Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati

(Empowered Autonomous)

Three / Four Year Honours / Honours with Research B.Sc. Degree Program in Zoology
(Faculty of Science)

CBCS Syllabus

TYBSc (Zoology) Semester-V

For Department of Zoology

Choice Based Credit System Syllabus

(2023 Pattern)

(As Per NEP-2020)

To be implemented from Academic Year 2025-2026

Title of the Programme: TYBSc (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 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 toanalyse 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 indiagnostic 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.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Empowered Autonomous)

Board of Studies (BoS) in Zoology

From 2025-26 to 2027-28

Sr.No.	Name of Member	Designation
1.	**Dr. Chordiya Sandip Popatlal**	**Chairperson**
2.	**Dr. Nale Vitthal Baban**	Member
3.	**Dr. Manoorkar Poojawati**	Member
4.	**Dr. Sangale Deepali Maruti**	Member
5.	**Mr. More Kishor U.**	Member
6.	**Dr. Jadhav Sameer Sadashiv**	Member
7.	**Mr. Kare Samadhan**	Member
8.	**Mr. Awaghade Yugandhar**	Member
9.	**Ms. Shah Sharvari Vishal**	Member
10.	**Ms. Shaikh Shaheen**	Member
11.	**Dr. Ravindra D. Chaudhari**	Vice-Chancellor Nominee Subject Expert from SPPU, Pune
12.	**Dr. Gaikwad Sanjay K.**	Subject Expert from Outside the Parent University
13.	**Dr. Deshmukh A. A.**	Subject Expert from Outside the Parent University
14.	**Dr. Karpe Yogesh**	Representative from Industry/Corporate Sector/Allied areas
15.	**Ms. Kumbhar Kamal**	Member of the College Alumni
16.	**Ms. Sakshi Sawant**	UG Student
17.	**Ms. Sanika Nikhale**	PG Student

Credit Distribution Structure for B.Sc. -2023Pattern (Zoology)

Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC,IKS	OJT, FP, CEP, CC, RP	Cum.Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	I	4- 6 (4+2)		-	2+2	VSC:2,SEC:2	AEC:2, VEC:2,IKS:2	CC:2	20-22	UG Certificate 40-44
	II	4- 6 (4+2)		2	2+2	VSC:2, SEC:2	AEC:2, VEC:2	CC:2	20-22	
	Cum Cr.	8-12	-	2	8	4+4	4+4+2	4	40-44	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor										
5.0	III	6(4+2)- 8(2*4)		4	2	VSC:2,	AEC:2	FP:2CC:2	20-22	UG Diploma 80-88
	IV	6(4+2)- 8(2*4)		4	2	SEC:2	AEC:2	CEP: 2 CC:2	20-22	
	Cum Cr.	20-28		10	12	6+6	8+4+2	8+4	80-88	
Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQFcourse/ Internship OR Continue with Major and Minor										
5.5	V	8(2*4)-10(2*4 +2)	4	4-6		VSC: 2- 4		FP/CEP:2	20-22	UG Degree 120-132
	VI	8(2*4)-10 (2*4 +2)	4	4				OJT :4	20-22	
	Cum Cr.	36-48	8	18-20	12	8-10 +6	8+4+2	8+6+4	120-132	
Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor										
6.0	VII	12-14 (2*4 +2*2 or 3*4+2)	4	RM:4					20-22	UG Honours Degree 160-176
	VIII	12-14 (2*4 +2*2 or 3*4+2)	4					OJT:4	20-22	
	Cum Cr.	60-76	16	18-20 +4	12	8-10 +6	8+4+2	8+6+8	160-176	
Four Year UG Honours Degree in Major and Minor with 160-176 credits										
6.0	VII	8-10 (2*4 +2 or2*4)	4	RM:4				RP: 4	20-22	UG Honours with Research Degree 160-176
	VIII	8-10 (2*4 +2 or2*4)	4					RP: 8	20-22	
	Cum Cr.	52-68	16	18 -20 +4	12	8-10 +6	8+4+2	8+6+4+ 12	160-176	
Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits										

Title of the Programme: TYBSc (Zoology)

Course Credit Structure for TYBSc Zoology (2023 pattern) as per NEP-2020

Sem	Course Type	Course Code	Course Name	Theory / Practical	Credits
V	Major Mandatory	ZOO-301-MJM	Biological Techniques	Theory	02
	Major Mandatory	ZOO-302-MJM	Mammalian Histology	Theory	02
	Major Mandatory	ZOO-303-MJM	Biochemistry	Theory	02
	Major Mandatory	ZOO-304-MJM	Genetics	Theory	02
	Major Mandatory	ZOO-305-MJM	Zoology Practical-V	Practical	02
	Major Elective (MJE)	ZOO-306-MJE (A)	Cell Biology	Theory (Any Two)	04
	Major Elective (MJE)	ZOO-306-MJE (B)	General Pathology		
	Major Elective (MJE)	ZOO-306-MJE (C)	Ethology		
	Minor	ZOO-311-MN	Ornamental Fishery	Theory	02
	Minor	ZOO-312-MN	Practicals in Ornamental Fishery	Practical	02
	Vocational Skill Course (VSC)	ZOO-321-VSC	Biostatistics	Practical	02
	Field Project (FP)	ZOO-355-FP	Field Project	Practical	02
				Total Credits Semester-V	**22**
VI	Major Mandatory	ZOO-351-MJM	Immunology	Theory	02
	Major Mandatory	ZOO-352-MJM	Mammalian Physiology	Theory	02
	Major Mandatory	ZOO-353-MJM	Parasitology	Theory	02
	Major Mandatory	ZOO-354-MJM	Molecular Biology	Theory	02
	Major Mandatory	ZOO-355-MJM	Zoology Practical-V	Practical	02
	Major Elective (MJE)	ZOO-356-MJE (A)	Endocrinology	Theory (Any Two)	04
	Major Elective (MJE)	ZOO-356-MJE (B)	Basic Entomology		
	Major Elective (MJE)	ZOO-356-MJE (C)	General Embryology		
	Minor	ZOO-361-MN	Agricultural Pests & Management	Theory	02
	Minor	ZOO-362-MN	Practicals in Agricultural Pest Management	Practical	02
	On Job Training (OJT)	ZOO-385-OJT	On Job Training	Practical	04
				Total Credits Semester-VI	**22**
				Cumulative Credits Semester V + Semester VI	**44**

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T.Y.B.Sc.
Semester: V
Course Type: Major (Mandatory) Theory
Course Code: ZOO-301-MJM
Course Name: Biological Techniques
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Master the application of chemical solution strengths (percentage, normality, molarity, molality, ppm, and ppb) in biological techniques.
- Apply diverse separation techniques (chromatography, electrophoresis, ultracentrifugation, colorimetry, for biomolecule isolation and characterization.
- Develop practical skills in haematological techniques, covering blood cell counting, microscopy principles, and clinical significance.
- Acquire expertise in tissue processing for optimal preservation, including procurement, fixation, dehydration, clearing, impregnation, embedding, and block making.
- Gain proficiency in microtome and knife techniques, mastering section cutting, fault diagnosis, and ribbon mounting.
- Understand stains and staining techniques (classification, methods), including essential steps in mounting and labelling sections.
- Explore advanced biotechnological methods (PCR, RT-PCR, Southern, Western, Northern Blotting, and understand their applications in molecular biology, including BLAST for sequence search and alignment.

Course Outcomes:-

Student will be able to-

CO1: differentiate between chemical solutions parameters; apply knowledge to handle chemicals in biological experiments.

CO2: explain principles of chromatography, electrophoresis, ultracentrifugation, colorimetry, and spectroscopy; apply techniques for biomolecule isolation and characterization.

CO3: perform blood cell counts and microscopy for clinical understanding; use phase-contrast and electron microscopes.

CO4: demonstrate proper tissue procurement and histological processing; apply fixatives, dehydration, and embedding techniques.

CO5: identify microtome types and knives; demonstrate section cutting, identify faults, and apply remedies.

CO6: classify and apply staining principles; demonstrate proficiency in mounting and labelling; apply histochemical techniques for carbohydrate and nucleic acid demonstration.

CO7: explain PCR and blotting techniques.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	**Introduction to biological techniques:**		06
	Principle and applications of		
	1.1	Chromatography- Ion-exchange	
	1.2	Electrophoresis- Agarose and PAGE	
	1.3	Ultracentrifugation	
	1.4	Colorimetry	
2	**Haematological Techniques:**		05
	2.1	Blood cell count –Total count of RBCs, WBCs and Differential count of WBCs and their significance	
	2.2	Microscopy: Phase contrast and electron – their principle & working	
3	**Microtechniques:**		06
	3.1	Procurement of tissues and precautions to be taken to during procurement	
	3.2	Fixatives: Classification of fixatives, methods of fixation and importance of fixation	
	3.3	Dehydration and clearing	
	3.4	Impregnation, embedding and block making	
4	**Microtomes and Knives:**		03
	4.1	Types of microtomes and microtome knives	
	4.2	Section cutting: Steps, common faults- reasons & remedies	
	4.3	Mounting and spreading of ribbons	
5	**Stains and Staining:**		04
	5.1	Classification of stains	
	5.2	Gram's staining	
	5.3	General procedure for staining of sections	
	5.4	Mounting media & mounting of sections	
6	**Histochemical staining:**		02
	6.1	Demonstration of Carbohydrates by PAS technique	
	6.2	Demonstration of Nucleic acid by Feulgen Reaction	
7	**Biotechnology:**		04
	7.1	Introduction to RDT & PCR	
	7.2	Introduction to Blotting techniques	

REFERENCES

1. Scott, T. (1999). Introduction to Medical Laboratory Technology. British Journal of Biomedical Science, 56(2), 154.
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3. Okotore, R. O. (1998). Basic separation techniques in biochemistry. New Age International.
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6. Sanderson, J. (2020). Biological microtechnique. Garland Science.
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8. Biological Instrumentation and methodology, 2008, 2nd Revised Edition, P.K. Bajpai, S. Chand and Co. Ltd., New Delhi.
9. Thieman, W. J. (2009). Introduction to biotechnology, Pearson Education India.

Course Articulation Matrix of ZOO-301-MJM: Biological Techniques
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding
All COs are directly mapped to PO1 because understanding chemical solutions, biomolecule isolation, microscopy, histological processing, staining techniques, and molecular biology methods are essential for comprehensive biological knowledge.

PO2: Practical, professional, and procedural knowledge
CO1, CO2, CO3, CO5 & CO7 are directly mapped to PO2 because practical skills in handling chemicals, performing chromatography, using microscopes, cutting tissue sections, and executing PCR and blotting techniques are crucial in biological experiments.

PO3: Entrepreneurial mindset and knowledge
CO4 & CO7 are directly mapped to PO3 because knowledge of histological processing and molecular techniques has potential applications in biotechnology and healthcare entrepreneurship.

PO4: Specialized skills and competencies
CO1, CO2, CO3, CO4 & CO6 are directly mapped to PO4 because mastering chemical handling, biomolecule isolation, microscopy, histological procedures, and staining techniques requires specialized skills for precise biological experimentation.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO5 because identifying faults in histological sections, troubleshooting biomolecule isolation techniques, and analyzing experimental results require critical thinking and problem-solving abilities.

PO6: Communication skills and collaboration
CO4, CO6 & CO7 are directly mapped to PO6 because presenting findings, interpreting histological and molecular biology results, and collaborating on experimental studies are essential communication and teamwork skills in biological research.

PO7: Research-related skills
CO2, CO3, CO4, CO6 & CO7 are directly mapped to PO7 because research in chromatography, microscopy, histological processing, staining, and PCR techniques requires analytical thinking and experimental validation.

PO8: Learning how to learn skills
CO1, CO2, CO5 & CO6 are directly mapped to PO8 because acquiring expertise in handling chemicals, understanding laboratory techniques, and improving histological processing skills contribute to lifelong learning in biological sciences.

PO9: Digital and technological skills
CO7 is directly mapped to PO9 because molecular biology techniques like PCR and blotting require computational tools and advanced digital instrumentation.

PO10: Multicultural competence, inclusive spirit, and empathy
CO1, CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO10 because biological experiments often require consideration of diverse perspectives, collaborative work, and ethical research practices.

PO11: Value inculcation and environmental awareness
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO11 because responsible handling of chemicals, safe laboratory practices, and awareness of environmental impact are crucial in biological research.

PO12: Autonomy, responsibility, and accountability
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO12 because conducting biological experiments independently, maintaining laboratory safety, and ensuring accuracy in experimental results require responsibility and accountability.

PO13: Community engagement and service
All COs are directly mapped to PO13 because practical biological knowledge, research skills, and laboratory expertise contribute to healthcare, forensic investigations, and environmental sustainability, benefiting the community.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T.Y.B.Sc.
Semester: V
Course Type: Major (Mandatory) Theory
Course Code: ZOO-302-MJM
Course Name: Mammalian Histology
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Gain a comprehensive understanding of the principles and techniques of histology, including tissue processing, microscopy, and staining methods.
- Differentiate and describe the structure, function, and location of various epithelial tissues (simple, stratified, transitional) and their subtypes.
- Classify and analyze the diverse range of connective tissues (proper, loose, dense, and reticular) with emphasis on their components, organization, and roles in different organs.
- Distinguish and explain the functional features of striated, smooth, and cardiac muscle tissues, including their cellular organization and contractile mechanisms.
- Identify and understand the types of neurons (multipolar, bipolar, and pseudounipolar) and non-medullated and medullated nerve fibers, recognizing their significance in neural transmission.
- Perform detailed histological analyses of major organs (skin, alimentary canal, respiratory system, kidneys, and reproductive organs) through micrographs, interpreting normal structure and potential pathological alterations.
- Apply histological knowledge to identify and comprehend the microscopic features of common cancers (colon, lung, and uterus) for diagnostic purposes and to understand their potential origins and progression.

Course Outcomes:-

Student will be able to-

CO1: demonstrate proficiency in tissue processing techniques, microscopy operation (including light and electron microscopy), and various staining methods used to visualize different tissue components.
CO2: differentiate and describe the structure, function, and location of various epithelial tissues (simple, stratified, transitional) and their subtypes (squamous, columnar, cuboidal, etc.), understanding their roles in different organ systems.
CO3: classify and analyze the diverse range of connective tissues (proper, loose, dense, reticular) with a thorough grasp of their components (fibers, cells, ground substance), organization patterns, and specific functions within various organs.
CO4: distinguish and explain the functional features of striated, smooth, and cardiac muscle tissues, including their cellular organization, contractile mechanisms, and roles in movement and organ function.
CO5: identify and understand the types of neurons (multipolar, bipolar, pseudounipolar) and non-medullated and medullated nerve fibers, recognizing their significance in neural transmission and information processing.
CO6: perform detailed histological analyses of major organs (skin, alimentary canal, respiratory system, kidneys, and reproductive organs) through micrographs, interpreting normal structures and potential pathological alterations, correlating them to functional consequences.
CO7: apply histological knowledge to identify and comprehend the microscopic features of endocrine glands.

TOPICS:

UNIT NO	SUBUNIT NO.	SYLLABUS	NO. OF LECTURES
1	**Introduction**		01
	1.1	Definition and scope of histology	
	1.2	Applications of histology	
2	**Tissues**		06
	2.1	Epithelial tissue	
	2.2	Connective tissue	
	2.3	Muscle tissue	
	2.4	Nervous tissue	
3	**Histological study of following organs:**		19
	3.1	Skin & tooth	
	3.2	Tongue: Mucosa papillae and taste buds	
	3.3	Alimentary canal: Basic histological organization with reference to T. S of oesophagus, stomach, duodenum, Ileum and rectum	
	3.4	Associated digestive glands: Basic histological organization with reference to T.S. of liver and pancreas	
	3.5	Respiratory organs: T. S of trachea and lung	
	3.6	Blood vessels: T.S. of artery and vein	
	3.7	L. S. of Kidney; juxtaglomerular complex	
	3.8	Reproductive organs: T. S. of testis and ovary	
4	**Histology of endocrine glands:**		04
	4.1	Pituitary gland	
	4.2	Thyroid gland	
	4.3	Adrenal gland	

REFERENCES

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3. Histology, 1987, 9th Edn., Arthur W. Ham, David H. Cormack, J. B. Lippincott Co. Philadelphia.
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10. Hand Book of Histological and Histochemical Techniques, 1991, 1st Edn. S. K. David, CBS publisher and Distributors, Delhi.

Course Articulation Matrix of ZOO-302-MJM: Mammalian Histology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding
CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly mapped to PO1 because understanding tissue processing techniques, microscopy, histological structures, staining methods, and endocrine tissue analysis is fundamental to mastering histology.

PO2: Practical, professional, and procedural knowledge
CO1, CO2, CO3, CO5, CO6 & CO7 are directly mapped to PO2 because practical skills in microscopy operation, tissue sectioning, staining procedures, and histopathological analysis are essential for laboratory-based histological studies.

PO3: Entrepreneurial mindset and knowledge
CO4, CO7 are directly mapped to PO3 because expertise in histological processing and molecular techniques (such as PCR and blotting) has applications in diagnostic pathology, biotechnology startups, and forensic investigations.

PO4: Specialized skills and competencies
CO1, CO2, CO3, CO4 & CO6 are directly mapped to PO4 because mastering tissue identification, microscopy techniques, histological processing, and staining methods requires precision and technical expertise critical for clinical and research applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO5 because troubleshooting tissue processing errors, analyzing histological sections, and interpreting staining results require critical thinking and problem-solving skills.

PO6: Communication skills and collaboration
CO4, CO6 & CO7 are directly mapped to PO6 because presenting histological findings, documenting tissue staining results, and collaborating on laboratory-based research require effective communication and teamwork.

PO7: Research-related skills
CO2, CO3, CO4, CO6 & CO7 are directly mapped to PO7 because conducting histological studies, utilizing microscopy techniques, applying staining principles, and analyzing molecular methods are essential for biomedical research and clinical investigations.

PO8: Learning how to learn skills
CO1, CO2, CO5 & CO6 are directly mapped to PO8 because acquiring expertise in histological techniques, continuously improving tissue staining proficiency, and adapting to new laboratory protocols promote lifelong learning.

PO9: Digital and technological skills
CO7 is directly mapped to PO9 because molecular biology techniques like PCR and blotting rely on computational tools, digital imaging, and advanced laboratory equipment.

PO10: Multicultural competence, inclusive spirit, and empathy
CO1, CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO10 because biological and medical research requires ethical considerations, collaboration across diverse teams, and sensitivity to patient-oriented histopathological analysis.

PO11: Value inculcation and environmental awareness
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO11 because safe laboratory practices, ethical tissue handling, and minimizing environmental impact through responsible chemical usage are essential for sustainable biological research.

PO12: Autonomy, responsibility, and accountability
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO12 because maintaining histological precision, ensuring accuracy in staining and microscopy, and handling laboratory equipment responsibly require accountability in research and clinical settings.

PO13: Community engagement and service
CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly mapped to PO13 because histological techniques and biomedical research contribute to healthcare advancements, diagnostic pathology, and community-based medical awareness programs.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T.Y.B.Sc.
Semester: V
Course Type: Major (Mandatory) Theory
Course Code: ZOO-303-MJM
Course Name: Biochemistry
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Differentiate between the different types of bonds (ionic, covalent, non-covalent) and explain their roles in the structure and function of biomolecules.
- Classify carbohydrates based on their structure and complexity (monosaccharides, disaccharides, polysaccharides).
- Describe the classification of amino acids, including the functional groups and side chains.
- Explain the crucial roles of proteins in various biological processes, including catalysis, transport, and immune response.
- Classify enzymes based on their substrate specificity and reaction type.
- Describe the components of nucleic acids (nucleotides, nucleosides, nitrogenous bases, pentose sugars).
- Apply the knowledge of basic biochemistry to real-world situations, such as interpreting laboratory results, understanding the basis of medical treatments, and analyzing the impact of environmental factors on biological processes.

Course Outcomes:-

Student will be able to-

CO1: analyze and differentiate between ionic, covalent, and non-covalent bonds, explaining their contributions to the stability of various biomolecules (proteins, carbohydrates, lipids and nucleic acids).

CO2: classify carbohydrates as monosaccharides, disaccharides, and polysaccharides based on their structural composition, size, and complexity. Apply this knowledge to understand the functional roles of different carbohydrates in cells and organisms.

CO3: explain the structure of amino acids, including the central core, functional groups, and diverse side chains. Relate this structure to the classification of amino acids (polar, non-polar, acidic, basic) and their specific properties.

CO4: evaluate the diverse roles of proteins in biological processes like catalysis (enzyme action), transport, and immune response. Analyze the relationship between protein structure and function.

CO5: categorize enzymes based on their substrate specificity (lock-and-key model) and reaction type (oxidation, reduction, hydrolysis etc.). Apply this knowledge to interpret enzyme activity in metabolic pathways and drug action.

CO6: deconstruct the components of nucleic acids (nucleotides, nucleosides, nitrogenous bases, pentose sugars), understanding their assembly and roles in DNA and RNA structures.

CO7: bridge the gap between theoretical biochemistry and real-world applications by interpreting laboratory results related to biomolecules, analyzing the rationale behind medical treatments targeting specific biochemical processes, and evaluating the impact of environmental factors on cellular biochemistry.

TOPICS:

UNIT	SUBUNIT	SYLLABUS	NO.OF LECTURES
1	**Basic Biochemistry:**		06
	1.1	Chemical Bonds: Types: Ionic, covalent & non-covalent bonds - hydrogen, hydrophobic, electrostatic, Van der Waal forces and their functions in biomolecules.	
	1.2	Structure of water molecule - Liquid and ice	
	1.3	Physico-chemical properties of water.	
	1.4	Concept of acid and base, pH, Sorenson's scale, derivation of Henderson–Hasselbalch equation, and its applications	
	1.5	Concept of Buffer: Types of Buffer	
2	**Carbohydrates:**		04
	2.1	Definition and classification of carbohydrates	
	2.2	Isomerism in carbohydrates- Structural and stereoisomerism.	
	2.3	Biological significance of carbohydrates.	
3	**Proteins:**		05
	3.1	Essential and non-essential amino acids	
	3.2	Classification of amino acids	
	3.3	Peptide bond, types of proteins, Protein structures - primary, secondary, tertiary and quaternary structure with suitable examples	
	3.4	Bonds responsible for protein structures	
	3.5	Biological significance of proteins	
4	**Lipids:**		05
	4.1	Introduction, classification of lipids	
	4.2	Clinical significance – Obesity & atherosclerosis	
	4.3	Biological significance of lipids	
5	**Enzymes:**		05
	5.1	Classification and properties of enzymes	
	5.2	Factors influencing enzyme activity - pH, temperature, substrate concentration & enzyme concentration	
	5.3	Enzyme kinetics & Michaelis-Menten equation	
6	**Nucleic Acids:**		05
	6.1	Introduction, definition, nitrogen bases, pentose sugar, nucleosides, nucleotides.	
	6.2	DNA: Watson & Crick's model, Comparative study of DNA: A, B & Z; Chargaff's rule.	
	6.3	RNA: Types & structure- mRNA, rRNA, tRNA	

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Course Articulation Matrix of ZOO-303-MJM: Biochemistry
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	2	3	3	2	2	3	2	1	2	2	1
CO2	3	2	2	3	3	2	2	3	2	1	2	2	1
CO3	3	2	2	3	3	2	2	3	2	1	2	2	1
CO4	3	3	2	3	3	2	3	3	2	1	2	2	1
CO5	3	3	2	3	3	2	3	3	2	1	2	2	1
CO6	3	2	2	3	3	2	3	3	2	1	2	2	1
CO7	3	3	2	3	3	2	3	3	2	1	2	3	2

PO1: Comprehensive knowledge and understanding
CO1 – CO7 are mapped to PO1 as they provide fundamental biochemical knowledge, including molecular interactions, biomolecule classification, enzyme mechanisms, and nucleic acid structure.

PO2: Practical, professional, and procedural knowledge
CO1, CO2, CO4, CO5, CO6, and CO7 are mapped to PO2 because they involve hands-on biochemical concepts such as laboratory techniques, enzyme kinetics, and biomolecule analysis.

PO3: Entrepreneurial mindset and knowledge
CO4, CO5, and CO7 are mapped to PO3 because understanding protein functions, enzyme applications, and biochemical problem-solving skills can lead to innovations in biotechnology, pharmaceuticals, and healthcare entrepreneurship.

PO4: Specialized skills and competencies
CO1 – CO7 are mapped to PO4 because mastering biochemical concepts requires a specialized understanding of molecular interactions, enzymatic reactions, and metabolic pathways, which are crucial for research and industry applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1 – CO7 are mapped to PO5 as they involve the application of biochemical principles to understand metabolism, enzyme activity, and biomolecular interactions, which require strong problem-solving abilities.

PO6: Communication skills and collaboration
CO4, CO6, and CO7 are mapped to PO6 as students need to interpret biochemical results, collaborate on experiments, and present findings in scientific discussions.

PO7: Research-related skills
CO1 – CO7 are mapped to PO7 since the course includes experimental techniques, enzyme assays, biomolecule analysis, and understanding biochemical pathways, which are crucial for research in medical and environmental sciences.

PO8: Learning how to learn skills
CO1 – CO7 are mapped to PO8 as students develop independent learning skills, engage with biochemical literature, and apply theoretical concepts in experimental settings.

PO9: Digital and technological skills
CO1 – CO7 are mapped to PO9 because biochemical research relies on computational tools, databases, and laboratory instruments for data analysis and molecular modeling.

PO10: Multicultural competence, inclusive spirit, and empathy
CO4 – CO7 are partially mapped to PO10 as biochemistry is applied in healthcare and environmental sciences, where understanding global perspectives and ethical considerations is important.

PO11: Value inculcation and environmental awareness
CO4 – CO7 are mapped to PO11 as biochemical principles help address environmental issues, sustainability in biotechnology, and ethical practices in scientific research.

PO12: Autonomy, responsibility, and accountability
CO1 – CO7 are mapped to PO12 because students develop independent research skills, follow ethical guidelines in biochemical experiments, and take responsibility for scientific accuracy.

PO13: Community engagement and service
CO7 is strongly mapped to PO13 as biochemical knowledge is applied in medical diagnostics, nutritional science, and environmental sustainability projects that benefit society.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T.Y.B.Sc.
Semester: V
Course Type: Major (Mandatory) Theory
Course Code: ZOO-304-MJM
Course Name: Genetics
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Define and differentiate classical and modern Gene, Cistron, Muton, Recon, Replicon concepts.
- Categorize gene mutations, including spontaneous, induced, somatic, gametic, forward and reverse mutations, and point mutations.
- Explain the principles of Non-Mendelian Inheritance, focusing on cytoplasmic inheritance and extra-nuclear (mitochondrial) inheritance, and how they differ from classical Mendelian genetics.
- Explain basic population genetics concepts: Mendelian population, gene pool, gene frequency, chance mating, and Hardy-Weinberg law equilibrium.
- Define and explore linkage and crossing over, covering types of linkage, types of crossing over, and the mechanism and molecular basis of recombination.
- Present evidence supporting DNA as genetic material, along with describing chromatin structure.
- Analyze patterns of human inheritance through pedigree construction and interpretation, understanding autosomal, sex-linked, and mitochondrial inheritance patterns.

Course Outcomes:-

Student will be able to

CO1: differentiate classical and modern gene concepts, including cistrons, mutons, recons, and replicons.
CO2: classify and understand gene mutations, distinguishing spontaneous, induced, somatic, and gametic mutations. Identify point mutation types.
CO3: understand the impact of extra-nuclear inheritance and how it differs from Mendelian inheritance patterns.
CO4: apply population genetics principles, including Mendelian populations, gene pools, gene frequencies, and Hardy-Weinberg equilibrium.
CO5: explain linkage and crossing over, categorizing linkage types and understanding the molecular basis of recombination.
CO6: analyze DNA and RNA as genetic material, understanding chromatin structure and examples like Griffith's, Avery et al, and Hershey-Chase experiments.
CO7: construct and analyze a family pedigree to identify the mode of inheritance (autosomal and mitochondrial) for a specific trait.

TOPICS:

UNIT	SUBUNIT	SYLLABUS	NO. OF LECTURES
1	**Introduction to genetics:**		01
	1.1	Classical and Modern concepts of Gene, Cistron, Muton, Recon, Replicon	
2	**Introduction to deviations from Mendelism**		04
	2.1	Incomplete Dominance, Co-dominance, Multiple Alleles, Linkage, Pleiotropy & Epistasis	
3	**Non-Mendelian inheritance**		01
	3.1	Cytoplasmic inheritance	
4	**Gene Mutation**		06
	4.1	Definition Types of mutations: spontaneous, induced, somatic, gametic, forward, and reverse mutation Point mutation & Types: deletion, insertion, Frameshift, substitution, transversion, transition	
	4.2	Mutagenic agents: Physical Mutagen: UV radiation and ionizing radiation Chemical Mutagen: Base analogs, alkylating and intercalating agents	
5	**Population Genetics**		04
	5.1	Basic Concepts in population genetics: Mendelian population, gene pool, gene frequency, chance mating (Panmictic mating), Hardy-Weinberg's law and its applications	
6	**Linkage and crossing over**		05
	6.1	Types of Linkage, crossing over & its types, mechanism, and molecular basis of recombination (Holiday model)	
7	**The Genetic material**		02
	7.1	DNA as genetic material- evidences (Griffith's, Avery et al, and Hershey-Chase experiment)	
8	**Chromatin Structure-**		03
	8.1	Heterochromatin (Example Barr bodies), Euchromatin, histones, nucleosome arrangement, packaging of DNA	
9	**Introduction to Human Genetics**		04
	9.1	Definition, Pedigree- gathering family history, pedigree symbols, construction of pedigrees, Autosomal inheritance- Dominant & Recessive.	

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Course Articulation Matrix of ZOO-304-MJM: Genetics
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	2	3	3	2	3	2	1	1	2	2	1
CO2	3	3	2	3	3	2	3	2	1	1	2	2	1
CO3	3	2	2	3	3	1	3	2	1	1	2	2	1
CO4	3	2	2	3	3	2	3	3	1	1	2	2	2
CO5	3	3	2	3	3	2	3	2	1	1	2	2	1
CO6	3	3	2	3	3	2	3	3	1	1	2	2	1
CO7	3	2	2	3	3	3	3	2	1	1	2	2	2

PO1: Comprehensive knowledge and understanding
CO1–CO7 are mapped because genetics requires fundamental understanding of gene concepts, mutations, inheritance, linkage, and molecular biology.

PO2: Practical, professional, and procedural knowledge
CO2, CO5, and CO6 are mapped because understanding mutations, genetic material, and recombination involves experimental and analytical skills.

PO3: Entrepreneurial mind-set and knowledge
CO3 and CO7 are mapped as knowledge of genetic inheritance and pedigree analysis has applications in genetic counseling, biotechnology, and personalized medicine.

PO4: Specialized skills and competencies
CO1–CO7 are mapped because genetic studies require expertise in population genetics, gene frequency analysis, pedigree construction, and chromatin structure analysis.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1–CO7 are mapped because analyzing genetic phenomena, identifying inheritance patterns, and predicting genetic disorders require strong analytical and problem-solving skills.

PO6: Communication skills and collaboration
CO4, CO6, and CO7 are mapped since presenting findings, interpreting genetic patterns, and discussing family pedigrees require effective communication and teamwork.

PO7: Research-related skills
CO2, CO3, CO4, CO6, and CO7 are mapped as studying mutations, extra-nuclear inheritance, and

molecular experiments demand research skills and data validation.

PO8: Learning how to learn skills
CO1–CO7 are mapped because genetics is a rapidly evolving field that requires continuous learning of new theories, technologies, and applications.

PO9: Digital and technological skills
CO5 and CO6 are mapped as bioinformatics tools, genetic databases, and molecular modeling software are essential for analyzing genetic data and predicting inheritance patterns.

PO10: Multicultural competence, inclusive spirit, and empathy
CO3 and CO7 are mapped since understanding diverse genetic traits, hereditary diseases, and genetic counseling promotes inclusivity and social responsibility.

PO11: Value inculcation and environmental awareness
CO4 and CO6 are mapped as genetic knowledge contributes to biodiversity conservation, ethical decision-making, and awareness of genetic impact on ecosystems.

PO12: Autonomy, responsibility, and accountability
CO1–CO7 are mapped because conducting genetic experiments, analyzing hereditary conditions, and making ethical genetic decisions require individual accountability and precision.

PO13: Community engagement and service
CO3, CO5, and CO7 are mapped since genetics plays a crucial role in public health awareness, genetic counseling, and educating communities about hereditary conditions.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T.Y.B.Sc.
Semester: V
Course Type: Major (Mandatory) Practical
Course Code: ZOO-305-MJM
Course Name: Zoology Practical V
Number of Credits: 02
Number of Teaching hours: 60

Course Objectives:-

- Develop proficiency in histological techniques by learning tissue collection, fixation, block making, sectioning, staining, and mounting to prepare permanent slides for microscopic analysis.
- Demonstrate microscopy skills by utilizing Camera Lucida, micrometers, and various histological staining techniques to examine tissue structures and cellular components.
- Apply biochemical principles by performing colorimetric analysis, pH effect studies, and enzymatic activity assessments to understand biochemical reactions in biological samples.
- Analyze histological structures of major organs through the study of permanent slides of skin, digestive organs, respiratory system, kidneys, reproductive organs, and endocrine glands to correlate microscopic features with physiological functions.
- Perform molecular biology techniques by detecting DNA and RNA using Methyl Green Pyronine staining and preparing polytene chromosome slides to understand genetic material organization.
- Utilize chromatographic techniques such as thin-layer chromatography (TLC) and paper chromatography for the separation and identification of biomolecules like amino acids, sugars, and lipids.
- Apply genetic and statistical concepts by studying the Hardy-Weinberg law and analyzing genetic traits, enhancing understanding of population genetics and inheritance patterns.

Course Outcomes:-

Student will be able to-

CO1: independently perform tissue processing, sectioning, staining, and mounting, enabling them to prepare high-quality histological slides for microscopic evaluation.

CO2: effectively operate Camera Lucida, micrometers, and microscopes, demonstrating precision in measuring and analyzing histological samples.

CO3: accurately conduct biochemical experiments using colorimetric analysis, pH variation studies, and enzymatic assays, interpreting results to understand biological processes.

CO4: correctly identify and differentiate microscopic structures of major organs, correlating histological observations with their functional significance in physiological processes.

CO5: successfully detect DNA and RNA using histochemical staining methods and prepare polytene chromosome slides, demonstrating proficiency in molecular biology techniques.

CO6: efficiently separate and identify biomolecules using thin-layer chromatography (TLC) and paper chromatography, applying chromatographic techniques for biochemical analysis.

CO7: analyze genetic traits using the Hardy-Weinberg principle, applying statistical methods to assess allele frequency and inheritance patterns in populations.

PRACTICALS:

Practical No.	Name of the practical	E/D	Teaching Hours
1.	a) Principle & use of Camera Lucida b) Study of micrometer	E	4
2.	Tissue collection, fixation and Block making	E	8
3.	Sectioning, staining & mounting (Submission of three permanent slides from any two different organs)	E	8
4.	Experimental verification of Beer's and Lambert's Law	E	4
5.	Temporary mounting of medullated nerve fibre and striated muscle fibre	E / D	4
6.	Study of permanent histological slides of skin, tooth, tongue, stomach, duodenum, ileum, liver and pancreas	D	4
7.	Study of permanent histological slides of trachea, lung, kidney, testis, ovary, thyroid and adrenal gland	D	4
8.	Preparation of human blood smear to observe different cells	E	4
9.	Study of preparation of standard acid and alkali and its standardization	D	4
10.	To study the effect of pH, temperature and inhibition on salivary amylase	E	4
11.	Detection of carbohydrates (monosaccharides, disaccharides and polysaccharides) with the help of suitable tests	D	4
12.	Estimation of proteins from suitable biological sample by Lowry's method	D	4
13.	Separation of amino acids / sugars / lipids by thin layer chromatography / paper chromatography (TLC)	D	4
14.	To study the Hardy-Weinberg law with suitable recording of genetic traits	E	4
15.	Temporary preparation of polytene chromosome from suitable material	E	4
16.	Detection of DNA and RNA by Methyl Green Pyronine	E	4
17.	Preparation of DNA Paper model	E	4
18.	Isolation of DNA from suitable material	E / D	4

REFERENCES

Course Articulation Matrix of ZOO-305-MJM: Zoology Practical V
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive Knowledge and Understanding
CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly mapped to PO1 because understanding tissue processing techniques, microscopy, histological structures, staining methods, and endocrine tissue analysis is fundamental to mastering histology.

PO2: Practical, Professional, and Procedural Knowledge
CO1, CO2, CO3, CO5, CO6 & CO7 are directly mapped to PO2 because practical skills in microscopy operation, tissue sectioning, staining procedures, and histopathological analysis are essential for laboratory-based histological studies.

PO3: Entrepreneurial Mindset and Knowledge
CO4, CO7 are directly mapped to PO3 because expertise in histological processing and molecular techniques (such as PCR and blotting) has applications in diagnostic pathology, biotechnology startups, and forensic investigations.

PO4: Specialized Skills and Competencies
CO1, CO2, CO3, CO4 & CO6 are directly mapped to PO4 because mastering tissue identification, microscopy techniques, histological processing, and staining methods requires precision and technical expertise critical for clinical and research applications.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO5 because troubleshooting tissue processing errors, analyzing histological sections, and interpreting staining results require critical thinking and problem-solving skills.

PO6: Communication Skills and Collaboration
CO4, CO6 & CO7 are directly mapped to PO6 because presenting histological findings, documenting tissue staining results, and collaborating on laboratory-based research require effective communication and teamwork.

PO7: Research-Related Skills
CO2, CO3, CO4, CO6 & CO7 are directly mapped to PO7 because conducting histological studies, utilizing microscopy techniques, applying staining principles, and analyzing molecular methods are essential for biomedical research and clinical investigations.

PO8: Learning How to Learn Skills
CO1, CO2, CO5 & CO6 are directly mapped to PO8 because acquiring expertise in histological techniques, continuously improving tissue staining proficiency, and adapting to new laboratory protocols promote lifelong learning.

PO9: Digital and Technological Skills
CO7 is directly mapped to PO9 because molecular biology techniques like PCR and blotting rely on computational tools, digital imaging, and advanced laboratory equipment.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy
CO1, CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO10 because biological and medical research requires ethical considerations, collaboration across diverse teams, and sensitivity to patient-oriented histopathological analysis.

PO11: Value Inculcation and Environmental Awareness
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO11 because safe laboratory practices, ethical tissue handling, and minimizing environmental impact through responsible chemical usage are essential for sustainable biological research.

PO12: Autonomy, Responsibility, and Accountability
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO12 because maintaining histological precision, ensuring accuracy in staining and microscopy, and handling laboratory equipment responsibly require accountability in research and clinical settings.

PO13: Community Engagement and Service
CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly mapped to PO13 because histological techniques and biomedical research contribute to healthcare advancements, diagnostic pathology, and community-based medical awareness programs.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T.Y.B.Sc.
Semester: V
Course Type: Major (Elective) Theory
Course Code: ZOO-306 MJE (A)
Course Name: Cell Biology
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Introduce the fundamental concepts of cell biology, including the differences between prokaryotic and eukaryotic cells.
- To understand the structure, composition, and models of biological membranes, along with their transport mechanisms.
- Study the structure and functions of major cell organelles, such as the endoplasmic reticulum, Golgi complex, lysosomes, and mitochondria.
- Explore the organization and functions of the nucleus, including nuclear membrane, pore complexes, nucleolus, and nucleo-cytoplasmic interactions.
- Analyze the cytoskeletal components (microfilaments, intermediate filaments, and microtubules) and their roles in cellular structure and function.
- To examine the cell cycle, cell division mechanisms (mitosis & meiosis), and their regulation, including checkpoints and the role of centrioles.
- Understand cellular ageing, apoptosis, necrosis, and modern techniques in animal cell culture, including stem cell research and applications.

Course Outcomes:-

Student will be able to-

CO1: explain the fundamental concepts of cell biology, including the structure and differences between prokaryotic and eukaryotic cells.
CO2: describe the structure, composition, and models of biological membranes, along with the mechanisms of passive and active transport.
CO3: identify and explain the structure and functions of major cell organelles such as the endoplasmic reticulum, Golgi complex, lysosomes, and mitochondria.
CO4: analyze the ultrastructure of the nucleus, nuclear membrane, pore complexes, nucleolus, and their role in nucleo-cytoplasmic interactions.
CO5: illustrate the components of the cytoskeleton (microfilaments, intermediate filaments, and microtubules) and their functional significance.
CO6: demonstrate an understanding of the cell cycle, mitosis, meiosis, cell division checkpoints, and the role of centrioles in cell regulation.
CO7: explain cellular ageing, apoptosis, necrosis, and the principles and applications of animal cell culture and stem cell research.

TOPICS:

UNIT	SUB UNIT	SYLLABUS	NO. OF LECTURES
1	**Introduction to Cell biology**		01
	1.1	Definition and scope	
	1.2	Prokaryotic and eukaryotic cell	

2	**Bio membrane system:**		04
	2.1	Models: lipid membrane concept, sandwich model, unit membrane concept and fluid mosaic model	
	2.2	Membrane transport: Passive and active	
3	**Study of following cell organelles with respect to structure and functions in brief**		04
	3.1	Endoplasmic reticulum	
	3.2	Golgi complex	
	3.3	Lysosomes	
	3.4	Mitochondria	
	3.5	Ribosomes	
4	**Nucleus**		05
	4.1	Ultrastructure of nuclear membrane and pore complex	
	4.2	Nucleolus: General organization, chemical composition and functions	
	4.3	Nucleo-cytoplasmic interactions	
5	**Cytoskeleton: Structure and functions-** Microfilaments Intermediate Filament, & Microtubules		03
6	**Cell cycle and cell division**		05
	6.1	Various phases of cell cycle, mitosis, meiosis and role of centriole in the cell division, Check points and regulation of cell cycle	
7	**Cellular ageing and cell death**		04
	7.1	Intracellular changes: Free radicals	
	7.2	Extra cellular changes	
	7.3	Cell death: Apoptosis & necrosis	
8	**Animal cell culture techniques and applications**		04
	8.1	Animal cell culture: Introduction, principle and applications.	
	8.2	Stem Cells: Introduction to stem cells & their potency	

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Course Articulation Matrix of ZOO-306 MJE (A): 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	2	1	3	2	1	1	1	1	1	1	1	1
CO2	3	2	2	2	3	1	3	2	1	2	2	1	1
CO3	3	2	1	2	3	1	2	1	1	1	2	1	1
CO4	3	1	2	2	3	2	2	2	1	1	1	1	1
CO5	3	2	1	2	3	1	2	1	1	1	2	1	1
CO6	3	1	1	2	3	3	3	3	1	2	2	1	1
CO7	2	2	2	1	1	2	2	1	2	1	1	1	1

PO1: Comprehensive knowledge and understanding
All COs are directly mapped to PO1 because understanding the fundamental concepts of cell biology, including prokaryotic and eukaryotic cells, cell organelles, membrane structure, cytoskeleton, cell cycle, and cell death, is essential for developing a strong foundation in biological sciences.

PO2: Practical, professional, and procedural knowledge
CO1, CO2, CO3, CO5 & CO7 are directly mapped to PO2 because practical knowledge of cell organelles, membrane transport, cytoskeleton, cell culture techniques, and experimental procedures is crucial for hands-on biological research and laboratory applications.

PO3: Entrepreneurial mindset and knowledge
CO4 & CO7 are directly mapped to PO3 because knowledge of nuclear structures, cell cycle regulation, apoptosis, necrosis, and stem cell research has potential applications in biotechnology, regenerative medicine, and biomedical entrepreneurship.

PO4: Specialized skills and competencies
CO1, CO2, CO3, CO4 & CO6 are directly mapped to PO4 because mastering cellular structures, membrane dynamics, nuclear interactions, and cell cycle checkpoints requires specialized knowledge and technical skills for biological experimentation and research.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO5 because analyzing cellular structures, understanding transport mechanisms, troubleshooting cell cycle abnormalities, and interpreting experimental results require critical thinking and problem-solving abilities.

PO6: Communication skills and collaboration
CO4, CO6 & CO7 are directly mapped to PO6 because presenting findings, discussing cell cycle checkpoints, apoptosis, and stem cell applications, and collaborating in research studies are essential for scientific communication and teamwork.

PO7: Research-related skills
CO2, CO4 & CO6 are directly mapped to PO7 because investigating membrane models, studying nuclear interactions, and analyzing cell division mechanisms involve research-based approaches essential for experimental biology.

PO8: Learning how to learn skills
CO1, CO2, CO3 & CO6 are directly mapped to PO8 because understanding fundamental cell structures, division processes, and cellular aging promotes continuous learning and adaptation in advanced biological studies.

PO9: Digital and technological skills
CO2, CO6 & CO7 are directly mapped to PO9 because using digital tools for cell imaging, analyzing cell cycle progression, and applying technology in cell culture and stem cell research are crucial for modern biological sciences.

PO10: Multicultural competence, inclusive spirit, and empathy
CO2 & CO7 are directly mapped to PO10 because ethical considerations in stem cell research, biomedical applications, and understanding the global impact of cell biology research foster inclusivity and empathy in scientific studies.

PO11: Value inculcation and environmental awareness
CO3, CO6 & CO7 are directly mapped to PO11 because knowledge of cellular organization, cell division, and cell culture techniques contributes to ethical considerations in biological research and sustainable scientific practices.

PO12: Autonomy, responsibility, and accountability
CO1, CO4 & CO7 are directly mapped to PO12 because understanding cell structures, nuclear interactions, and apoptosis requires independent learning, responsible experimentation, and accountability in research methodologies.

PO13: Community engagement and service
CO6 & CO7 are directly mapped to PO13 because cell biology knowledge, particularly in cell division regulation and stem cell applications, has direct implications for healthcare, medical advancements, and societal well-being.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T.Y.B.Sc.
Semester: V
Course Type: Major (Mandatory) Theory
Course Code: ZOO-306-MJE (B)
Course Name: General Pathology
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Accurately define and utilize key pathological terms related to the scope of pathology, applied pathology (biopsy and surgery), and autopsy procedures.
- Describe and explain the significance of various clinical pathology procedures, including gastric analysis, urine examination, csf examination, liver function tests, and renal function tests, and their role in disease diagnosis.
- Analyze the causes, effects, and pathological consequences of circulatory disturbances such as hyperemia, ischemia, hemorrhage, thrombosis, and embolism.
- Describe the inflammatory process, including the definition, causes, cardinal signs, vascular phenomena, and cellular responses in both acute and chronic inflammation.
- Explain the process of tissue repairs, including regeneration, connective tissue proliferation, and the different types of healing (primary and secondary).
- Define, classify, and differentiate between benign and malignant tumors, as well as describe the characteristics and types of leukemia.
- Integrate the concepts learned across different units to understand the interconnectedness of pathological processes and their impact on disease development and progression.

Course Outcomes:-

Student will be able to-

CO1: accurately define and explain the scope of pathology, applied pathology (biopsy and surgery), and autopsy procedures, demonstrating understanding through written or oral assessments.

CO2: interpret the results of common clinical pathology procedures (gastric analysis, urine examination, CSF examination, liver function tests, and renal function tests) and relate them to potential disease states.

CO3: analyze case studies or scenarios involving circulatory disturbances (hyperemia, ischemia, hemorrhage, thrombosis, embolism) and explain the underlying pathological mechanisms and potential consequences.

CO4: describe the cardinal signs of inflammation and explain the vascular and cellular events that occur during acute and chronic inflammatory responses.

CO5: describe the process of wound healing and repair, including regeneration and connective tissue proliferation, and differentiate between primary and secondary healing in various scenarios.

CO6: classify and differentiate between benign and malignant tumors, as well as describe the characteristics and types of leukemia through case analysis or written assignments.

CO7: integrate knowledge from different areas of pathology to explain the pathogenesis of diseases and apply this understanding to analyze clinical cases or scenarios.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	**Introduction:**		04
	1.1	Definition, scope and basic branches	
	1.2	Autopsy- Post mortem changes	
2	**Clinical pathology:**		07
	2.1	Definition and scope	
	2.2	Urine examination	
	2.3	Importance of CSF examination	
	2.4	Liver function tests	
	2.5	Renal function tests	
3	**Circulatory disturbances:**		08
	3.1	Hyperemia: active and passive (causes and effects)	
	3.2	Ischemia: causes and effects	
	3.3	Hemorrhage: causes, effects and hemorrhagic effects	
	3.4	Thrombosis: thrombus formation, its causes and effects	
	3.5	Embolism: Definition, sources, types and effects	
4	**Inflammation:**		03
	4.1	Definition and causes, cardinals of inflammation (signs), vascular phenomenon and cellular response	
	4.2	Acute and chronic inflammation	
5	**Repair:**		04
	5.1	Process of Repair	
	5.2	Types: Regeneration & connective tissue proliferation	
	5.3	Healing: Primary and secondary	
6	**Neoplasia:**		04
	6.1	Definition, causes and types of tumours- benign and malignant	
	6.2	Leukemia: Acute and chronic.	

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Course Articulation Matrix of ZOO-306-MJE (B): General Pathology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding
CO1, CO2, CO3, CO4, CO5, CO6, CO7 are mapped strongly because understanding chemical solutions, biomolecule isolation, microscopy, histological processing, staining techniques, and molecular biology methods is essential for a strong foundation in biological sciences.

PO2: Practical, professional, and procedural knowledge
CO1, CO2, CO3, CO5, CO7 are mapped moderately to strongly as these COs involve hands-on practical skills such as chemical handling, chromatography, tissue sectioning, PCR techniques, and microscope usage, which are fundamental in biological experiments.

PO3: Entrepreneurial mindset and knowledge
CO4, CO7 are mapped because knowledge of histological processing and molecular techniques has potential applications in biotechnology and healthcare entrepreneurship.

PO4: Specialized skills and competencies
CO1, CO2, CO3, CO4, CO6 are mapped strongly as mastering chemical handling, biomolecule isolation, microscopy, histological procedures, and staining techniques requires specialized laboratory skills crucial for precise biological experimentation.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO4, CO5, CO6 are mapped strongly since identifying faults in histological sections, troubleshooting biomolecule isolation techniques, and analyzing experimental results require critical thinking and problem-solving abilities.

PO6: Communication skills and collaboration
CO4, CO6, CO7 are mapped moderately since presenting findings, interpreting histological and molecular biology results, and collaborating on experimental studies are essential communication and teamwork skills in biological research.

PO7: Research-related skills
CO2, CO3, CO4, CO6, CO7 are mapped strongly as research in chromatography, microscopy, histological processing, staining, and PCR techniques requires analytical thinking, experimentation, and validation.

PO8: Learning how to learn skills
CO1, CO2, CO5, CO6 are mapped moderately because acquiring expertise in handling chemicals, understanding laboratory techniques, and improving histological processing skills contribute to lifelong learning in biological sciences.

PO9: Digital and technological skills
CO7 are mapped because molecular biology techniques like PCR and blotting require computational tools and advanced digital instrumentation.
PO10: Multicultural competence, inclusive spirit, and empathy
CO1, CO2, CO3, CO4, CO5, CO6 are mapped because biological experiments often require consideration of diverse perspectives, collaborative work, and ethical research practices.

PO11: Value inculcation and environmental awareness
CO1, CO2, CO4, CO5, CO6 are mapped since responsible handling of chemicals, safe laboratory practices, and awareness of environmental impact are crucial in biological research.

PO12: Autonomy, responsibility, and accountability
CO1, CO2, CO4, CO5, CO6 are mapped as conducting biological experiments independently, maintaining laboratory safety, and ensuring accuracy in experimental results require responsibility and accountability.

PO13: Community engagement and service
All COs are mapped since practical biological knowledge, research skills, and laboratory expertise contribute to healthcare, forensic investigations, and environmental sustainability, benefiting the community.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T. Y. B.Sc.
Semester: V
Course Type: Major (Elective) Theory
Course Code: ZOO-306-MJE(C)
Course Name: Ethology
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives: -

- To introduce the fundamental concepts of Ethology, including the scope, significance, and contributions of key ethologists.
- To understand the neural, hormonal, and developmental influences on animal behaviour.
- To explore various forms of animal communication and social behaviour, including cooperation and altruism.
- To study the mechanisms of migration and navigation, including homing instincts and orientation mechanisms.
- To examine behavioural ecology and adaptive strategies such as foraging behaviour and predation avoidance.
- To understand reproductive strategies and mating systems, including mate choice and parental care.
- To analyse biological rhythms and their impact on animal behaviour across different time scales.

Course Outcomes: -

Student will be able to-

CO1: explain the significance of animal behaviour; differentiate between proximate and ultimate causes of behaviour; apply knowledge of ethological principles to study animal interactions.

CO2: describe the role of the nervous system and hormones in shaping reflexes, aggression, mating, and learning; apply principles of neuroethology to analyse behavioural responses.

CO3: interpret different modes of animal communication, including visual, auditory, chemical, and tactile signals; analyse the evolution of language in apes and social structures in insects, mammals, and birds.

CO4: identify migration patterns and types; explain homing instincts and orientation mechanisms; apply concepts of navigation to understand animal movement.

CO5: analyse foraging strategies using optimal foraging theory; evaluate grouped and stereotyped behaviours; apply behavioural ecology principles to animal survival strategies.

CO6: differentiate between reproductive strategies such as monogamy, polygyny, and polyandry; explain mate choice, courtship displays, and parental care; apply sexual selection concepts to understand reproductive success.

CO7: explain biological rhythms including circadian, circa-lunar, circa-tidal, and circannual cycles; apply knowledge of biological clocks to analyse animal activity patterns.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	**Foundations of Ethology**		05
	1.1	Definition, Scope, Importance and significance of animal behaviour	
	1.2	Contribution of Konrad Lorenz, Niko Tinbergen, Karl von Frisch and Edward Thorndike	
	1.3	Proximate and ultimate causes of behavior	
2	**Neural, Molecular and Developmental basis of behaviour**		06
	2.1	The Role of the Nervous System – Reflexes, Stimulus-Response Mechanisms	
	2.2	Hormones and Behaviour – Influence on Aggression, Mating, and Parental Care.	
	2.3	Development and Animal Behavior.	
3	**Communication and social behaviour**		08
	3.1	Animal Communication – Signals, Modes - Visual, Auditory, Chemical & Tactile	
	3.2	Social Organization in Mammals	
	3.3	Cooperation and Altruism	
4	**Reproductive Behavior and Mating Systems**		06
	4.1	Courtship Displays, Mate Choice, Sexual Selection	
	4.2	Definitions; Monogamy, Polygyny, Polyandry, Polygynandry and Promiscuity	
	4.3	Maternal Care , Paternal Care, Sibling Care	
5	**Biological Rhythms**		05
	5.1	Circadian Rhythms, Circa-tidal Rhythms, Circalunar Rhythms, Circannual Rhythms	

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Course Articulation Matrix of ZOO-306-MJE(C): Ethology

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

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

PO1: Comprehensive knowledge and understanding
All COs are directly mapped to PO1 because understanding the foundations of ethology, behavioural ecology, communication, migration, reproductive strategies, and biological rhythms is essential for comprehending animal behaviour.

PO2: Practical, professional, and procedural knowledge
CO1, CO2, CO3, CO6 are directly mapped to PO2 because practical knowledge of behavioural observation, analyzing social interactions, and understanding hormonal and neural influences on behaviour are crucial in ethology.

PO3: Entrepreneurial mind-set and knowledge
CO3, CO4, CO7 are directly mapped to PO3 because knowledge of migration patterns, navigation mechanisms, and biological rhythms has potential applications in wildlife conservation, ecotourism, and animal husbandry.

PO4: Specialized skills and competencies
CO1, CO2, CO3, CO4, CO6 are directly mapped to PO4 because mastering behavioural analysis, understanding evolutionary adaptations, social structures, and reproductive strategies requires specialized ethological knowledge.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO3, CO4, CO5, CO6 are directly mapped to PO5 because analyzing behaviour patterns, foraging strategies, communication modes, and evolutionary mechanisms involves critical thinking and problem-solving.

PO6: Communication skills and collaboration
CO3, CO4, CO6, CO7 are directly mapped to PO6 because interpreting behavioural data, presenting research on animal behaviour, and working collaboratively in field studies require effective communication and teamwork.

PO7: Research-related skills
CO2, CO3, CO4, CO6, CO7 are directly mapped to PO7 because research in behavioural ecology, social organization, migration, and biological rhythms involves experimental validation, field observations, and analytical reasoning.

PO8: Learning how to learn skills
CO1, CO2, CO5, CO6 are directly mapped to PO8 because acquiring expertise in studying behaviour, analyzing case studies, and applying theoretical knowledge to real-life scenarios fosters lifelong learning in ethology.

PO9: Digital and technological skills
CO7 is directly mapped to PO9 because studying biological rhythms and navigation mechanisms involves computational tools, GPS tracking, and advanced behavioural analysis software.

PO10: Multicultural competence, inclusive spirit, and empathy
CO1, CO2, CO3, CO4, CO5, CO6 are directly mapped to PO10 because understanding animal behaviour fosters empathy, ethical treatment of animals, and interdisciplinary collaboration across diverse cultural and ecological backgrounds.

PO11: Value inculcation and environmental awareness
CO1, CO2, CO4, CO5, CO6 are directly mapped to PO11 because studying animal behaviour emphasizes conservation efforts, ecological balance, and responsible wildlife interactions.

PO12: Autonomy, responsibility, and accountability
CO1, CO2, CO4, CO5, CO6 are directly mapped to PO12 because conducting behavioural studies, ensuring ethical research practices, and maintaining scientific accuracy require responsibility and accountability.

PO13: Community engagement and service
All COs are directly mapped to PO13 because knowledge of ethology contributes to conservation efforts, wildlife rehabilitation, animal welfare, and public awareness about ecological sustainability.

SYLLABUS (CBCS) FOR T.Y.B.Sc. ZOOLOGY as per NEP 2020 (w.e.f.June,2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class:T.Y.B.Sc.
Semester: V
Course Type: Minor Theory
Course Code: ZOO-311-MN
Course Name: Ornamental Fishery
Number of Credits: 02
Number of Teaching hours: 30

Course Objectives:-

- Understand the basic concepts and scope of ornamental fish keeping.
- Familiarize students with the diversity of exotic and endemic ornamental fish species.
- Gain detailed knowledge about the biology of popular aquarium fishes
- Give an overview of the global aquarium trade and its present status
- Train students in the design, construction, and maintenance of different types of aquaria.
- Develop an understanding about various aquarium accessories and water quality management
- Enable students to identify common ornamental fish diseases and their management

Course Outcomes:-

Student will be able to-

CO1: understand the significance and potential of the ornamental fish industry.

CO2: distinguish between exotic and endemic ornamental fish species.

CO3: gain comprehensive knowledge of the biology and specific requirements of selected aquarium fishes

CO4: analyze the trends and challenges in the global aquarium trade.

CO5: develop skills in designing and setting up freshwater and marine aquaria.

CO6: select appropriate aquarium accessories and maintain optimal water quality.

CO7: diagnose and manage common diseases in ornamental fishes.

TOPICS:

UNIT NO.	TOPICS	NUMBER OF LECTURES
1.	**Introduction and scope**	02
2.	**Exotic and Endemic species of aquarium fishes**	02
3.	**Biology of Aquarium Fishes** • Guppy • Molly • Gold fish • Anemone fish • Butterfly fish	08
4.	**Introduction to aquarium** • World aquarium trade and present status	02
5.	**Design and construction of home and public aquaria** • Freshwater • Marine	04
6.	**Aquarium accessories**	04

	• Aerators • Filters (different types) • Lighting • Water quality requirements	
7.	**Criteria of selection for aquarium fishes**	**02**
8.	**Types of aquarium feed** • Live feed • Artificial feed	**02**
9.	**Ornamental Fish Diseases** (One each) • Bacterial • Viral • Protozoan • Fungal	**04**

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Course Articulation Matrix of ZOO-311-MN: Ornamental Fishery
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	2	3	3	1	2	1	2	2	2	2	2
CO2	3	3	1	3	3	1	2	1	2	2	2	2	2
CO3	3	2	2	2	3	2	3	2	1	3	2	2	3
CO4	3	1	2	2	3	2	2	2	1	2	2	2	2
CO5	3	2	3	2	3	2	2	2	3	2	2	2	3
CO6	3	2	2	2	3	3	3	2	2	2	2	2	2
CO7	3	2	1	2	2	3	3	1	2	1	1	2	2

PO1: Comprehensive knowledge and understanding
All COs are directly mapped to PO1 because understanding the significance of the ornamental fish industry, species differentiation, biology, aquarium trade, and disease management is fundamental to mastering aquaculture and fisheries sciences.

PO2: Practical, professional, and procedural knowledge
CO1, CO2, CO3, CO5, CO6 & CO7 are directly mapped to PO2 because practical skills in aquarium setup, species identification, water quality maintenance, and disease diagnosis are essential for professional competency in ornamental fish management.

PO3: Entrepreneurial min-dset and knowledge
CO3, CO5 & CO7 are directly mapped to PO3 because knowledge of aquarium trade trends, designing aquaria, and disease management has potential applications in ornamental fish farming, aquaculture entrepreneurship, and pet industry businesses.

PO4: Specialized skills and competencies
CO1, CO2, CO3, CO4 & CO6 are directly mapped to PO4 because expertise in fish biology, aquaria design, water quality management, and species identification requires specialized skills for sustainable ornamental fish farming and research.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO3, CO4, CO5 & CO6 are directly mapped to PO5 because troubleshooting aquarium conditions, analyzing water quality, managing fish diseases, and maintaining ecosystem balance require problem-solving and analytical skills.

PO6: Communication skills and collaboration
CO4, CO6 & CO7 are directly mapped to PO6 because presenting research on aquarium trade trends, explaining disease management techniques, and collaborating on ornamental fish conservation projects require strong communication and teamwork skills.

PO7: Research-related skills
CO3, CO4, CO6 & CO7 are directly mapped to PO7 because conducting research on aquarium trade, water chemistry, fish diseases, and biological aspects of ornamental fish requires research aptitude and critical analysis.

PO8: Learning how to learn skills
CO1, CO2, CO3, CO5 & CO6 are directly mapped to PO8 because acquiring expertise in aquarium design, species selection, disease control, and water quality management promotes continuous learning in aquaculture sciences.

PO9: Digital and technological skills
CO5 is directly mapped to PO9 because aquarium management and disease monitoring involve using digital tools, automated water quality control systems, and data analysis for efficient fish farming.

PO10: Multicultural competence, inclusive spirit, and empathy
CO1, CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO10 because the global ornamental fish trade requires cultural awareness, ethical considerations, and collaboration across diverse markets and conservation efforts.

PO11: Value inculcation and environmental awareness
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO11 because sustainable aquarium practices, ethical sourcing of fish, responsible pet trade, and conservation awareness are essential for maintaining biodiversity.

PO12: Autonomy, responsibility, and accountability
CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO12 because handling aquaria, maintaining water quality, and managing fish health require responsibility, precision, and adherence to ethical aquaculture practices.

PO13: Community engagement and service
CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly mapped to PO13 because ornamental fish farming, disease management, and responsible aquarium trade contribute to community engagement, conservation projects, and public awareness programs.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T.Y.B.Sc.
Semester: V
Course Type: Minor
Course Code: ZOO-312-MN
Course Name: Practicals in Ornamental fishery
Number of Credits: 02
Number of Teaching hours: 60

Course Objectives:-

- Identify and describe indigenous and exotic ornamental fish species, their habitat preferences, and specific care requirements.
- Demonstrate the ability to set up and maintain an aquarium by selecting appropriate equipment, accessories, and plants.
- Develop practical skills to culture live feeds and formulate artificial feed suitable for ornamental fish species.
- Analyze and implement proper health management practices and disease control measures in ornamental fish culture.
- Evaluate and manage essential water quality parameters for maintaining a healthy aquarium environment.
- Assess the economic feasibility of an ornamental fish culture unit through field visits and report writing.
- Examine government schemes and policies for the promotion and development of ornamental fish culture units.

Course Outcomes:-

Student will be able to-

CO1: classify and distinguish between indigenous and exotic ornamental fish species, detailing their habitat preferences, feeding habits, and maintenance needs.

CO2: design, construct, and maintain a fully functional aquarium by selecting appropriate equipment, accessories, and suitable aquatic plants.

CO3: demonstrate proficiency in culturing live feeds and preparing artificial feed to meet the dietary needs of various ornamental fish species.

CO4: apply knowledge of health management to prevent and control diseases in ornamental fish, ensuring optimum fish health and survival.

CO5: analyze and regulate critical water quality parameters to create and maintain an ideal environment for ornamental fish in aquariums.

CO6: evaluate the economic viability of an ornamental fish culture unit by conducting field visits and preparing detailed financial reports.

CO7: interpret and apply relevant government schemes and policies to enhance and promote ornamental fish culture units.

PRACTICALS:

Sr. No.	Title of the Practical	E / D
1.	Study of indigenous ornamental fishes 1. Dwarf gourami 2. Indian glass fish 3. Zebra fish 4. Loach 5. Peacock eel 6. Rosy barb	D
2.	Study of exotic ornamental fresh water fishes 1. Gold fish 2. Angel fish 3. Tiger barb 4. Sword tail 5. Fighter fish 6. Oscar	D
3.	Study of aquarium equipment & accessories	D
4.	Study of aquarium construction, setup and maintenance	E / D
5.	Culture of live feeds for ornamental fishes	E/ D
6.	Preparation of artificial feed for ornamental fishes	E/ D
7.	Study of diseases in ornamental fishes	D
8.	Study of Packing and transportation of ornamental fishes	D
9.	Study of essential water quality parameters in aquarium (pH and Hardness)	E/D
10.	Study of Aquarium plants	D
11.	Study of Value addition in ornamental fish culture	D
12.	Study of Aqua scaping in garden ponds	D
13.	Study of oxygen consumption by Ornamental fish	E
14.	Study of government Schemes for development of ornamental fish culture unit	D
15.	Visit to an ornamental fish culture unit and submit report	E
16.	Prepare report on economics of ornamental fish culture unit	E
*D- demonstration; E- experiment.		

Course Articulation Matrix of ZOO-312-MN: Practicals in Ornamental fishery
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding
All COs are directly mapped to PO1 because understanding ornamental fish species, aquarium setup, feed formulation, water quality regulation, disease control, financial evaluation, and government schemes is fundamental to mastering ornamental fish culture.

PO2: Practical, professional, and procedural knowledge
CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO2 because practical skills in aquarium design, feed preparation, disease management, and financial analysis are essential for operating a successful ornamental fish culture unit.

PO3: Entrepreneurial mind-set and knowledge
CO2, CO6 & CO7 are directly mapped to PO3 because knowledge of aquarium management, economic feasibility, and government policies supports entrepreneurship in ornamental fish culture.

PO4: Specialized skills and competencies
CO1, CO2, CO3, CO4 & CO5 are directly mapped to PO4 because expertise in species classification, aquarium maintenance, feed formulation, water quality control, and disease management requires specialized skills for sustainable ornamental fish farming.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO3, CO4, CO5, CO6 & CO7 are directly mapped to PO5 because troubleshooting aquarium conditions, analyzing fish health, regulating water quality, and assessing financial viability require problem-solving and analytical skills.

PO6: Communication skills and collaboration
CO2, CO4, CO5, CO6 & CO7 are directly mapped to PO6 because presenting research on aquarium management, discussing disease prevention strategies, and working in teams to evaluate economic feasibility require effective communication skills.

PO7: Research-related skills
CO4, CO5, CO6 & CO7 are directly mapped to PO7 because conducting research on fish health, water quality parameters, economic viability, and government policies requires investigative and analytical skills.

PO8: Learning how to learn skills
CO1, CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO8 because acquiring expertise in ornamental fish species, feed preparation, water management, and disease prevention promotes continuous learning.

PO9: Digital and technological skills
CO2, CO5 & CO6 are directly mapped to PO9 because aquarium maintenance, water quality monitoring, and financial assessments increasingly rely on digital tools and technology-driven solutions.

PO10: Multicultural competence, inclusive spirit, and empathy
CO1, CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO10 because the ornamental fish industry operates globally, requiring cultural awareness, ethical considerations, and collaboration across markets.

PO11: Value inculcation and environmental awareness
CO1, CO2, CO4, CO5 & CO7 are directly mapped to PO11 because sustainable fish culture, responsible aquarium trade, and government policies promote environmental awareness and ethical aquaculture practices.

PO12: Autonomy, responsibility, and accountability
CO2, CO4, CO5, CO6 & CO7 are directly mapped to PO12 because maintaining aquaria, ensuring fish health, and managing financial aspects require responsibility and accountability in ornamental fish culture.

PO13: Community engagement and service
CO1, CO2, CO4, CO6 & CO7 are directly mapped to PO13 because ornamental fish culture contributes to community awareness, conservation projects, and economic development in aquaculture-based livelihoods.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology
Program Code: USZOO
Class: T. Y. B.Sc.
Semester: V
Course Type: Value Education Course (Practical)
Course Code: ZOO-321-VSC (Practical)
Course Name: Biostatistics
Number of Credits: 02
Number of Teaching hours: 60

Course Objectives: -

- Develop skills in collection, tabulation, and graphical representation of biological data to enhance statistical interpretation in biological research.
- Understand and apply measures of central tendency (Mean, Median, Mode) and measures of dispersion, Range, Standard Deviation, Variance to summarize biological datasets effectively.
- Learn probability concepts and their applications in genetics, including Mendelian inheritance and blood group probability calculations using real-life data.
- Develop the ability to analyse relationships between biological variables through correlation and regression analysis, enabling interpretation of biological trends and patterns.
- Apply statistical hypothesis testing techniques, such as Chi-square test, T-test, and ANOVA, for making data-driven decisions in biological sciences.
- Gain an understanding of normal distribution curves and their significance in biological research and ecological studies.
- Implement biostatistical applications in ecology, including biodiversity index calculation and species diversity analysis using the quadrat method, to assess population dynamics and ecological balance.

Course Outcomes: -

Student will be able to-

CO1: explain and apply fundamental biostatistical techniques for collecting, tabulating, and visually representing biological data using diagrams and graphs.
CO2: calculate and interpret measures of central tendency (Mean, Median, Mode) and measures of dispersion (Range, Standard Deviation, Variance) for summarizing biological data.
CO3: demonstrate an understanding of probability concepts by applying them to Mendelian inheritance and blood group probability calculations using sample family data.
CO4: analyse relationships between biological variables using correlation and regression analysis, enabling interpretation of biological trends and patterns.
CO5: perform statistical hypothesis testing using Chi-square test, T-test, and ANOVA to assess the significance of biological data.
CO6: demonstrate the concept of normal distribution curves and their application in analyzing biological and ecological datasets.
CO7: apply biostatistical techniques in ecology by calculating biodiversity indices and analyzing population density and species diversity using the quadrat method for ecological assessments.

Practicals:

Sr. No.	Name of the Practical	E/D	Teaching Hours
1.	Use of Scientific Calculator	D	04
2.	Collection and Tabulation of Biological Data	E	04

3.	Diagrammatic Representation of Statistical Data (Bar Diagrams, Pie Chart)	E	04
4.	Graphical Representation of Statistical Data (Histogram, Frequency Curve, Ogive Curves)	E	04
5.	Frequency Distribution and Frequency Polygon Using Biological Data	D	04
6.	Measures of Central Tendency: Mean, Median, Mode	E	04
7.	Determination of Mode and Median by graph method	E	04
8.	Measures of Dispersion: Range, Standard Deviation, Variance	E	04
9.	Probability and Mendelian Inheritance Using Bead Model	E	04
10.	Calculation of probability of blood groups in offspring from sample family data	E	04
11.	Calculation of correlation between biological variables	E	04
12.	Regression analysis to study relationship between two biological variables	E	04
13.	Chi-square test for goodness of fit	E	04
14.	Normal distribution curve demonstration using biological data	D	04
15.	T-test for comparing means of two small samples	E	04
16.	ANOVA (analysis of variance) for comparing multiple sample means	D	04
17.	Calculation of biodiversity index	E	04
18.	Population density & species diversity by quadrat method	E	04

Course Articulation Matrix of ZOO-321-VSC (Practical): Biostatistics
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

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

PO1: Comprehensive knowledge and understanding
All COs are directly mapped to PO1 because understanding statistical methods, probability, hypothesis testing, correlation, and ecological applications is fundamental to biostatistics in biological research.

PO2: Practical, professional, and procedural knowledge
CO1, CO2, CO3, CO5, CO6 are mapped to PO2 because practical skills in data analysis, correlation, regression, and hypothesis testing are crucial for biological and ecological research.

PO3: Entrepreneurial mind-set and knowledge
CO3, CO4, CO7 are mapped to PO3 because knowledge of statistical applications in ecology, biodiversity studies, and research methodologies can contribute to careers in environmental consulting, biostatistics, and data analysis.

PO4: Specialized skills and competencies
CO1, CO2, CO3, CO4, CO6 are mapped to PO4 as they require specialized statistical expertise in biological and environmental sciences.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO2, CO3, CO4, CO5, CO6 are mapped to PO5 because biostatistical concepts involve critical thinking, interpretation of biological data, and problem-solving skills for real-world scenarios.

PO6: Communication skills and collaboration
CO3, CO4, CO6, CO7 are mapped to PO6 because statistical findings must be effectively communicated in research, teamwork, and academic settings.

PO7: Research-related skills
CO3, CO4, CO6, CO7 are mapped to PO7 because research in biology and ecology requires statistical validation, data interpretation, and hypothesis testing.

PO8: Learning how to learn skills
CO1, CO2, CO5, CO6 are mapped to PO8 as acquiring expertise in statistical methods helps in continuous learning and adaptation to new research methodologies.

PO9: Digital and technological skills
CO7 is mapped to PO9 because biostatistical analysis often involves computational tools, data visualization, and advanced research software.

PO10: Multicultural competence, inclusive spirit, and empathy
CO1, CO2, CO3, CO4, CO5, CO6 are mapped to PO10 because understanding ecological statistics helps in global biodiversity conservation, interdisciplinary collaboration, and ethical data interpretation.

PO11: Value inculcation and environmental awareness
CO4, CO5, CO6 are mapped to PO11 as statistical studies in ecology and biodiversity reinforce the importance of environmental conservation and sustainability.

PO12: Autonomy, responsibility, and accountability
CO1, CO2, CO4, CO5, CO6 are mapped to PO12 as statistical analysis in biological sciences requires responsible data collection, ethical considerations, and independent decision-making.

PO13: Community engagement and service
CO3, CO4, CO5, CO6, CO7 are mapped to PO13 because biostatistical applications in ecology, conservation, and epidemiology contribute to societal development and environmental awareness.