

INDIRA GANDHI UNIVERSITY, MEERPUR- REWARI, HARYANA (122502)

**(A State University Established under Haryana Act No.29 of 2013)
(Recognized u/s 12(B) & 2(f) of UGC Act, 1956)**

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Syllabus and Scheme of Examination

(in accordance with National Educational Policy 2020)

for

Post Graduate Programme

in

ZOOLOGY

Effective from Academic Session 2026-2027

Department of Zoology

Faculty of Life-Sciences

Indira Gandhi University,

Meerpur-Rewari (122502)

Haryana, India

Details of Approvals

Council/Board	Date	Remark
Staff Council		
Board of Studies		
Faculty		
Academic Council		
Year of implementation		

Chairperson
(Signature with Stamp)

VISION AND MISSION OF THE UNIVERSITY

VISION

To be a globally renowned university, recognized for excellence in teaching, innovative research, and welfare of the society, imbining the spirit of “*Vasudhaiv kutumbkam*”.

MISSION

- To introduce and implement innovation in teaching and learning process matching up the global standards to strengthen academic delivery through curriculum design, teaching pedagogy and usage of ICT.
- To develop a mechanism that attracts talented, qualified and experienced faculty from across the globe for pursuing their academic and research careers at the University.
- To offer academic programs at UG, PG, doctoral, Post-Doctoral levels which are learner-centric, industry focused, and adhere to outcome based international models.
- To create an ambiance that is conducive for undertaking sponsored research, innovation and consultancy services to a wide spectrum of societal and industrial requirements while encouraging interdisciplinary approach of learning, team work, and research.
- To establish state of art centres of excellence in frontier areas of research and design innovation through industry collaboration to innovate and incubate the products and services.
- To establish smart campus and promote e-governance activities in the university for the digitally empowered society and knowledge economy.
- To provide a hygienic, modern, environment friendly and vivacious campus attuned to the urgent needs of Green Technology.
- To consider and implement norms, metrics, standards, procedures and benchmarks for assessing and improving the quality in every aspect of University system and achieve quality certifications by National and International bodies.
- To make society self-reliant by organizing various programmes including literacy, gender sensitization, health awareness, and dissemination of information about livelihood generation.

VISION AND MISSION OF THE DEPARTMENT

VISION

To be a globally renowned university, recognized for excellence in teaching, innovative research, and welfare of the society, imbibing the spirit of “Vasudhaiv Kutumbkam”.

MISSION

- To introduce and implement innovation in teaching and learning process matching up the global standards to strengthen academic delivery through curriculum design, teaching pedagogy and usage of ICT.
- To impart innovative skills, teamwork, and ethical practices to the students to meet societal and industrial expectations.
- To offer academic programs at UG, PG, doctoral, Post-Doctoral levels which are learner centric, industry focused, and adhere to outcome based international models.

ABOUT THE PROGRAMME

The Department of Zoology at Indira Gandhi University (IGU), Meerpur (Rewari), established in 2016, is a key constituent of the Faculty of Life Sciences and offers a well-structured two-year M.Sc. Zoology program with an intake of 40 students. Designed for students passionate about the natural world and animal sciences, the program provides in-depth conceptual and practical knowledge across diverse areas such as animal diversity (Non-Chordata and Chordata), taxonomy, animal behavior, developmental biology, evolution, ecology, conservation, entomology, fishery science, genetics, and emerging fields like nanoscience and technology. The curriculum integrates interactive teaching methods, smart classrooms, advanced laboratory work, seminars, habitat studies, institute visits, and report writing to foster communication, critical thinking, and scientific inquiry. A dissertation further enhances students' research aptitude and problem-solving skills, preparing them to address real-world challenges in health, environment, and society. From 2024, the department has aligned its teaching approach with the National Education Policy (NEP) 2020, promoting interdisciplinary learning, skill development, and research-driven education. Supported by a dedicated team of experienced faculty members—including a Professor, Associate Professor, and Assistant Professors—the department offers a vibrant academic environment, state-of-the-art infrastructure, and mentoring that collectively prepare students for careers in academia, research, wildlife conservation, environmental management, and life science industries.

MINIMUM ELIGIBILITY CRITERIA

B.Sc. (Hons.) in Zoology/ B.Sc. (Pass) with any two of the subjects, viz., Anthropology, Biochemistry, Biotechnology, Botany, Chemistry, Environmental Science, Fisheries, Genetics, Geology, Microbiology, and Zoology with atleast 50% marks (47.5% for SC/ST/ Blind/ Visually and Differently Abled candidates of Haryana only) in aggregate or any other examination recognized by Indira Gandhi University, Meerpur as equivalent thereto.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Advanced Knowledge: Graduates will acquire advanced knowledge and practical competence in Zoology and allied disciplines to address biological and environmental challenges.
PEO 2	Research and Innovation: Graduates will develop research aptitude, analytical thinking, and problem-solving skills for scientific investigation and innovation in animal sciences.
PEO 3	Professional Competence: Graduates will apply modern tools, emerging technologies, and interdisciplinary approaches in academia, industry, healthcare, biodiversity conservation, and environmental management.
PEO4	Leadership and Ethics: Graduates will demonstrate professional ethics, scientific integrity, leadership, teamwork, and social responsibility in their professional careers.
PEO5	Lifelong Learning: Graduates will pursue higher education, entrepreneurship, and lifelong learning to adapt to emerging scientific and technological developments.

PROGRAMME OUTCOMES (POs)

PO 1	Knowledge	Demonstrate advanced knowledge of Zoology, including animal diversity, physiology, genetics, molecular biology, ecology, evolution, biotechnology, immunology, and related disciplines.
PO 2	Research Aptitude	Design, conduct, analyse, and interpret laboratory and field-based research using appropriate scientific methodologies.
PO 3	Communication	Communication: Communicate scientific ideas and research findings effectively through technical writing, presentations, publications, and digital platforms.
PO 4	Problem-Solving	Apply critical thinking and scientific reasoning to solve complex biological, environmental, and societal problems.
PO 5	Individual and Team Work	Work effectively as an individual and as a member or leader of multidisciplinary teams in academic, research, and professional environments.
PO 6	Investigation of Problems	Identify research problems, formulate hypotheses, design experiments, collect and analyse data, and draw valid scientific conclusions.
PO 7	Modern Tool Usage	Apply advanced laboratory techniques, microscopy, molecular methods, bioinformatics, nanotechnology, computational tools, and modern instrumentation in biological research.
PO 8	Scientific temperament	Demonstrate scientific temperament, innovation, environmental awareness, and evidence-based decision-making while addressing contemporary challenges in animal sciences.
PO 9	Life-Long Learning	Engage in continuous learning and professional development to keep pace with emerging trends in biological sciences and technology.
PO 10	Ethics	Practice scientific integrity, professional ethics, biosafety, animal ethics, environmental responsibility, and respect for intellectual property rights.
PO 11	Project Management	Demonstrate leadership, project planning, resource management, entrepreneurship, and decision-making skills for the successful execution of scientific projects.

PROGRAMME SPECIFIC OUTCOMES (PSOs) (If applicable)

PSO 1	Advanced Zoological Knowledge: Apply advanced knowledge of animal diversity, physiology, genetics, molecular biology, developmental biology, ecology, evolution, immunology, endocrinology, and biotechnology to understand biological systems.
PSO 2	Research and Experimental Competence: Design and execute independent research using advanced laboratory, Drosophila biology, reproductive biology, molecular biology, wildlife exercises, and field techniques to address contemporary challenges in animal sciences.
PSO 3	Applied Zoology and Entomology: Apply principles of entomology, wildlife biology, Drosophila, pest management, biodiversity conservation, and environmental monitoring to solve problems related to agriculture, public health, and ecosystem sustainability.
PSO 4	Emerging Technologies and Professional Development: Utilize nanotechnology, nanotoxicology, molecular diagnostics, bioinformatics, AI and other emerging technologies to enhance research, innovation, employability, entrepreneurship, and higher studies in Zoology.

Scheme of Examination for Postgraduate Programme	
Subject	ZOOLOGY
Total number of Semesters	IV
Total Marks	2700
Total Credit	108
Framework	2
Scheme	P (as per PG ordinance)

Example of Scheme P

Semester	Course Type	Course Code*	Nomenclature of course	Theory (T)/ Practical (P)	Credits		Contact hours per week L: Lecture P: Practical T: Tutorial To: Total				Internal Assessment Marks	End Term Examination Marks	Total Marks	Examination Hours
						To	L	T	P	To				
1	CC-1	26L6.0-ZOO-101	Advances in Cell Biology	T	4	26	4	0	0	4	30	70	100	3
	CC-2	26L6.0-ZOO-102	Biochemistry and Biotechniques	T	4		4	0	0	4	30	70	100	3
	CC-3	26L6.0-ZOO-103	Structure and Function of Invertebrates	T	4		4	0	0	4	30	70	100	3
	CC-4	26L6.0-ZOO-104	Biosystematics and Biostatistics	T	4		4	0	0	4	30	70	100	3
	PC-1	26L6.0-ZOO-105	Practical based on 26L6.0-ZOO-101 & 26L6.0-ZOO-102	P	4		0	0	8	8	30	70	100	3
	PC-2	26L6.0-ZOO-106	Practical based on 26L6.0-ZOO-103 & 26L6.0-ZOO-104	P	4		0	0	8	8	30	70	100	3
	SEM	26L6.0-ZOO-107	Seminar	-	2		2	-	-	2	-	50	50	-
2	CC-5	26L6.0-ZOO-201	Structure and Function of Vertebrates	T	4	26	4	0	0	4	30	70	100	3
	CC-6	26L6.0-ZOO-202	Population Genetics & Evolution	T	4		4	0	0	4	30	70	100	3
	CC-7	26L6.0-ZOO-203	Comparative Physiology	T	4		4	0	0	4	30	70	100	3
	CC-8	26L6.0-ZOO-204	Population and Community Ecology	T	4		4	0	0	4	30	70	100	3

	PC-3	26L6.0-ZOO-205	Practical based on 26L6.0-ZOO-201 & 26L6.0-ZOO-202	P	4		0	0	8	8	30	70	100	3
	PC-4	26L6.0-ZOO-206	Practical based on 26L6.0-ZOO-203 & 26L6.0-ZOO-204	P	4		0	0	8	8	30	70	100	3
	CHM	26L6.0-CHM-201	Constitutional, Human and Moral Values and IPR	T	2		2	0	0	2	15	35	50	2
	Internship	26L6.0-ZOO-INT	An internship course of 4 Credits of 4-6 weeks duration during summer vacation after 2 nd semester is to be completed by every student. Internship can be either for enhancing the employability or for developing the research aptitude.								50	50	100	
3	CC-9	26L6.5-ZOO-301	Molecular Endocrinology	T	4	26	4	0	0	4	30	70	100	3
	CC-10	26L6.5-ZOO-302	Advances in Molecular Biology	T	4		4	0	0	4	30	70	100	3
	DEC-1	26L6.5-ZOO-303	Biology of the Immune System	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-304	Bioinformatics	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-305	Chronobiology	T	4		4	0	0	4	30	70	100	3
	DEC-2	26L6.5-ZOO-306	Molecular Reproduction-I	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-307	Animal Behaviour & Wildlife Conservation-I	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-308	Fish, Fisheries and Aquaculture-I	T	4		4	0	0	4	30	70	100	3
	PC-5	26L6.5-ZOO-309	Practical based on 26L6.5-ZOO-301 & 26L6.5-ZOO-302	P	4		0	0	8	8	30	70	100	3
	PC-6	26L6.5-ZOO-310	Practical based on 26L6.0-ZOO 303/304/305 & 26L6.0-ZOO-306/307/308	P	4		0	0	8	8	30	70	100	3
	OEC	26L6.5-OEC-ZOO-301	(*for the students of other than PG Programme __Zology__) Students of PG Programme __Zoology__ will choose from the pool of open elective offered by the university.	T	2	2	0	0	2	15	35	50	2	

4	CC-11	26L6.5-ZOO-401	Developmental Biology	T	4	26	4	0	0	4	30	70	100	3
	CC-12	26L6.5-ZOO-402	Molecular Cytogenetics	T	4		4	0	0	4	30	70	100	3
	DEC-3	26L6.5-ZOO-403	Economic Entomology and Insect Morphology	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-404	Environmental Biology and Toxicology	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-405	Economic Zoology	T	4		4	0	0	4	30	70	100	3
	DEC-4	26L6.5-ZOO-406	Molecular Reproduction-II	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-407	Animal Behaviour and Wildlife Conservation-II	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-408	Fish, Fisheries and Aquaculture-II	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-409	Nanoscience and Nanotechnology	T	4		4	0	0	4	30	70	100	3
	PC-7	26L6.5-ZOO-410	Practical based on 26L6.5-ZOO-401 & 24L6.5-ZOO-402	P	4		0	0	8	8	30	70	100	3
	PC-8	26L6.5-ZOO-411	Practical based on 26L6.5-ZOO-403/404/405 & 26L6.5-ZOO-406/407/408/409	P	4		0	0	8	8	30	70	100	3
	EEC	26L6.5-EEC-RPE-400	Research Ethics	T	2		2	0	0	2	15	35	50	2

Scheme of Semester IV when a student opts for Dissertation Work or Project Work

	CC-11	26L6.5-ZOO-401	Developmental Biology	T	4	26	4	0	0	4	30	70	100	3
	DEC-3	26L6.5-ZOO-403	Economic Entomology and Insect Morphology	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-404	Environmental Biology and Toxicology	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-405	Economic Zoology	T	4		4	0	0	4	30	70	100	3
	DEC-4	26L6.5-ZOO-406	Molecular Reproduction-II	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-407	Animal Behaviour and Wildlife Conservation-II	T	4		4	0	0	4	30	70	100	3
		26L6.5-ZOO-408	Fish, Fisheries and Aquaculture-II	T	4		4	0	0	4	30	70	100	3

		26L6.5-ZOO-409	Nanoscience and Nanotechnology	T	4		4	0	0	4	30	70	100	3
	EEC	26L6.5-EEC-RPE-400	Research Ethics	T	2		2	0	0	2	15	35	50	2
	Dissertation / Project work	26L6.5-ZOO-413	Dissertation/Project work	D	12		0	0	0	12	0	300	300	

Part A – Introduction			
Name of Subject	M.Sc. Zoology		
Semester	I st		
Nature of Course	Theory		
Nomenclature of the Course	Advances in Cell Biology		
Course Code	26L6.0-ZOO-101		
Course Type	CC-1		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO ₁	Understand the molecular organization of biomembranes, membrane transport systems, and cell-cell interactions	
	CLO ₂	Explain the structure and functions of cytoskeletal components, cell motility, and intracellular protein transport mechanisms	
	CLO ₃	Analyze the stages and regulation of the cell cycle, meiosis, genome organization, and signal transduction pathways	
	CLO ₄	Evaluate the processes of apoptosis, stem cell maintenance, cancer biology, and Biology of ageing	
	Theory	Tutorial	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	3		
Part B- Contents of the Course			
Instructions for Paper- Setter:			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Biomembranes: Molecular composition and arrangement, functional consequences, membrane transportation; diffusion, active transport and pumps, uniports, symports and antiports, Donnan equilibrium; ion movements and cell function:, Maintenance of cellular pH; Receptor mediated endocytosis. The Extra Cellular Matrix Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata Ca ⁺⁺ dependent and Ca ⁺⁺ independent Homophilic cell-cell adhesion.	CLO ₁	16

II	Cytoskeleton and cell movement: Structure and organization of actin filaments, Actin, myosin and cellular movements, Structure and dynamic organizations of microtubules, Intermediate filaments, Cilia and flagella, Cell matrix adhesion, Integrins, Collagen, Non-collagen components, Protein sorting and transport, Protein uptake into the ER, Membrane proteins and Golgi sorting, Mechanism of vesicular transport, Lysosomes, Molecular mechanism of secretory pathway.	CLO ₂	17
III	Cell cycle: The eukaryotic cell cycle, Regulators of cell cycle progression, The events of M phase, Meiosis and fertilization, Genome organization, Chromosomal organization of genes and noncoding DNA, Mobile DNA, Pathways of intracellular signal transduction, Signaling networks.	CLO ₃	13
IV	Cell death and cell renewal: Apoptosis, Stem cells and the maintenance of adult tissues, Embryonic stem cells and therapeutic cloning, Biology of Cancer, Oncogenes, Tumor suppressor genes, Molecular approaches to cancer treatment, Biology of Ageing.	CLO ₄	14
	Total Contact hours		60
Evaluation Methods			
Internal Assessment: 30 Marks		End Term Examination: 70 Marks	
• Class Participation:	5	Written Examination: 70	
• Seminar/presentation/assignment/quiz/ class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/Journals/ e-resources/ Learning Management Systems (LMS):			
Instructions			
1. 1.Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2022). <i>Molecular biology of the cell</i> (7th ed.). W. W. Norton & Company.			
2. 2.Alberts, B., Hopkin, K., Johnson, A., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2024). <i>Essential cell biology</i> (6th ed.). W. W. Norton & Company.			
3. 3.Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Martin, K. C. (2021). <i>Molecular cell biology</i> (9th ed.). W. H. Freeman.			
4. 4.Cooper, G. M., & Hausman, R. E. (2019). <i>The cell: A molecular approach</i> (8th ed.).			

Sinauer Associates/Oxford University Press.

5. 5.Hardin, J., Becker, G., & Skliar, M. (2020). *Becker's world of the cell* (10th ed.). Pearson.
6. 6.Karp, G., Iwasa, J., & Marshall, W. (2019). *Karp's cell and molecular biology: Concepts and experiments* (9th ed.). John Wiley & Sons.
7. 7.Hancock, J. T. (2021). *Cell signalling* (4th ed.). Oxford University Press.
8. 8.Pollard, T. D., & Earnshaw, W. C. (2016). *Cell biology* (3rd ed.). Elsevier.
9. 9.Voet, D., Voet, J. G., & Pratt, C. W. (2019). *Fundamentals of biochemistry: Life at the molecular level* (5th ed.). John Wiley & Sons.

LINK- e-resources

1. <https://egyankosh.ac.in/handle/123456789/24994>
2. <http://www.bio-nica.info/Biblioteca/Bolsover2004CellBiology.pdf>
3. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBMA1101.pdf
4. <https://www.scribd.com/document/878494779/Cell-and-Molecular-Biology-by-P-K-gupta-Tadvicki>
5. <https://www.mustafaaltinisik.org.uk/s-molecularcellbiology.pdf>

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs) & Program Specific Outcomes (PSOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	-	2	3	2	2	2	-	3	2	-	3
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	-	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	1	3
CLO ₄	3	3	2	3	2	3	2	3	3	3	2	3	3	2	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	6
Entrepreneurship	3
Skill Enhancement	8
Communication Development	2

Indian Knowledge System	2
Environmental Awareness/SDGs	3
Current Issues and Social Awareness	4
Gender issues	2
Public policies	2
Any Other	3

Part A - Introduction			
Name of Subject	M.Sc. Zoology		
Semester	I st		
Nature of Course	Theory		
Nomenclature of the Course	Biochemistry and Biotechniques		
Course Code	26L6.0-ZOO-102		
Course Type	CC-2		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO ₁	Explain structure and function of biomolecules, including proteins, enzymes, and nucleic acids with their mechanisms	
	CLO ₂	Analyze major metabolic pathways and their regulation, including carbohydrate, lipid, and cholesterol metabolism	
	CLO ₃	Understand analytical instruments and apply microbiological and cell culture techniques in laboratory practices	
	CLO ₄	Explain and analyze separation and molecular biology techniques such as chromatography, centrifugation, blotting, and flow cytometry	
	Theory	Tutorial	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	3		
Part B- Contents of the Course			
Instructions for Paper- Setter: The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	General Introduction to Biomolecules; Protein Biology: Primary, Secondary, tertiary and quaternary structure of proteins: i)Domain, ii)Reverse turn of Ramachandran plot and its significance; Enzyme: Classification and nomenclature, Co-enzymes and Cofactors Induced fit and Molecular Mechanism of Enzyme action, Enzyme feedback mechanism, Isozymes; Nucleic acids: Structure and Functions, DNA structure and functions, RNA structure and functions.	CLO ₁	14
II	Metabolism: Glycolysis, citric acid cycles its regulation and role as metabolic hub. Hexose monophosphate	CLO ₂	12

	pathway its regulation and significance. Cholesterol biosynthesis, its metabolism and steroidogenesis. Bile acids and their metabolism, Saturated and unsaturated fatty acid and their metabolism.		
III	Principles and uses of analytical instruments: Microscopes and imaging, NMR Spectroscopy, Spectrophotometers, Cryopreservation for cells, tissue, organisms. Microbiological and cell culture Techniques: Setting of microbiological laboratory, Sterilization and Media preparation techniques, Inoculation and growth monitoring (Standard plate count technique), Isolation of a microbial colony and slant preparation. Design and functioning of tissue culture laboratory, Basics of cell/tissue culture, Culture media preparation. Biosafety and levels.	CLO ₃	17
IV	Separation techniques in biology: Molecular separations by chromatography, electrophoresis. Organelle separation by centrifugation. Density gradient centrifugation, Rate zonal centrifugation, Isopycnic centrifugation, Ultra Centrifugation, Differential centrifugation, Autoradiography, Biosensors, DNA fingerprinting, Cell separation by flow cytometry and FACS; ELISA, Southern blot, Western blot, Northern Blot.	CLO ₄	17
	Total Contact hours		60
Evaluation Methods			
Internal Assessment: 30 Marks		End Term Examination: 70 Marks	
•Class Participation:		5	Written Examination: 70
•Seminar/presentation/assignment/quiz/ class test etc.:		10	
•Mid-Term Exam:		15	
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Masters, J. R. W. (2000). <i>Animal cell culture: A practical approach</i> (4th ed.). Oxford University Press (IRL Press).			
2. Braun, R. D. (1987). <i>Introduction to instrumental analysis</i> . McGraw-Hill.			
3. Wilson, K., & Walker, J. (2010). <i>Principles and techniques of biochemistry and molecular biology</i> (7th ed.). Cambridge University Press.			

4. Nelson, D. L., & Cox, M. M. (2021). *Lehninger principles of biochemistry* (8th ed.). W. H. Freeman.
5. Berg, J. M., Tymoczko, J. L., Gatto, G. J., & Stryer, L. (2023). *Biochemistry* (10th ed.). W. H. Freeman.
6. Voet, D., Voet, J. G., & Pratt, C. W. (2024). *Fundamentals of biochemistry: Life at the molecular level* (6th ed.). Wiley.

LINK- e-resources

1. <https://bgc.ac.in/pdf/study-material/Keith-Wilson-John-Walker-Principles-and-Techniques-of-Biochemistry-and-Molecular-Biology-Cambridge-University-Press-2010.pdf>
2. <https://axonb.com/wp-content/uploads/2020/05/Animal-Cell-Culture-A-Practical-Approach-2001.pdf>
3. https://www.researchgate.net/profile/Sourbh-Garg/post/What_is_a_buffer_solution/attachment/5fd31982d6d02900019d0dc2/AS%3A967452859056129%401607670144604/download/Lehninger_Principles_of_Biochemistry_6th.pdf
4. https://dn790008.ca.archive.org/0/items/JeremyM.BergJohnL.TymoczkoGregoryJ.GattoJr.LubertStryerBiochemistry_201708/Jeremy%20M.%20Berg%2C%20John%20L.%20Tymoczko%2C%20Gregory%20J.%20Gatto%20Jr.%2C%20Lubert%20Stryer%20Biochemistry.pdf
5. [https://library.uniq.edu.iq/storage/books/file/Fundamentals%20of%20Biochemistry_%20Life%20at%20the%20Molecular%20Level/1671012774Fundamentals%20of%20Biochemistry_%20Life%20at%20the%20Molecular%20Level%20\(%20PDFDrive%20\).pdf](https://library.uniq.edu.iq/storage/books/file/Fundamentals%20of%20Biochemistry_%20Life%20at%20the%20Molecular%20Level/1671012774Fundamentals%20of%20Biochemistry_%20Life%20at%20the%20Molecular%20Level%20(%20PDFDrive%20).pdf)
6. <https://uou.ac.in/sites/default/files/slm/MSCZO-504.pdf>

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs) & Program Specific Outcomes (PSOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	-	2	3	2	2	2	-	3	2	-	3
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	-	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	1	3
CLO ₄	3	3	2	3	2	3	2	3	3	3	2	3	3	2	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	8
Entrepreneurship	3
Skill Enhancement	10
Communication Development	2
Indian Knowledge System	2
Environmental Awareness/SDGs	3
Current Issues and Social Awareness	4
Gender issues	1
Public policies	2
Any Other	3

Part A - Introduction			
Name of Subject	M.Sc. Zoology		
Semester	I st		
Nature of Course	Theory		
Nomenclature of the Course	Structure and Function of Invertebrates		
Course Code	26L6.0-ZOO-103		
Course Type	CC-3		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO ₁	Explain the classification, body organization, and evolutionary relationships of major invertebrate groups.	
	CLO ₂	Describe locomotion, nutrition, digestion, and respiration in invertebrates.	
	CLO ₃	Explain excretion, osmoregulation, nervous systems, and reproduction in invertebrates.	
	CLO ₄	Discuss larval forms, insect adaptations, metamorphosis, social behavior, pest management, and invertebrate conservation.	
	Theory	Tutorial	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	3		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Introduction to invertebrates with their general characters and classification up to class Level Minor Phyle, Concept and significance, Organization and general characters of Acoelomate, Pseudocoelomates and Coelomates minor phyla (with special emphasis on Ctenophora, Rotifera, Endoprocta, Ectoprocta, Phoronida, Sipunculida and Echiuroidea). Organization of coelom, Concept and structure of Acoelomate, Pseudocoelomates and Coelomates, Protostomia and Deuterostomia, Metamerism in Annelida, Pseudometamerism.	CLO ₁	15
II	Locomotion, Flagella and ciliary movement in Protozoa, Hydrostatic movement in Coelenterata, Annelida and	CLO ₂	15

	Echinodermata, Nutrition and Digestion, Patterns of feeding and digestion in lower metazoan, Filter-feeding in Polychaeta, Mollusca and Echinodermata, Respiration, Organs of respiration: Gills, lungs and trachea, Respiratory pigments, Mechanism of respiration.		
III	Excretion: Organs of excretion: Coelom, coelomoducts, Nephridia and Malpighian tubules. Mechanism of excretion and osmoregulation, Nervous system, Primitive nervous system: Coelenterata and Echinodermata, Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda), Trends in neural evolution. Mode of reproduction.	CLO ₃	15
IV	Invertebrate larvae, Larval forms of free-living invertebrates, Strategies and Evolutionary, significance of larval forms, Conservation of invertebrates, Introduction to insects, Mouthparts of Insects, How are insects able to fly? Mechanism of insect flight Metamorphosis in insects, Hormonal control of moulting. Social life in insects, Integrated pest management.	CLO ₄	15
	Total Contact hours		60
Evaluation Methods			
Internal Assessment: 30 Marks		End Term Examination: 70 Marks	
• Class Participation:		5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:		10	
• Mid-Term Exam:		15	
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Invertebrates. Brusca, R. C., Moore, W., & Shuster, S. M. (2023). Invertebrates (4th ed.). Oxford University Press.			
2. Integrated Principles of Zoology. Hickman, C. P., Roberts, L. S., Keen, S. L., Larson, A., Eisenhour, D. J., & l'Anson, H. (2024). Integrated Principles of Zoology (19th ed.). McGraw-Hill Education.			
3. Invertebrate Zoology. Jordan, E. L., & Verma, P. S. (2022). Invertebrate Zoology (Latest revised edition). S. Chand Publishing.			
4. A Textbook of Invertebrate Zoology. Kotpal, R. L. (2021). A Textbook of Invertebrate Zoology . Rastogi Publications.			
5. Biology of Animals. Ganguly, B. B., Sinha, A. K., & Adhikari, S. (2021). Biology of Animals, Volume I: Invertebrates . New Central Book Agency.			

LINK- e-resources

1. https://swayam.gov.in/?utm_source
2. https://nptel.ac.in?utm_source
3. https://ndl.iitkgp.ac.in?utm_source
4. https://epgp.inflibnet.ac.in?utm_source

**Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)
& Program Specific Outcomes (PSOs)**

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	-	2	3	2	2	2	-	3	2	2	2
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	2	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	2	3
CLO ₄	3	3	2	3	2	3	2	3	3	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	6
Entrepreneurship	3
Skill Enhancement	8
Communication Development	2
Indian Knowledge System	2
Environmental Awareness/SDGs	4
Current Issues and Social Awareness	3
Gender issues	1
Public policies	2
Any Other	3

Part A - Introduction			
Name of Subject	M.Sc. Zoology		
Semester	I st		
Nature of Course	Theory		
Nomenclature of the Course	Biosystematics and Biostatistics		
Course Code	26L6.0-ZOO-104		
Course Type	CC-4		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO ₁	Understand and integrate the principles of biosystematics and taxonomy, including species concepts, classification theories, and modern taxonomic approaches such as chemotaxonomy, cytotoxonomy, and molecular taxonomy.	
	CLO ₂	Apply the principles of taxonomic collection, preservation, identification, nomenclature (ICZN), and systematic publications using different taxonomic keys and type methods.	
	CLO ₃	Interpret measures of central tendency and dispersion, and analyze correlation, regression, and Chi-square tests for interpreting biological data.	
	CLO ₄	Analyse sampling methods, probability distributions, and tests of significance, and use computers and statistical software for analysis and interpretation of biological data.	
	Theory	Tutorial	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	3		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Biosystematics and taxonomy: Definition and perspectives, Historical resume, Importance and applications of systematics in biology. Concepts of newer aspects of biosystematics: Chemotaxonomy, Cytotaxonomy, Molecular taxonomy. Dimensions of speciation and taxonomic characters: Different Species concepts – species category, Sub-species and other intra-	CLO ₁	15

	specific categories. Theories of biological classification, hierarchy of categories. Taxonomic characters – different kinds. Evaluation of Biodiversity indices.		
II	Taxonomic collections, preservation, curation process and identification. Taxonomic keys-different kinds of taxonomic keys, their merits and demerits. Systematic publications: Different kinds of publications. International code of Zoological Nomenclature (ICZN): principles, objectives and rules: Stability, Priority, Concept of availability, formation of names, synonymy, homonymy, the type method, kinds of type specimen, type-designation. Principles of Bioethics in Biodiversity. Traditional Knowledge of conservation practices in India	CLO ₂	15
III	Measures of central value: Arithmetic mean, mode and median, Definition, calculation and its properties. Measures of Dispersion: Range, Interquartile range, Quartile deviation. Mean deviation and standard deviation, Standard error, Correlation: Types and Methods studying correlation – Scatter diagram method, Graphic method, Karl Pearson coefficient of correlation, Rank correlation. Regression analysis (Regression lines and regression equation) Chi-square analysis	CLO ₃	15
IV	Concept of sampling and sampling methods: Definition and law of sampling, Judgment sampling, Random sampling, stratified sampling, systematic sampling, multistages sampling and quota sampling. Test of significance for large samples and small samples (student t-test, F- test; ANOVA). Probability and law of probability, Theoretical probability distribution: Binomial distribution, Poisson distribution, Normal distribution. Components of computers, Basic functioning of computers, Use of Statistical Software in Biology.	CLO ₄	15
	Total Contact hours		60
Evaluation Methods			
Internal Assessment: 30 Marks		End Term Examination: 70 Marks	
• Class Participation:	5	Written Examination: 70	
• Seminar/presentation/assignment/quiz/ class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			

Recommended Books/e-resources/LMS:

1. Saha, I., & Paul, B. (2023). *Essentials of biostatistics and research methodology*. Academic Publishers.
2. Baise, M., Nayak, N. K., Rao, M. S., Jhala, N., & Tanwar, N. (2025). *Text book of biostatistics and research methodology*. Shashwat Publication.
3. Rao, T. R. (2026). *Basic biostatistics: Concepts and applications*. Springer Nature.
4. Kapoor, V. C. (2021). *Theory and practice of animal taxonomy*. Oxford & IBH Publishing.
5. Mayr, E., & Ashlock, P. D. (2021). *Principles of systematic zoology* (2nd ed.). McGraw-Hill.
6. Winston, J. E. (2022). *Describing species: Practical taxonomic procedure for biologists*. Columbia University Press.
7. Magurran, A. E. (2023). *Measuring biological diversity* (2nd ed.). Wiley-Blackwell.

**Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)
& Program Specific Outcomes (PSOs)**

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	-	2	3	2	2	2	-	3	2	2	2
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	2	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	2	3
CLO ₄	3	3	2	3	2	3	2	3	3	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	7
Entrepreneurship	2
Skill Enhancement	10
Communication Development	2
Indian Knowledge System	2
Environmental Awareness/SDGs	4
Current Issues and Social Awareness	3
Gender issues	1
Public policies	3
Any Other	4

Part A – Introduction			
Name of the Programme	M.Sc. Zoology		
Semester	1st		
Nature of Course/Course Composition	Practical		
Nomenclature of the Course	Practical based on 26L6.0-ZOO-101 & 26L6.0-ZOO-102		
Course Code	26L6.0-ZOO-105		
Course Type	PC-1		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO ₁	Apply cytological techniques to prepare, analyze, and interpret mitotic and meiotic chromosomes, karyotypes, and idiograms.	
	CLO ₂	Demonstrate skills in studying meiotic behavior, mapping polytene chromosomes, and preparing accurate laboratory solutions.	
	CLO ₃	Perform quantitative biochemical assays for proteins, carbohydrates, lipids, and nucleic acids using standard laboratory methods.	
	CLO ₄	Utilize chromatography techniques, laboratory instruments, and microbiological methods for biomolecule analysis and microbial culture handling.	
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
<u>Instructions for Examiner:</u> Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO/s Attempt	Contact Hours
Unit-I	Preparation of mitotic chromosomes from onion root tips Preparation of meiotic chromosomes from grasshopper testes. Preparation of karyotypes from micrographs. Calculation of morphometric data and preparations of idiogram.	CLO ₁	30
Unit-II	Determination of chiasma frequency and terminalization coefficient. Study of permanent slides of different stages of meiosis and mitosis. Preparation of polytene chromosomes (Chironomous/mosquito) and mapping. Preparation of Solutions- Standard solution, Molar, Molal and Normal solution.	CLO ₂	30

Unit-III	Proteins: Quantitative estimation of proteins by Biuret method and Lowry's method. Carbohydrates: quantitative estimation of total carbohydrates and glucose Analysis of Fats/ Oils: iodine number, saponification value, acid value quantitative estimation of total lipids. Preparation of Standard curve for the estimation and extraction of nucleic acids (DNA and RNA).	CLO ₃	30
Unit-IV	Paper chromatography: amino acids and carbohydrates. Thin layer chromatography: neutral and phospholipids. Tools: demonstration of parts and working of the following tools: PCR, GLC, Spectrophotometers, various kinds of microscopes, pH meter, Electrophoresis, Centrifuges, Tissue culture unit, Incubators Microbiological media preparation, sterilization, dilution, inoculation and standard plate count.	CLO ₄	30
Total Contact Hours			120
Evaluation Methods			
Internal Assessment:30	MM-30	End Term Examination: 70	MM- 70
Class Participation:	5	Lab record	10
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
Mid-Term Exam:	15	Write-up and execution of the practical	40
Part C-Learning Resources			
Recommended Books/Journals/ e-resources/ Learning Management Systems (LMS):			
Instructions			
1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2015). <i>Molecular biology of the cell</i> (6th ed.). Garland Science. 2. Karp, G. (2019). <i>Cell and molecular biology: Concepts and experiments</i> (9th ed.). Wiley. 3. Plummer, D. T. (2017). <i>An introduction to practical biochemistry</i> (3rd ed.). McGraw-Hill Education. 4. Wilson, K., & Walker, J. (2010). <i>Principles and techniques of biochemistry and molecular biology</i> (7th ed.). Cambridge University Press. 5. Gupta, P. K. (2018). <i>Cytogenetics</i> (3rd ed.). Rastogi Publications. 6. Sadasivam, S., & Manickam, A. (2008). <i>Biochemical methods</i> (3rd ed.). New Age International Publishers. 7. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Martin, K. C. (2021). <i>Molecular cell biology</i> (9th ed.). W. H. Freeman and Company. 8. Sambrook, J., & Russell, D. W. (2001). <i>Molecular cloning: A laboratory manual</i> (3rd ed.). Cold Spring Harbor Laboratory Press.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs) & Program Specific Outcomes (PSOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	-	2	3	2	2	2	-	3	2	-	3
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	-	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	1	3
CLO ₄	3	3	2	3	2	3	3	3	3	3	2	3	3	2	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	24
Entrepreneurship	6
Skill Enhancement	40
Communication Development	5
Indian Knowledge System	3
Environmental Awareness/SDGs	10
Current Issues and Social Awareness	8
Gender issues	2
Public policies	7
Any Other	15

Part A – Introduction			
Name of the Programme	M.Sc. Zoology		
Semester	1st		
Nature of Course/Course Composition	Practical		
Nomenclature of the Course	Practical based on 24L6.0-ZOO-103 & 24L6.0-ZOO-104		
Course Code	24L6.0-ZOO-106		
Course Type	PC-2		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO ₁	Identify and classify major invertebrate phyla using museum specimens and permanent slides.	
	CLO ₂	Examine insect mouthparts and prepare mounts of selected invertebrates for morphological identification.	
	CLO ₃	Demonstrate major organ systems of invertebrates and apply taxonomic keys for identification.	
	CLO ₄	Analyze biological data using basic statistical tools and interpret the results.	
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
<u>Instructions for Examiner:</u>			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO/s Attempt	Contact Hours
Unit-I	Slides and Museum specimens of following phyla: (a) PROTOZOA (b) PORIFERA (c) CNIDARIA (d) ANNELIDA (e) ARTHROPODA (f) MOLLUSCA (g) ECHINODERMATA (h) HEMICHORDATA	CLO ₁	30
Unit-II	Study of mouth parts of Cockroach, Honey Bee, Red cotton bug and House fly; Mounting: Obelia, Tubularia, Bougainvillea, Trachea of Cockroach, Crustacean Larva, Cyclops, Nauplius, Daphnia	CLO ₂	30

Unit-III	Demonstration of Digestive system, reproductive system and nervous system of Earthworm, Cockroach, Prawn, Loligo and Star fish. Preparation and use of different types of taxonomic keys.	CLO ₃	30
Unit-IV	Statistical analysis of data using manual and computer software methods a. Mean, mode & Median b. Standard deviation and S.E. c. Coefficient of correlation d. Diversity Indices e. Test of Significance (Student's t - test)	CLO ₄	30
Total Contact Hours			120
Evaluation Methods			
Internal Assessment:30	MM-30	End Term Examination: 70	MM- 70
Class Participation:	5	Lab record	10
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
Mid-Term Exam:	15	Write-up and execution of the practical	40
Part C-Learning Resources			
Recommended Books/Journals/ e-resources/ Learning Management Systems (LMS):			
Instructions			
1. Verma, P. S. (2010). <i>A Manual of Practical Zoology: Invertebrates</i>. New Delhi: S. Chand Publishing. ISBN: 9788121908290. 2. Jordan, E. L., & Verma, P. S. (2019). <i>Invertebrate Zoology</i> (15th ed.). New Delhi: S. Chand Publishing. A standard textbook covering classification, morphology, anatomy, and biology of all major invertebrate phyla. 3. Sundar Rao, P. S. S., & Richard, J. (2012). <i>An Introduction to Biostatistics: A Manual for Students in Health Sciences</i> (4th ed.). New Delhi: Prentice-Hall of India. 4. Kapoor, V. C. (2019). <i>Theory and Practice of Animal Taxonomy</i>. New Delhi: S. Chand Publishing. 5. Sokal, R. R., & Rohlf, F. J. (2012). <i>Biometry: The Principles and Practice of Statistics in Biological Research</i> (4th ed.). New York: W. H. Freeman and Company.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs) & Program Specific Outcomes (PSOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	-	2	2	2	2	2	-	3	2	2	2
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	2	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	2	3
CLO ₄	3	3	2	3	2	3	3	3	3	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	22
Entrepreneurship	5
Skill Enhancement	40
Communication Development	6
Indian Knowledge System	3
Environmental Awareness/SDGs	12
Current Issues and Social Awareness	8
Gender issues	2
Public policies	7
Any Other	15

Part A - Introduction			
Name of Programme	M.Sc. Zoology		
Semester	1st		
Nature of Course/Course Composition	Theory (Lecture + Tutorial)		
Nomenclature of the Course	SEMINAR		
Course Code	26L6.0-ZOO-107		
Course Type	SEMINAR		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO ₁	By the end of the seminar, students will be able to demonstrate a clear understanding of the core concepts, theories, and current developments related to the seminar topic, connecting them to broader disciplinary knowledge.	
	CLO ₂	Students will be able to present, discuss, and critically analyze ideas in a structured manner, applying seminar learnings to practical or research-oriented contexts, and engaging effectively in academic dialogue.	
	Theory	Practical	Total
Credits	0	2	2
Teaching Hours per week	0	2	2
Internal Assessment Marks	0	50	50
End Term Exam Marks	0	0	0
Max. Marks	50	0	50
Examination Duration (in Hours)	-		
Part B- Contents of the Course			
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters as decided by staff council of the department. There will be no external examination/ viva-voce examination.			
General Instructions: The seminar will be delivered before the students and teachers of the department. A three-member committee (one coordinator and two teachers of the department) duly approved by the departmental council will be constituted to evaluate the seminar.			

Part A - Introduction			
Name of Subject	M.Sc. Zoology		
Semester	II nd		
Nature of Course	Theory		
Nomenclature of the Course	Structure and Function of Vertebrates		
Course Code	26L6.0-ZOO-201		
Course Type	CC-5		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO ₁	Students will be able to understand various biological functions, the evolution of life from most primitive to most advanced form with respect to their habit and habitat.	
	CLO ₂	Acquire basic concepts, external morphology and sexual dimorphism in chordates and understand the various systems, adaptation and dentition in chordates.	
	CLO ₃	Analyze and differentiate the major classes of phylum Chordata—Pisces, Reptilia, Aves, and Mammalia—based on their diagnostic features, structural adaptations, and evolutionary significance.	
	CLO ₄	Recognize and appreciate the diversity of vertebrates in their surroundings, identifying representative groups and relating their structural and ecological adaptations to everyday environment.	
	Theory	Tutorial	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	3		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Origin of Chordates, Protochordata, hemichordate & urochordata Classification of Vertebrates upto orders, Vertebrate integument and its derivatives: Development, general	CLO ₁	15

	structure and functions of skin and its derivatives, Glands, scales, horns, claws, nails, hoofs, feathers and hairs Skeletal system: Types, function, body size and skeletal elements of the body, Comparative account of jaw suspensorium, Vertebral column, Limbs and girdles.		
II	Digestive system: Comparative account of Dentition, Stomach, Digestive organs & Glands Respiratory system: Characteristics of respiratory tissue, Internal and External Respiration, Comparative account of respiratory organs.	CLO ₂	15
III	General plan & types of circulation in various groups, Blood, Evolution of heart, Evolution of aortic arches, and Portal systems , Evolution of Urinogenital system in vertebrate series.	CLO ₃	15
IV	Nervous system, Comparative anatomy of nervous system in relation to its functions, Comparative anatomy of brain & spinal cord, Nerves-Cranial, Peripheral and Autonomous nervous systems, Sense organs, Simple receptors, Organs of Olfaction and taste, Lateral line system, Electroreception.	CLO ₄	15
	Total Contact hours		60
Evaluation Methods			
Internal Assessment: 30 Marks		End Term Examination: 70 Marks	
• Class Participation:	5	Written Examination: 70	
• Seminar/presentation/assignment/quiz/ class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/Journals/ e-resources/ Learning Management Systems (LMS):			
Instructions			
1. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinburgh.			
2. Bourne, G.H. The structure and functions of nervous tissue. Academic Press, New York.			
3. Carter, G.S. Structure and habit in vertebrate evolution - Sedgwick and Jackson, London.			
4. Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates. Central Book Depot, Allahabad.			
5. Kent, C.G. Comparative anatomy of vertebrates.			
6. Milton Hilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.			
7. Sedgwick, A. A Students Text Book of Zoology, Vol. II.			
8. Torrey, T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York and London.			
9. Walters, H.E. and Sayles, L.D. Biology of vertebrates. MacMillan & Co., New York.			
10. Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn. McGraw Hall Book Co., New York.			
11. Messers, H.M. An introduction of vertebrates anatomy.			
12. Montagna, W. Comparative anatomy. John Wiley and Sons Inc.			
13. Andrews, S.M. Problems in vertebrate evolution. Academic Press, New York.			
14. Kotpal, R.L. Vertebrates. Rastogi Publication, Delhi.			

**Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)
& Program Specific Outcomes (PSOs)**

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	-	2	2	2	2	2	-	3	2	2	2
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	2	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	2	3
CLO ₄	3	3	2	3	2	3	3	3	3	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	7
Entrepreneurship	2
Skill Enhancement	10
Communication Development	2
Indian Knowledge System	2
Environmental Awareness/SDGs	3
Current Issues and Social Awareness	3
Gender issues	1
Public policies	2
Any Other	3

Part A - Introduction			
Name of Subject	M.Sc. Zoology		
Semester	II nd		
Nature of Course	Theory		
Nomenclature of the Course	Population Genetics and Evolution		
Course Code	26L6.0-ZOO-202		
Course Type	CC-6		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO ₁	To provide students with basic insight about the mechanism of evolution and to enable them to relate different forms of life on our planet. It will also provide them with in-depth knowledge about the changing frequency and distribution of alleles within the population.	
	CLO ₂	Acquire a clear understanding of genetic equilibrium in natural populations.	
	CLO ₃	To know about the genetics of quantitative traits in populations.	
	CLO ₄	Detail understanding of molecular phylogenetics and methods of construction of phylogenetic tree.	
	Theory	Tutorial	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	3		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u>			
The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Concepts of Mendelian Populations: Introduction to qualitative and quantitative traits, Comparative analysis of Mendelian inheritance and polygenic inheritance patterns, discontinuous and continuous variation, heritability (broad-sense and narrow-sense). Gene pool, gene/allele frequencies, and genotype frequencies. Hardy-Weinberg Equilibrium (HWE): Hardy-Weinberg law of genetic equilibrium. A detailed account of destabilizing forces: (i) Natural selection, (ii) Mutation,	CLO ₁	15

	(iii) Genetic drift, (iv) Migration, (v) Meiotic drive.		
II	Mutation: Mutation rates, mutation-selection balance, and the fate of new mutations. Natural Selection: Types of selection (directional, stabilizing, disruptive), fitness components, selection coefficients, and overdominance (heterozygote advantage). Genetic Drift: Stochastic processes, effective population size, population bottlenecks, and founder effects. Gene Flow: Migration rates, island and stepping-stone models, and the Wahlund effect.	CLO ₂	15
III	Genetics of speciation: Concept of species, Patterns and mechanisms of reproductive isolation, Modes of speciation (Allopatric, Sympatric, Parapatric, Peripatric); Molecular Evolution: Gene Evolution, Evolution of gene families, Molecular drive, Assessment of molecular variations; Origin of higher categories: Phylogenetic gradualism and punctuated equilibrium, Major trends in the origin of higher categories, Micro-and Macro-evolution	CLO ₃	15
IV	Molecular phylogenetics: Concept of phylogenetic trees, Methods of construction of Phylogenetic trees; Population genetics and ecology: Metapopulations, Monitoring Natural Populations, Population size and extinction, Measuring Genetic Variation: Polymorphism, heterozygosity, nucleotide diversity, and molecular markers (SNPs, RFLPs, microsatellites). Loss of genetic variations, Conservation of genetic resources in diverse taxa.	CLO ₄	15
	Total Contact hours		60
Evaluation Methods			
Internal Assessment: 30 Marks		End Term Examination: 70 Marks	
• Class Participation:	5	Written Examination: 70	
• Seminar/presentation/assignment/quiz/ class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/Journals/ e-resources/ Learning Management Systems (LMS):			
Instructions			
1. John H. Gillespie, <i>Population Genetics: A Concise Guide</i> (2nd Ed.), 2004, Johns Hopkins University Press.			
2. Futuyama, D.J. <i>Evolutinary Biology</i> , Suinuaer Associates, INC Publishers, Dunderland			
3. Daniel L. Hartl, <i>A Primer of Population Genetics and Genomics</i> (4th Ed.), 2020, Oxford University Press.			
4. Alan R. Templeton, <i>Population Genetics and Microevolutionary Theory</i> (2nd Ed.) 2021, Wiley-Blackwell			
5. Daniel M. Weinreich, <i>The Foundations of Population Genetics</i> , 2023, MIT Press..			

6. Merrel, D.J. Evolution and Genetics. Holt, Rinehart and Winston, Inc.
7. Smith, J.M. Evolutionary Genetics. Oxford University Press, New York.
8. Strikberger, M.W. Evolution. Jones and Bartett Publishers, Boston London.
9. Genetics: A Conceptual Approach, Benjamin A. Pierce, Vol-4th, W. H. Freeman.
10. Matthew B. Hamilton, *Population Genetics* (2nd Ed.), 2021, Wiley-Blackwell.

**Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)
& Program Specific Outcomes (PSOs)**

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	3	-	2	2	2	2	2	-	3	2	2	2
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	2	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	2	3
CLO ₄	3	3	2	3	2	3	3	3	3	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	7
Entrepreneurship	2
Skill Enhancement	10
Communication Development	2
Indian Knowledge System	2
Environmental Awareness/SDGs	4
Current Issues and Social Awareness	3
Gender issues	1
Public policies	3
Any Other	4

Part A - Introduction			
Name of Subject	M.Sc. Zoology		
Semester	II nd		
Nature of Course	Theory		
Nomenclature of the Course	Comparative Physiology		
Course Code	26L6.0-ZOO-203		
Course Type	CC-7		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs ₁) After completing this course, the learner will be able to:	CLO ₁	Analyze comparative mechanisms of feeding, digestion, absorption, and respiration across animal groups, including physiological responses to oxygen deficiency.	
	CLO ₂	Evaluate thermoregulatory strategies, circulatory systems, receptor physiology, and muscle contractile mechanisms across phylogenetic groups.	
	CLO ₃	Assess comparative reproductive physiology, neuronal structure and synaptic transmission, diversity of neurotransmitters, and physiological adaptations to environmental stressors.	
	CLO ₄	Explain and evaluate the principles of synaptic transmission, diversity of neurotransmitters, and physiological adaptations to environmental stressors, including acclimatization, acclimation, and stress regulatory mechanisms.	
	Theory	Tutorial	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	3		
Part B- Contents of the Course			
<u>Instructions for Paper- Setter:</u> The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Digestion: Feeding mechanisms and regulation, Comparative physiology of digestion and absorption in different animal groups, Respiration: Respiratory organs, Types of respiration, mechanism of breathing,	CLO ₁	15

	Transport of respiratory gases, Respiratory pigments through different phylogenetic groups, Physiological response to oxygen deficient stress. Excretion: Patterns of nitrogen excretion among different animal groups, Functional anatomy of renal unit; mechanisms of ultrafiltration, Counter Current mechanism, Dialysis; Osmoregulation in different animal groups: Definition and basic classification of organisms on the basis of osmoregulation, Osmotic challenges of different environments Mechanism of Osmoregulation in fresh water, Estuarine and Marine animals, Osmoregulation in migratory organisms, Control and regulation of osmoregulation		
II	Thermoregulation: Homeothermic animals, Poikilotherms, Hibernation and Aestivation, Physical, chemical, neural regulation, Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature; Circulation of body fluids and their regulation among different animal groups: Systems of circulation, heart beat and blood pressure, Cardiac cycle, Cardiac output and its regulation, Lymphatic system ; Receptor physiology – a comparative study of Mechanoreception, Photoreception, Chemoreception and Equilibrium reception; Muscle and Contractile physiology: Contractile elements, cells and tissues among different phylogenetic groups; Muscle structure and function-correlation; Electric organs and tissues	CLO ₂	15
III	Comparative testicular physiology in animals: Morphology, Differentiation, Function and its regulation; Comparative ovarian physiology and differentiation in vertebrates: Morphology, Endocrinology, Oogenesis vitellogenesis; Neuronal physiology: Structure and classification of neurons and glial cells, Synaptic action, dendritic properties and functional operation of spinal cord, Brain stem, Autonomic nervous system.	CLO ₃	15
IV	Principles of synaptic transmission: Ca ²⁺ and transmitter release; post synaptic transmission mechanism, diversity of neurotransmitters: acetylcholine, catecholamine, serotonin, GABA, glycine, histamine, peptides, NO, and opioids; Physiological adaptations to different environments: Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature, physiological adaptation at high altitude and in deep sea environment; Stress Physiology Concept of Stress and Strain, Stress hormones and stress regulatory mechanisms.	CLO ₄	15

	Total Contact hours		60
Evaluation Methods			
Internal Assessment: 30 Marks		End Term Examination: 70 Marks	
• Class Participation:	5	Written Examination: 70	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		
Part C-Learning Resources			
Recommended Books/Journals/ e-resources/ Learning Management Systems (LMS):			
Instructions			
1. Hammond, C. (2024). <i>Cellular and molecular neurophysiology</i> (5th ed.). Elsevier.			
2. Bowers, M. R., Shields, M. C., & Reist, N. E. (2026). Synaptic transmission. In E. Carafoli & C. M. Sanders (Eds.), <i>Cell physiology source book</i> (5th ed., pp. 589–614). Academic Press. https://doi.org/10.1016/B978-0-12-823420-7.00025-4 .			
3. Mavroudis, I. (Ed.). (2025). <i>Synaptic plasticity: Neurobiology, neuroanatomy, and clinical neuroscience</i> . IntechOpen. https://doi.org/10.5772/intechopen.1003581 .			
4. Hill, R. W., Wyse, G. A., & Anderson, M. (2022). <i>Animal physiology</i> (5th ed.). Sinauer Associates — Covers comparative physiology including respiration, osmoregulation, and thermoregulation.			
5. Randall, D., Burggren, W., & French, K. (2019). <i>Eckert animal physiology: Mechanisms and adaptations</i> (7th ed.). Cambridge University Press. — A classic updated text on environmental adaptations and stress physiology.			
6. Bear, M. F., Connors, B. W., & Paradiso, M. A. (2021). <i>Neuroscience: Exploring the brain</i> (5th ed.). Wolters Kluwer. — Comprehensive coverage of neurotransmitters and synaptic mechanisms.			
7. McEwen, B. S., & Akil, H. (2022). <i>Stress: Concepts, cognition, emotion, and behavior</i> (2nd ed.). Academic Press. — Focuses on stress physiology, hormones, and regulatory mechanisms.			
8. Prosser, C. L. (2023). <i>Comparative animal physiology</i> (updated ed.). Wiley. — Discusses adaptations in high altitude, deep sea, and temperature stress environments.			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs) & Program Specific Outcomes (PSOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	3	-	2	2	2	2	2	-	3	2	2	2
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	2	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	2	3
CLO ₄	3	3	2	3	2	3	3	3	3	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	8
Entrepreneurship	2
Skill Enhancement	10
Communication Development	2
Indian Knowledge System	2
Environmental Awareness/SDGs	4
Current Issues and Social Awareness	3
Gender issues	2
Public policies	2
Any Other	4

Part A - Introduction			
Name of Subject	M.Sc. Zoology		
Semester	II nd		
Nature of Course	Theory		
Nomenclature of the Course	Population and Community Ecology		
Course Code	26L6.0-ZOO-204		
Course Type	CC-8		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO ₁	Students will be able to understand and explain the need for intra- and interdisciplinary cooperation in researching different ecosystems.	
	CLO ₂	Students will understand all the biotic and abiotic factors that are related to individual, population, community and ecosystem and define the relationships between them.	
	CLO ₃	Information provided will give an insight about the benefits of the ecosystem and can be used in the management of natural resources for sustainable development in ways that leave the environment healthy.	
	CLO ₄	Many specialties within ecology such as marine, vegetation and statistical ecology provides students information to better understand the environment around them.	
	Theory	Tutorial	Total
Credits	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Duration (in Hours)	3		
Part B- Contents of the Course			
Instructions for Paper- Setter: The paper setter shall prepare 9 questions selecting two questions from each unit with consideration given to the Course Learning Outcomes. Among these, question number 1 will be compulsory, comprising 7 short answer type questions carrying two marks each (total 14 marks) and covering the entire syllabus. The remaining questions will be carrying 14 marks each. Examinees will be required to attempt five questions: the compulsory question no. 1 and 1 question from the each of the four units.			
Unit	Topics	CLO/s Attempt	Contact Hours
I	Basic Concepts: Definition, Scope and Significance of Ecology, Concept of biosphere, atmosphere, litho sphere and hydrosphere; Organizational level of ecological systems, Ecological aspects of abiotic, biotic and edaphic factors, limiting factors; Ecosystem: Concept,	CLO ₁	15

	Kinds and components; Ecological energetic and energy flow: Food chains, food webs, trophic structure; concept of productivity: primary, secondary, gross and net, Energy flow models.		
II	Restoration Ecology Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems; Population characteristics: Introduction and concepts of population ecology, Attributes of populations, Population density, methods of population density measurement, Growth rate and growth forms, Natality, mortality, survivorship curves and life tables, Biotic potential – Generation time, net reproductive rate reproductive values, Population distribution, Population dispersion	CLO ₂	15
III	Population regulation and Interactions; Extrinsic and intrinsic mechanisms, Concept of density dependent and density independent factors in population regulation, Concept of intra specific and inter specific population interactions, Protocooperation, mutualism and commensalisms, Host-parasite interactions, Life history strategies – r and k selection; Competition and niche theory: Intraspecific and inter specific interactions, History of niche concepts, Gause’s theory of niche	CLO ₃	15
IV	Predation: Theory; predator-prey oscillations, Model of prey – predatory dynamics, Role of predation in nature, Parasitism; Community characteristics: Species diversity; Biodiversity indices: Diversity, dominance, Similarity& dissimilarity Index, Ecological Succession, Ecological dominance, Ecotones and Edge effect; Ecological Impact Assessment	CLO ₄	15
	Total Contact hours		60
Evaluation Methods			
Internal Assessment: 30 Marks		End Term Examination: 70 Marks	
• Class Participation:		5	Written Examination: 70
• Seminar/presentation/assignment/quiz/ class test etc.:		10	
• Mid-Term Exam:		15	
Part C-Learning Resources			
Recommended Books/Journals/ e-resources/ Learning Management Systems (LMS):			
Instructions			
1. Begon, M., Townsend, C. R., & Harper, J. L. (2021). <i>Ecology: From individuals to</i>			

ecosystems (5th ed.). Wiley-Blackwell.

2. Canter, L. W. (1996). *Environmental impact assessment* (2nd ed.). McGraw-Hill.
3. Gaston, K. J., & Spicer, J. I. (2013). *Biodiversity: An introduction* (2nd ed.). Wiley-Blackwell.
4. Odum, E. P., & Barrett, G. W. (2005). *Fundamentals of ecology* (5th ed.). Cengage Learning.
5. Sharma, P. D. (2022). *Ecology and environment* (14th ed.). Rastogi Publications.
6. Smith, T. M., & Smith, R. L. (2015). *Elements of ecology* (9th ed.). Pearson.
7. Southwood, T. R. E., & Henderson, P. A. (2009). *Ecological methods* (3rd ed.). Wiley-Blackwell.
8. Van Andel, J., & Aronson, J. (2012). *Restoration ecology: The new frontier* (2nd ed.). Wiley-Blackwell.
9. Vandermeer, J. H., & Goldberg, D. E. (2013). *Population ecology: First principles* (2nd ed.). Princeton University Press.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs) & Program Specific Outcomes (PSOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	2	3	2	2	2	3	2	2	2	3	2	2	2
CLO ₂	3	2	1	3	1	2	3	3	2	2	1	3	3	2	3
CLO ₃	3	3	2	3	1	3	3	3	3	3	2	3	3	3	3
CLO ₄	3	3	2	3	2	3	3	3	3	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	7
Entrepreneurship	2
Skill Enhancement	10
Communication Development	2
Indian Knowledge System	2
Environmental Awareness/SDGs	5
Current Issues and Social Awareness	3
Gender issues	1
Public policies	3
Any Other	3

Part A – Introduction			
Name of the Programme	M.Sc. Zoology		
Semester	2 nd Sem		
Nature of Course/Course Composition	Practical		
Nomenclature of the Course	Practical based on 24L6.0-ZOO-201 & 24L6.0-ZOO-202		
Course Code	24L6.0-ZOO-205		
Course Type	PC-3		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO ₁	Demonstrate and classify major organ systems and chordate museum specimens.	
	CLO ₂	Compare skeletal elements and integumentary structures across vertebrate groups.	
	CLO ₃	Construct phylogenetic trees and explain genetic principles with models and photographs.	
	CLO ₄	Interpret evolutionary ancestry and origins of vertebrate and invertebrate groups using charts and museum visits.	
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
Instructions for Examiner:			
Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO/s Attempt	Contact Hours
Unit-I	Demonstration of cranial nerves and aortic arches of Scoliodon, Digestive system, Nervous system, Arterial and venous system of frog, Lizard, Pigeon and rabbit. Museum specimens and slides : (i) Protochordates (ii) Fishes (iii) Amphibians (iv) Reptiles (v) Birds (vi) Mammals	CLO ₁	30
Unit-II	Comparative Osteology (i) Skull and lower jaw (ii) Vertebrae (iii) Girdles	CLO ₂	30

	(iv) Limb bones Temporary/Permanent mounts of Hair & Scales Different types of Feathers, Scales & Hair		
Unit-III	Construction of Phylogenetic tree Demonstration of monohybrid and dihybrid cross, Co-dominance, Incomplete dominance and Epistasis with the help of beads and photographs. Study of genetic disorders with the help of photographs. Study of structural and numerical alteration of chromosomes: deletion, substitution, duplication etc	CLO ₃	30
Unit-IV	Study of ancestry of man, horse, camel and elephant through charts/models. Visit to a Fossil park/Geology and Anthropology museums. Study of origin of invertebrate and vertebrate groups through charts.	CLO ₄	30
Total Contact Hours			120
Evaluation Methods			
Internal Assessment:30	MM-30	End Term Examination: 70	MM- 70
Class Participation:	5	Lab record	10
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
Mid-Term Exam:	15	Write-up and execution of the practical	40
Part C-Learning Resources			
Recommended Books/Journals/ e-resources/ Learning Management Systems (LMS):			
Instructions			
1. Paululat, A., & Purschke, G. (2025). <i>Metazoa: Morphology and evolution of animals – A practical guide to the dissection and comparative study of animals</i>. Springer Nature. 2. Romer, A. S., & Parsons, T. S. (1986). <i>The vertebrate body</i> (6th ed.). Saunders College Publishing. 3. Hildebrand, M., & Goslow, G. E. (2001). <i>Analysis of vertebrate structure</i> (5th ed.). Wiley. 4. Gupta, P. K. (2018). <i>Cytogenetics</i> (3rd ed.). Rastogi Publications. 5. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2015). <i>Molecular biology of the cell</i> (6th ed.). Garland Science. 6. Wilson, K., & Walker, J. (2010). <i>Principles and techniques of biochemistry and molecular biology</i> (7th ed.). Cambridge University Press. 7. Futuyma, D. J. (2017). <i>Evolution</i> (4th ed.). Sinauer Associates. 8. Benton, M. J. (2015). <i>Vertebrate palaeontology</i> (4th ed.). Wiley-Blackw			

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs) & Program Specific Outcomes (PSOs)

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	2	-	2	2	2	2	2	-	3	2	2	2
CLO ₂	3	2	1	3	1	2	3	2	2	2	1	3	3	2	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	2	3
CLO ₄	3	3	2	3	2	3	3	3	3	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	25
Entrepreneurship	5
Skill Enhancement	40
Communication Development	6
Indian Knowledge System	4
Environmental Awareness/SDGs	10
Current Issues and Social Awareness	8
Gender issues	3
Public policies	7
Any Other	12

Part A – Introduction			
Name of the Programme	M.Sc. Zoology		
Semester	2 nd Sem		
Nature of Course/Course Composition	Practical		
Nomenclature of the Course	Practical based on 24L6.0-ZOO-203 & 24L6.0-ZOO-204		
Course Code	24L6.0-ZOO-206		
Course Type	PC-4		
Course Level	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	CLO ₁	Analyze pond and grassland ecosystems by assessing abiotic components (DO, pH, CO ₂ , salinity, transparency, alkalinity, hardness) and biotic interactions.	
	CLO ₂	Apply field methods to identify biota in aquatic, forest, and other ecosystems, estimate biodiversity indices, and measure population density.	
	CLO ₃	Demonstrate tissue preparation, microtomy, cryo techniques, fixation, and histochemical staining methods for structural and functional analysis of cells and gametes.	
	CLO ₄	Evaluate enzyme activity under varying conditions (pH, temperature, concentration), perform vitamin assays, and conduct hematological tests (RBC, WBC counts, plasma estimation).	
	Theory	Practical	Total
Credits	0	4	4
Teaching hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Duration (in Hours)	0	03	
Part B- Contents of the Course			
Instructions for Examiner: Write-up and execution of the practical will be conducted as per the nature of the practical by the external examiner, with consideration given to the Course Learning Outcomes.			
Unit	Topics	CLO/s Attempt	Contact Hours
Unit-I	Study of various components of pond and grassland ecosystem. Determination of Water quality characteristics viz: Dissolved oxygen, pH, free carbon dioxide, salinity, transparency, alkalinity and hardness.	CLO ₁	20
Unit-II	Field Visit to Aquatic, Forest and other ecosystems for identification of biota. Estimation of biodiversity indices. Methods of population density measurements.	CLO ₂	20

Unit-III	Preparation of tissues for microtomy and demonstration of cryo techniques Histochemistry: Methods of fixation of different tissues. Histochemical test: (a) Haemotoxylin-eosin (b) Toluidine Blue (c) Sudan Block-B (d) Mercury bromophenol blue (e) Methyl green-pyronin-Y (f) Periodic acid Schiff's (g) Acid phosphatase (h) Alkaline phosphatase Demonstration of live gametes and their staining procedure.	CLO ₃	40
Unit-IV	Determination of optimum pH, temperature and concentration for optimum activity of salivary amylase To demonstrate that the optimum activity of trypsin enzyme is pH temperature dependent. Qualitative test of vitamins and Quantification of vitamin A and C. Total RBC, WBC and Different WBC count Estimation of Blood plasma	CLO ₄	40
Total Contact Hours			120
Evaluation Methods			
Internal Assessment:30	MM-30	End Term Examination: 70	MM- 70
Class Participation:	5	Lab record	10
Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Viva-Voce	20
Mid-Term Exam:	15	Write-up and execution of the practical	40
Part C-Learning Resources			
Recommended Books/Journals/ e-resources/ Learning Management Systems (LMS):			
Instructions			
1. Campbell, N. A., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Reece, J. B. (2026). <i>Campbell biology</i> (12th ed.). Pearson. 2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2025). <i>Molecular biology of the cell</i> (7th ed.). Garland Science. 3. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Martin, K. C. (2026). <i>Molecular cell biology</i> (10th ed.). W. H. Freeman. 4. Nelson, D. L., Cox, M. M., & Lehninger, A. L. (2026). <i>Lehninger principles of biochemistry</i> (9th ed.). W. H. Freeman. 5. Trinder, C. J. (2026). <i>Interpreting ecological data: Exercises for undergraduates</i>. CRC Press. 6. Jana, B. B. (2026). <i>Aquatic sciences in the tropics: Inland waters, domain and nutrient geochemistry</i>. CRC Press. 7. Taneja, J., & Bhardwaj, P. (2026). <i>Laboratory manual of reproductive biology and assisted reproductive technologies: A practical hands-on guide for undergraduate students</i>. CRC Press. 8. Ijaz, S., Ul Haq, I., & Ali, H. M. (2026). <i>Barcoding life: For exploring and protecting biodiversity</i>. CRC Press.			

**Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)
& Program Specific Outcomes (PSOs)**

CLOs	PLO ₁	PLO ₂	PLO ₃	PLO ₄	PLO ₅	PLO ₆	PLO ₇	PLO ₈	PLO ₉	PLO ₁₀	PLO ₁₁	PSO ₁	PSO ₂	PSO ₃	PSO ₄
CLO ₁	3	2	1	3	1	2	2	3	2	2	1	3	3	2	2
CLO ₂	3	3	2	3	2	3	3	3	3	2	2	3	3	3	3
CLO ₃	3	3	2	3	1	3	3	3	3	2	2	3	3	3	3
CLO ₄	3	3	2	3	2	3	3	3	3	3	2	3	3	3	3

Content Mapping with NEP thrust areas

Field	Hours devoted
Employability	20
Entrepreneurship	5
Skill Enhancement	45
Communication Development	5
Indian Knowledge System	4
Environmental Awareness/SDGs	12
Current Issues and Social Awareness	8
Gender issues	3
Public policies	8
Any Other	10