microscopic dimensions - Applies a practical technique for measurement.
- CO5: Prepares slides of chromosomes with proper cell material, staining technique - Develops practical skills in chromosome preparation.
- CO6: Compares the mounting types of cells - Understands different methods for sample preservation.

PO3: Entrepreneurial mindset and knowledge

CO4: May develop the entrepreneurial mindset after learning basic skills in cell biology.

PO4: Specialized skills and competencies

- CO1: Explains handling, principle and working of the microscope - Develops a competency in using a microscope.
- CO2: Cultures protozoan animals - Acquires a specialized skill in cell culture.
- CO3: Identifies the cell organelles using electron micrographs - Develops the ability to analyze electron microscope images.
- CO4: Uses micrometry to measure microscopic dimensions - Learns a specialized measurement technique.

- CO5: Prepares slides of chromosomes with proper cell material, staining technique - Develops a competency in chromosome preparation.
- CO6: Compares the mounting types of cells - Acquires knowledge of different cell preservation methods.
- CO7: Identifies the stages of cell division - Develops the ability to recognize cell division stages.

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

- CO2: Cultures protozoan animals - May involve problem-solving during cell culture process.
- CO3: Identifies the cell organelles using electron micrographs - Requires analytical skills to interpret images.
- CO4: Uses micrometry to measure microscopic dimensions - Applies the concept of measurement to biological samples.
- CO5: Prepares slides of chromosomes with proper cell material, staining technique - Involves applying knowledge to prepare a specific sample.
- CO7: Identifies the stages of cell division - Requires analytical skills to recognize cell division stages.

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. May utilize the digital technology to collect the information about scientists and to write the reports.

PO10: Multicultural competence, inclusive spirit, and empathy

May cooperate with fellow students, will show empathy during the need,

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: USZOO
Class: F.Y. B.Sc.
Semester: II
Course Type: Open Elective (Practical)
Course Code: ZOO-153-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 व्यवसायसाठी प्रकल्प अहवाल तयार करणे	01E	04
10	मत्स्य पालन प्रकल्प भेट		08

Course Articulation Matrix of ZOO-153-OE Fresh Water Fishery (गोड्या पाण्यातील मत्स्यशेती प्रात्य क्षक) **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 Skills	CO6	While not explicitly mentioned, some COs might involve basic digital skills for accessing information about government schemes (CO6).
10.	(Not	This program likely focuses on technical fisheries management and may not

Multicultural Competence, Inclusive Spirit, and Empathy	Applicable)	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, 2024)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: F.Y. B.Sc.
Semester: II
Course Type: Skill Enhancement Course (Practical)
Course Code: ZOO-154-SEC
Course Name: Medical Laboratory Techniques-II
Number of Credits: 02
Number of Teaching hours: 60

Course Outcomes

- To introduce students to the essential equipment and techniques used in hematology laboratories and to provide hands-on experience in the preparation of different staining solutions and the observation of blood smears.
- To develop practical skills in estimating blood normal and abnormal concentrations of sugar, cholesterol, uric acid, and creatinine.
- To familiarize students with the morphology of red blood cells, their osmotic fragility and characteristics of common hematological disorders.
- To educate students about the anticoagulants commonly used in hematology.
- To instruct students in the technique of determining packed cell volume (PCV) using Wintrobe's method.
- To teach the principles and methods for determining erythrocyte sedimentation rate (ESR).
- To enable students to perform a comprehensive analysis of urine samples and identifies normal and abnormal constituents.

Course Outcomes

After completion of this course, student will be able to

CO 1: operate hematology laboratory equipment and prepare staining solutions for blood smears effectively.

CO 2: accurately estimate blood concentrations of sugar, cholesterol, uric acid, and creatinine, distinguishing between normal and abnormal levels.

CO 3: recognize red blood cell morphology, assess osmotic fragility, and identify common hematological disorders.

CO 4: explain the use and impact of common anticoagulants in hematology.

CO 5: proficiently determine packed cell volume (PCV) using Wintrobe's method.

CO 6: understand and execute the principles and methods for erythrocyte sedimentation rate (ESR) determination.

CO 7: perform a comprehensive analysis of urine samples, precisely identifying normal and abnormal constituents.

Sr. No	Title of practical	E/D	Teaching Hours
1.	Demonstration of haematology equipment	E	04
2	Preparation of Leishman, Acetocarmine & Giemsa stain.	E	04
3.	Preparation of haemin crystals using human blood.	E	04
4.	Estimation of blood sugar by GOD-POD method	E	04

5.	Estimation of serum cholesterol	D	08
6.	Estimation of serum uric acid	E	04
7.	Estimation creatinine in serum	E	04
8.	Study of normal and abnormal constituents of blood	E	04
9.	Morphology of Red Blood Cells	E	04
10.	Osmotic fragility test of RBCs	E	04
11.	Demonstration of slides of various disorders of anaemia & leukemia	D	04
12.	Study of anticoagulants used in Haematology	E	08
13.	Determination of Erythrocyte sedimentation rate by Wintrobe's method	D	04
14.	Urine analysis – normal & abnormal constituents of urine.	D	04
15.	Determination of PCV by Wintrobe's method	E	04
D- Demonstration; E- Experiment.			

Course Articulation Matrix of ZOO-154-SEC: Medical Laboratory Technology-II
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	2	1	2	1	1
CO2	1	3	2	1	2	1	1	2	1	1	3	2	2
CO3	2	3	2	3	2	1	1	1	1	1	1	1	1
CO4	3	2	1	1	3	1	1	1	1	2	2	2	1
CO5	1	1	2	2	1	1	1	3	1	3	3	1	1
CO6	3	1	1	1	1	1	1	1	1	1	1	1	1
CO7	1	2	2	2	1	2	1	3	1	3	1	1	1

PO1: Comprehensive knowledge and understanding

CO2: Requires understanding of blood chemistry and reference ranges for various components.
CO3: Involves knowledge of red blood cell morphology and hematological disorders.
CO4: Requires understanding of anticoagulant mechanisms and their impact on blood analysis.
CO6: Requires understanding of ESR principles and their clinical significance.
CO7: Requires knowledge of normal and abnormal urine constituents.

PO2: Practical, professional, and procedural knowledge

CO1: Directly applies to practical skills in operating hematology equipment and preparing stains.
CO3: Involves applying knowledge to assess red blood cell morphology and identify disorders.
CO5: Requires proficiency in performing the PCV test using a specific method.
CO6: Requires applying understanding of ESR principles to perform the test.
CO7: Involves applying knowledge to analyze urine samples and interpret results.

PO3: Entrepreneurial mindset and knowledge

CO1: The skills developed in operating equipment and preparing solutions could be indirectly relevant to PO3 if students consider opening their own diagnostic lab. Understanding these procedures is valuable for entrepreneurs in the medical field.

PO4: Specialized skills and competencies

CO1: Develops the ability to operate hematology equipment and prepare stains.
CO2: Acquires the skill to perform blood chemistry tests.

CO3: Provides specialized skills in RBC analysis and hematological disorder identification.
CO5: Develops proficiency in a specific method for PCV determination.
CO6: Acquires the skill to perform and interpret ESR tests.
CO7: Provides the skill for comprehensive urine analysis.

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

CO2: Requires applying knowledge to interpret blood chemistry results and distinguish normal from abnormal.
CO3: Involves applying knowledge to analyze red blood cell morphology and diagnose disorders, developing problem-solving skills in clinical settings.
CO5: Applies knowledge to perform the PCV test accurately.
CO6: Applies understanding of ESR principles to interpret test results, fostering analytical reasoning in evaluating patient health.
CO7: Applies knowledge to analyze urine samples and identify potential health issues, developing problem-solving skills for diagnosis.

PO6: Communication skills and collaboration (developed through lab reports)

CO1-CO7: Writing lab reports can contribute to developing communication skills by documenting procedures, observations, and interpretations. Clear communication is essential for collaboration with other healthcare professionals.

PO7: Research-related skills

CO2, CO5, CO6, CO7: The skills developed in these COs could be a foundation for further research involving blood or urine analysis (PO7). These skills provide a strong base for further investigation in hematology and related fields.

PO8: Learning how to learn skills

All Course Outcomes (COs) involve learning new skills and knowledge related to hematology, fostering the ability to learn independently (PO8). This course lays the groundwork for lifelong learning in the field.

PO9: Digital and technological skills

CO1-CO7: Depending on the laboratory equipment used, some COs might involve using digital interfaces or software for data acquisition or analysis, introducing basic digital skills (PO9). These skills can be further developed in future endeavors.

PO10: Multicultural competence, inclusive spirit, and empathy

CO1-CO7: While not directly related, the knowledge and skills developed in these COs can indirectly contribute to PO10 if the course emphasizes the importance of accurate blood and urine analysis for patients from diverse backgrounds. Understanding these tests can contribute to providing culturally competent healthcare.

PO11: Value inculcation and environmental awareness

CO1-CO7: The laboratory practices learned in this course can indirectly contribute to PO11 by emphasizing the importance of proper handling and disposal of laboratory waste to minimize environmental impact. Responsible lab practices are essential for environmental awareness.

PO12: Autonomy, responsibility, and accountability

CO1-CO7: Performing these tasks in a laboratory setting can develop autonomy, responsibility, and accountability in following protocols and handling samples (PO12). These are essential qualities for any medical professional.

PO13: Community engagement and service

CO1-CO7: The knowledge and skills developed in this course can be indirectly applied to PO13 if students volunteer in healthcare settings or community outreach programs that utilize blood or urine analysis.