Ch. Ranbir Singh University, Jind

Scheme of Examination
for
Post Graduate Programme

M.Sc. ZOOLOGY

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2025-26 (in phased manner)

DEPARTMENT OF ZOOLOGY
FACULTY OF LIFE SCIENCES

CH. RANBIR SINGH UNIVERSITY, JIND

Programme Learning Outcomes (PLOs) for M.Sc. Zoology as per NEP-2020

PLOs	Master Degree in Zoology
After the completion of Master degree in Zoology the student will be able to:	
PLO-1: Knowledge and Understanding	Demonstrate the fundamental and advanced knowledge of the subject and understanding of recent developments and issues, including methods and techniques, related to the **Zoology**.
PLO-2: General Skills	Acquire the general skills required for performing and accomplishing the tasks as expected to be done by a skilled professional in the fields of **Zoology**.
PLO-3: Technical/ Professional Skills	Demonstrate the learning of advanced cognitive technical/professional skills required for completing the specialized tasks related to the profession and for conducting and analyzing the relevant research tasks in different domains of the **Zoology**.
PLO-4: Communication Skills	Effectively communicate the attained skills of the **Zoology** in well-structured and productive manner to the society at large.
PLO-5: Application of Knowledge and Skills	Apply the acquired knowledge and skills to the problems in the subject area, and to identify and analyze the issues where the attained knowledge and skills can be applied by carrying out research investigations to formulate evidence-based solutions to complex and unpredictable problems associated with the field of **Zoology** or otherwise.
PLO-6: Critical thinking and Research Aptitude	Attain the capability of critical thinking in intra/inter-disciplinary areas of the **Zoology** enabling to formulate, synthesize, and articulate issues for designing of research proposals, testing hypotheses, and drawing inferences based on the analysis.
PLO-7: Constitutional, Humanistic, Moral Values and Ethics	Know constitutional, humanistic, moral and ethical values, and intellectual property rights to become a scholar/professional with ingrained values in expanding knowledge for the society, and to avoid unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
PLO-8: Capabilities/qualities and mindset	To exercise personal responsibility for the outputs of own work as well as of group/team and for managing complex and challenging work(s) that requires new/strategic approaches.
PLO-9: Employability and job-ready skills	Attain the knowledge and skills required for increasing employment potential, adapting to the future work and responding to the rapidly changing demands of the employers/industry/society with time.

CH. RANBIR SINGH UNIVERSITY, JIND

Scheme of Examination for Postgraduate Programme Zoology

as per NEP 2020 Curriculum and Credit Framework for Postgraduate Programmes (CBCS LOCF) with effect from the session 2025-26 (in phased manner)

Framework-2

Scheme-P

Semester	Course Type	Course Code	Nomenclature of Course	Theory (T)/ Practical (P)	Credits		Contact hours per week L: Lecture P: Practical S: Seminar				Internal Assessment Marks	End Term Examination Marks	Total Marks	Examination hours
						Total	L	S	P	Total				
1	CC-1	M24-ZOO-101	Cell Biology	T	4	26	4	0	0	4	30	70	100	3
	CC-2	M24-ZOO-102	Biochemistry and Bio-techniques	T	4		4	0	0	4	30	70	100	3
	CC-3	M24-ZOO-103	Biosystematics and Biostatistics	T	4		4	0	0	4	30	70	100	3
	CC-4	M24-ZOO-104	Biology of Invertebrates	T	4		4	0	0	4	30	70	100	3
	PC-1	M24-ZOO-105	Practical based on Papers M24-ZOO-101 & M24-ZOO-102	P	4		0	0	8	8	30	70	100	4
	PC-2	M24-ZOO-106	Practical based on Papers M24-ZOO-103 & M24-ZOO-104	P	4		0	0	8	8	30	70	100	4
	SEMINAR	M24-ZOO-107	Seminar	S	2		0	2	0	2	0	50	50	1
2	CC-5	M24-ZOO-201	Population and Community Ecology	T	4	26	4	0	0	4	30	70	100	3
	CC-6	M24-ZOO-202	Comparative Physiology	T	4		4	0	0	4	30	70	100	3
	CC-7	M24-ZOO-203	Population Genetics & Evolution	T	4		4	0	0	4	30	70	100	3
	CC-8	M24-ZOO-204	Biology of Vertebrates	T	4		4	0	0	4	30	70	100	3
	PC-3	M24-ZOO-205	Practical based on Papers M24-ZOO-201 & M24-ZOO-202	P	4		0	0	8	8	30	70	100	4

	PC-4	M24-ZOO-206	Practical based on Papers M24-ZOO-203 & M24-ZOO-204	P	4		0	0	8	8	30	70	[illegible]	[illegible]
	CHM	M24-CHM-201	Constitutional, Human and Moral values, and IPR	T	2		2	0	0	2	15	35	50	3
	Internship	M24-INT-200	AN INTERNSHIP COURSE OF 4 CREDITS OF 4-6 WEEKS DURATION DURING SUMMER VACATION AFTER IIND 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	-
	CC-9	M24-ZOO-301	Molecular Biology	T	4		4	0	0	4	30	70	100	3
	CC-10	M24-ZOO-302	Molecular Endocrinology	T	4		4	0	0	4	30	70	100	3
	DEC-1	M24-ZOO-303	Applied Zoology	T	4		4	0	0	4	30	70	100	3
	DEC-2 Any one from M24-ZOO-304/305/306	M24-ZOO-304	Molecular Reproduction-I	T	4	26	4	0	0	4	30	70	100	3
		M24-ZOO-305	Animal Behaviour & Wildlife Conservation-I	T	4		4	0	0	4	30	70	100	3
		M24-ZOO-306	Fish, Fisheries and Aquaculture-I	T	4		4	0	0	4	30	70	100	3
3	PC-5	M24-ZOO-307	Practical based on Papers M24-ZOO-301 to M24-ZOO-303	P	4		0	0	8	8	30	70	100	4
	PC-6	M24-ZOO-308	Practical based on Papers M24-ZOO-304/ M24-ZOO-305/ M24-ZOO-306	P	4		0	0	8	8	30	70	100	4
	OEC	FOR ZOOLOGY STUDENTS					Course to be opted from the Pool of OEC course other than the ones offered by Zoology Department							
	OEC (To be offered to the students of other departments)	M24-OEC-352	Animal Diversity & Conservation	T	2		2	0	0	2	15	35	50	3

4	CC-11	M24-ZOO-401	Developmental Biology	T	4	26	4	0	0	4	30	70	100	3
	CC-12	M24-ZOO-402	Vertebrate Immunology	T	4		4	0	0	4	30	70	100	3
	DEC-3	M24-ZOO-403	Environmental Toxicology	T	4		4	0	0	4	30	70	100	3
	DEC-4 Any one from M24-ZOO-404/405/406	M24-ZOO-404	Molecular Reproduction-II	T	4		4	0	0	4	30	70	100	3
		M24-ZOO-405	Animal Behaviour & Wildlife Conservation-II	T	4		4	0	0	4	30	70	100	3
		M24-ZOO-406	Fish, Fisheries and Aquaculture-II	T	4		4	0	0	4	30	70	100	3
	PC-7	M24-ZOO-407	Practical based on Papers M24-ZOO-401 to M24-ZOO-403	P	4		0	0	8	8	30	70	100	4
	PC-8	M24-ZOO-408	Practical based on Papers M24-ZOO-404/ M24-ZOO-405/ M24-ZOO-406	P	4		0	0	8	8	30	70	100	4
	EEC	M24-ZOO-409	Entrepreneurship Approaches in Zoology	T	2		2	0	0	2	15	35	50	3
4	**OR DISSERTATION (NOTE: IF A CANDIDATE IS OFFERED DISSERTATION COURSE, THEN HE/SHE WILL ALSO STUDY CC-11, DEC-3, DEC-4 & EEC FROM ABOVE COURSES OF SEMESTER 4)**													
4	Dissertation / Project work	M24-ZOO-410	Dissertation/Project Work	D	12	26	0	0	0	-	0	300	300	-
TOTAL CREDITS						**108**	**TOTAL MARKS**						**2700**	

Ch. Ranbir Singh University, Jind

Syllabus P.G. NEP 2020
(Ist & 2nd Sem)

Scheme of Examination
for
Post Graduate Programme

M.Sc. ZOOLOGY

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Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

DEPARTMENT OF ZOOLOGY
FACULTY OF LIFE SCIENCES

CH. RANBIR SINGH UNIVERSITY, JIND

Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**1**
Name of the Course	**Cell Biology**
Course Code	**M24-ZOO-101**
Course Type	**CC-1**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**
Course Learning Outcomes (CLO)	CLO 1: This core course will make students able to understand how the cell functions as a unit of life. CLO 2: Through this course, students will be able to appreciate the importance of various cell function and structures in the evolution of multicellular organisms. CLO 3: The studies will make the students reveal elegance, dynamics and economy in the living cell and a gratifying unity in the principles by which a cell functions. CLO 4: The students will know about the basic cellular and molecular approaches for cancer development and treatment.

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**1. Biomembranes** 1.1 Molecular composition and arrangement, functional consequences 1.2 Cellular Transport – Recapitulation of the plasma membrane; diffusion, active transport and pumps, uniports, symports and antiports. 1.3 Donnanequilibrium;ionmovementsandcellfunction:acidificationofcellorganelles 1.4 Maintenanceofcellular pH;cellexcitation;bulktransport;Receptor mediatedendocytosis 1.5 Transepithelial transport **2. Cytoskeleton and cell movement** 2.1 Introduction to cytoskeleton and its role 2.2 Molecular structure of Actin, myosin and their organisation 2.3 Structure and dynamic organizations of microtubules and microfilaments 2.4 Microtubule motors and movement 2.5 Intermediate filaments 2.6 Role of Centrioles and basal bodies 2.7 Structure and functions of Cilia and flagella	15
II	3 **The Extra Cellular Matrix and Cell interactions** 3.1 Cell walls 3.2 The ECM and cell-matrix interactions 3.3 Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata 3.4 Ca^{++} dependent and Ca^{++} independent Homophilic cell-cell adhesion 4 **Cell matrix adhesion** 4.1 Integrins 4.2 Collagen 4.3 Non-collagen components	15

	4.4 Auxin and cell expansion 4.5 Cellulose fibril synthesis and orientation 5 **Protein sorting and transport** 5.1 Protein uptake into the ER 5.2 Membrane proteins and Golgi sorting 5.3 Mechanism of vesicular transport 5.4 Lysosomes 5.5 Molecular mechanism of secretory pathway	
III	**6 Cell cycle** 6.1 Eukaryotic cell cycle 6.2 Regulators of cell cycle progression 6.3 Role of Meiosis in Genetic Variation **7 Cell – Cell signaling** 7.1 Signaling molecules and their receptors 7.2 Pathways of intracellular signal transduction **8 Biology of Cancer** 8.1 The development and causes of cancer 8.2 Oncogenès 8.3 Tumor suppressor genes 8.4 Molecular approaches to cancer treatment	15
IV	**9 Genome organization** 9.1 Chromosomal organization of genes 9.2 Transposons in prokaryotes and eukaryotes 9.3 Morphological and functional elements of eukaryotic chromosomes **10 Cell Death** 10.1 Necrosis and Programmed cell death 10.2 Molecular Mechanism 10.3 Applications and Significance **11 Biology of Ageing** 11.1 Morphological, Physiological and Functional changes during Ageing 11.2 Telomeres and Ageing 11.3 Theories of Ageing	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Molecular Cell, Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
3. Cell and molecular biology Phillip Sheeler, Donald E. Bianchi Wiley, 1987
4. Life: The Science of Biology by David Sadava
5. Cell and Molecular Biology by De Robertis
6. Cell Biology by A.K. Berry, EMKAY Publlications
7. Molecular Cell Biology, Lodishet al., W.H. Freeman and Company (8th Ed. 2016)
8. Molecular Biology, Weaver R. F., McGraw-Hill Education (5th Ed. 2011)

Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Zoology**		
Semester	**1**		
Name of the Course	**Biochemistry and Bio-techniques**		
Course Code	**M24-ZOO-102**		
Course Type	**CC-2**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**		
Course Learning Outcomes (CLO)	CLO 1: It will provide the students a basic appreciation of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes. CLO 2: It will make the students to understand the general reactions of various metabolic pathways. CLO 3: Students will be able to explain the principle, working, materials used and applications of various biological techniques that are used to study the basic biological processes. CLO 4: Students will be able to describe the structure and classification of biomolecules.		
Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 **General Principles of Biochemistry and chemical composition of life** 1.1 General Introduction to Biomolecules 2.0 **Protein Biology:** 2.1 Primary, Secondary, tertiary and quaternary structure of proteins: i) Domain, ii) Ramachandran plot and its significance 3.0 **Enzyme:** 3.1 Classification and nomenclature, 3.2 Co-enzymes and Cofactors 3.3 Induced fit and Molecular Mechanism of Enzyme action, 3.4 Enzyme feedback mechanism, Isozymes. 4.0 **Nucleic acids: Structure and Functions** 4.1 DNA structure and functions 4.2 RNA structure and functions, 4.3 DNA choreography 4.4 Qualitative and quantitative estimation of DNA	15
II	5.0 **Metabolism:** 5.1 Glycolysis, citric acid cycles its regulation and role as metabolic hub. 5.2 Hexose monophosphate pathway its regulation and significance. 5.3 Cholesterol biosynthesis, its metabolism and steroidogenesis. 5.4 Bile acids and their metabolism 5.5 Saturated and unsaturated fatty acid and their metabolism.	15
III	6.0 Chemical and Biological assays (*in vitro* and *in vivo* assays). 7.0 Principles and uses of analytical instruments: 7.1 Microscopes and imaging 7.2 Spectrophotometers, 7.3 NMR spectrophotometer 8.0 Microbiological and cell culture Techniques	15

	8.1 Setting of microbiological laboratory, 8.2 Sterilization and Media preparation techniques 8.3 Inoculation and growth monitoring (Standard plate count technique), 8.4 Isolation of a microbial colony and slant preparation. 8.5 Design and functioning of tissue culture laboratory, 8.6 Basics of cell/tissue culture, Culture media preparation, 8.7 Cell proliferation measurements 8.8 Cell viability testing and Cell harvesting methods. 8.9 Biosafety and levels 9.0 **Cryotechniques** : 9.1 Cryopreservation for cells, tissue, organisms, 9.2 Cryotechniques for microscopy.	
IV	10.0 **Separation techniques in biology**. 10.1 Molecular separations by chromatography, electrophoresis, precipitation etc. 10.2 Organelle separation by centrifugation. Density gradient centrifugation Ultra Centrifugation, unit gravity centrifugation, affinity adsorption anchorage based techniques etc. 10.3 Cell separation by flow cytometery and FACS 11.0 **Radioisotope and mass isotope techniques in biology:** 11.1 Carbon dating and radioactive counting 11.2 Autoradiography 11.3 Biosensors 12.0 DNA fingerprinting	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Animal Cell Culture – A practical approach, Ed. John R.W. Masters, IRL Press.
2. Introduction to Instrumental analysis, Robert Braun, McGraw Hill International editions
3. A Biologists guide to Principles and Techniques of Practical Biochemistry, K. Wilson and K.H. Goulding, ELBS Edn.
4. Lehninger AL, Nelson DL & Cox MM (1993) Principles of Biochemistry, 2nd edn. New York: Worth.
5. Stryer L (1995) Biochemistry, 4th edn. New York: WH Freeman.
6. Voet D, Voet JG & Pratt CW (1999) Fundamentals of Biochemistry. New York: Wiley.

Session: 2024-25

Part A – Introduction

Name of Programme	**M.Sc. Zoology**
Semester	**1**
Name of the Course	**Biosystematics and Biostatistics**
Course Code	**M24-ZOO-103**
Course Type	**CC-3**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**
Course Learning Outcomes (CLO)	CLO 1: Knowledge of Taxonomy helps in classifying and identifying biodiversity and biologist study the well understood relationships by making phylogenetic trees. CLO 2: It will help to understand the overall biodiversity of the world and their application in all the fields of biological sciences. CLO 3: Biostatistics helps to generate a hypothesis from a set of observation and then design experiment to test the hypothesis. CLO 4: Able to acquire, analyse and understand the significance of data.

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 Biosystematics and taxonomy: Definition and perspectives, 2.0 Historical resume, Importance and applications of systematics in biology. Concepts of newer aspects of biosystematics: Chemotaxonomy, Cytotaxonomy, Molecular taxonomy. 3.0 Dimensions of speciation and taxonomic characters: 3.1 Different Species concepts – species category 3.2 Sub-species and other intra-specific categories. 4.0 Theories of biological classification, hierarchy of categories. 5.0 Taxonomic characters – different kinds, weighing of characters	15
II	6.0 **Methodology:** 6.1 Taxonomic collections, preservation, curetting process and identification. 6.2 Taxonomic keys-different kinds of taxonomic keys, their merits and demerits. 7.0 **Systematic publications:** 7.1 Different kinds of publications. 7.2 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. 8.0 Principles of Bioethics in Biodiversity	15
III	9.0 **Measures of central value:** 9.1 Arithmetic mean, mode and median, Definition, calculation and its properties. 10.0 **Measures of Dispersion: Range,** 10.1 Interquartile range, 10.2 Quartile deviation. 10.3 Mean deviation and standard deviation, 10.4 Standard error 11.0 **Correlation:** 11.1Types and Methods studying correlation – Scatter diagram method, Graphic	15

	method, Karl Pearson coefficient of correlation, Rank correlation. 12.0 Regression analysis (Regression lines and regression equation) 13.0 Chi-square analysis	
IV	14.0 **Concept of sampling and sampling methods:** 14.1 Definition and law of sampling, 14.2 Judgment sampling, Random sampling, stratified sampling, systematic sampling, multi-stages sampling and quota sampling. 15.0 Test of significance for large samples and small samples (student t-test, F- test; ANOVA). 16.0 Probability and law of probability, Theoretical probability distribution: Binomial distribution, Poison distribution, Normal distribution. 17.0 Components of computers, Basic functioning of computers, Use of Statistical Software in Biology	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. M. Kato. The Biology of Biodiversity, Springer.
2. E.O. Wilson, Biodiversity, Academic Press, Washington.
3. G.G. Simpson, Principle of animal taxonomy, Oxford ISH Publishing Company.
4. E. Mayer, Elements of Taxonomy.
5. E.O. Wilson, The Diversity of Life (The College Edition), W.W. Northerm & Co.
6. S.K. Tikadar, Threatened Animals of India, ZSI Publication, Calcutta.

Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**1**
Name of the Course	**Biology of Invertebrates**
Course Code	**M24-ZOO-104**
Course Type	**CC-4**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**
Course Learning Outcomes (CLO)	CLO 1: The study of invertebrates reveals progressive evolutionary history and adaptations together which forms the basis of huge complex and diverse life forms. CLO 2: Students will acquire a clear understanding about organization of minor phyla and their relationship with other animal phyla CLO 3: Students will be able to know the structure and significance of various systems of Invertebrates CLO 4: Will have detail understanding of adaptations and significance of Invertebrates

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 Introduction to invertebrates with their general characters, Basic body plan, Concept of Invertebrata v/s Vertebrata and Non-Chordata v/s Chordata 2.0 Organization of coelom 2.1 Concept and structure of Acoelomate, Pseudocoelomates and Coelomates. 2.2 Protostomia and Deuterostomia 2.3 Metamerism in Annelida, Pseudometamerism. 3.0 **Minor Phyla:** 3.1 Concept and significance 3.2 Organization and general characters of Acoelomate, Pseudocoelomates and Coelomates minor phyla (with special emphasis on Ctenophora, Rotifera, Endoprocta, Ectoprocta, Phoronida, Sipunculida and Echiuroidea).	15
II	4.0 **Locomotion** 4.1 Flagella and ciliary movement in Protozoa 4.2 Hydrostatic movement in Coelenterata, Annelida and Echinodermata 5.0 **Nutrition and Digestion** 5.1 Patterns of feeding and digestion in lower metazoa 5.2 Filter-feeding in Polychaeta, Mollusca and Echinodermata 6.0 **Respiration** 6.1 Organs of respiration: Gills, lungs, trachea,skin,Cloacal chamber, Buccopharyangeal area etc. 6.2 Respiratory pigments 6.3 Mechanism of respiration	15
III	7.0 **Excretion** 7.1 Organs of excretion: Coelom, coelomoducts, Nephridia and Malpighian tubules. 7.2 Mechanism of excretion and osmoregulation	15

	8.0	**Nervous system** 8.1 Primitive nervous system: Coelenterata and Echinodermata 8.2 Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda). 8.3 Trends in neural evolution. 9.0 Social life in insects, Social life in Isoptera and Hymenoptera	
IV	10.0	**Invertebrate larvae** 10.1 Larval forms of free living invertebrates 10.2 Strategies and Evolutionary significance of larval forms 10.3 Conservation of invertebrates. 11.0 **Introduction to insects** 11.1 Mouthparts of Insects 11.2 Mechanism of insect flight and hovering 11.3 Metamorphosis in insects 11.4 Hormonal control of moulting. 12.0 Economic importance of Invertebrates; Various Adaptations in Invertebrates	15
		Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Hyman, L.H. The invertebrates, Vol. I. Protozoa through Ctenophora, McGraw Hill Co., New York.
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltr J. London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
4. Barnes, R.D. Invertebrate Zoology, IIIrd edition. W.B. Saundrs Co., Philadelphia.
5. Russel-Hunter, W.D. A Biology of higher invertebrates, the Macmillin Co. Ltd. London.
6. Hyman, L.H. the Invertebrates smaller coelomate groups, Vol. V. McGraw Hill Co., New York
7. Read, C.P. Animal Parasitism. Prentice Hall Inc., New Jersey.
8. Sedgwick, A.A. Student text book of Zoology. Vol. I, II and III Central Book Depot, Allahabad
9. Parker, T.J., Haswell, W.A. Text book of Zoology, McMillan Co., London.

Session: 2024-25

Part A – Introduction

Name of the Programme	**M.Sc. Zoology**
Semester	**1**
Name of the Course	**Practical based on Papers M24-ZOO-101 & M24-ZOO-102**
Course Code	**M24-ZOO-105**
Course Type	**PC-1**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**

Course Learning Outcomes (CLO)	CLO1:	Students will develop skills in basic laboratory techniques and understand the principles in Biology.
	CLO2:	Able to apply the scientific method to the process of experimentation.
	CLO3:	This course will make students able to understand the regulation of chemical reactions in living cells.
	CLO4:	Students will be able to conduct the morphomatric analysis of chromosomes and demonstrate cell division

Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

	Practicals	Contact Hours
Course Contents	1. Preparation of mitotic chromosomes from onion root tips 2. Preparation of meiotic chromosomes from grasshopper testes. 3. Preparation of karyotypes from micrographs. 4. Calculation of morphometric data and preparations of idiogram. 5. Determination of chiasma frequency and terminalization coefficient. 6. Study of permanent slides of different stages of meiosis and mitosis. 7. Preparation of polytene chromosomes (Chironomous/mosquito) and mapping. 8. Preparation of Solutions- Standard solution, Molar, Molal and Normal solution. 9. Proteins: Quantitative estimation of proteins by Biuret method and Lowry's method. 10. Carbohydrates: quantitative estimation of total carbohydrates and glucose 11. Analysis of Fats/ Oils: iodine number, saponification value, acid value quantitative estimation of total lipids. 12. Preparation of Standard curve for the estimation and extraction of nucleic acids (DNA and RNA). 13. Paper chromatography: amino acids and carbohydrates. 14. Thin layer chromatography: neutral and phospholipids. 15. 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 16. Microbiological media preparation, sterilization, dilution, inoculation and standard plate count.	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		

• Mid-Term Exam:	15	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Sharma R K, Sangha S P S (2009). Basic Techniques in Biochemistry and Molecular Biology, I.K. International Publishing House Pvt. Ltd. New Delhi
2. Podder T, Mukhopadhyay S, Das S K (2003). An Advanced Laboratory Manual Of Zoology Published by Rajiv Beri for Macmillan India Limited, Rajkamal Electric Press, Delhi
3. Sadasivam S, Manickam A (1997). Biochemical Methods, Ed. 2 nd , New Age International Publishers, New Delhi
4. David T. Plummer(1987). An Introduction to Practical Biochemistry. Ed. , 3 rd , McGraw-Hill Publisher, Rajkamal Electric Press, Delhi
5. Rajgopal G, Toora B D (2022). Practical Biochemistry. Ed. 5 th , Ahuja Publishing House, New Delhi

Session: 2024-25

Part A – Introduction

Name of the Programme	**M.Sc. Zoology**
Semester	**1**
Name of the Course	**Practical based on Papers M24-ZOO-103 & M24-ZOO-104**
Course Code	**M24-ZOO-106**
Course Type	**PC-2**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**
Course Learning Outcomes (CLO)	CLO1: Students will able to understand the processes involved in the recognition of key groups of invertebrates CLO2: Students will be able to prepare permanent mounts of different mouthparts of insects to study the details of their structure. CLO3: Students will able to identify and classify the specimens of available invertebrate phyla. CLO4: Able to elaborate the different systems of invertebrates such as Earthworm, Cockroach, Prawn, Starfish etc.

Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

Practicals	Contact Hours
1. Slides and Museum specimens of following phyla: (a) PROTOZOA (b) PORIFERA (c) CNIDARIA (d) ANNELIDA (e) ARTHROPODA (f) MOLLUSCA (f) ECHINODERMATA (h) HEMICHORDATA 2. Study of mouth parts of Cockroach, Honey Bee, Red cotton bug and House fly 3. Mounting: Obelia, Tubularia, Bougainvillea, Trachea of Cockroach, Crustacean Larva, *Cyclops, Nauplius, Daphnia* 4. Demonstration of Digestive system, reproductive system and nervous system of Earthworm, Cockroach, Prawn, Loligo and Star fish. 5. Preparation and use of different types of taxonomic keys. 6. 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)	120

Suggested Evaluation Methods

Internal Assessment: 30		End Term Examination: 70	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. P S Verma (2010). A Manual of Practical Zoology: INVERTEBRATES, S Chand and Company Limited, New Delhi
2. S.S. Lal (1980). A Textbook of Practical Zoology: Invertebrate. Edition, 4. Publisher, Rastogi Publications
3. S.C. Agarwal (2019). Practical Invertebrate Zoology, Publisher: Pragati Prakashan
4. V Benerjee (2021) . A Textbook of Invertebrate Practical Zoology, Bharti Bhawan Publishers, Noida, UP
5. Robert L. Wallace, Walter K. Taylor (2002). Invertebrate Zoology Lab Manual, 6th edition, Publisher: Pearson

Session: 2024-25	
Name of the Programme	**M.Sc. Zoology**
Semester	**1**
Name of the Course	Seminar
Course Code	**M24-ZOO-107**
Course Type: (CC/DEC/PC/Seminar/CHM/OEC/EEC)	Seminar
Level of the course	400-499
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To enhance the communication skill of students to express the subject effectively during academic and professional discourse and to improve their ability to comprehend, and integrate academic text.
Credits	Seminar
	2
Teaching Hours per week	2
Max. Marks	50
Internal Assessment Marks	0
End Term Exam Marks	50
Examination Time	1 hour
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters a decided by staff council of the department. There will be no external examination/viva-voce examination.	

Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**2**
Name of the Course	**Population and Community Ecology**
Course Code	**M24-ZOO-201**
Course Type	**CC-5**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**
Course Learning Outcomes (CLO)	CLO1: Students will be able to understand and explain the need for intra- and interdisciplinary cooperation in researching different ecosystems. CLO2: Students will understand the all biotic and abiotic factors that are related to individual, population, community and ecosystem and defines the relationships between them. CLO3: Information provided will give an insight about the benefits of ecosystem and can be used in the management of natural resources for sustainable development in ways that leave the environment healthy. CLO4: Many specialties within ecology such as marine, vegetation and statistical ecology provides students information to better understand the environment around them.

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 Basic Concepts: Definition, Scope and Significance of Ecology, Concept of biosphere, atmosphere, lithosphere and hydrosphere. 2.0 Organizational level of ecological systems, Ecological aspects of abiotic, biotic and edaphic factors, limiting factors 3.0 **Ecosystem:** Concept, Kinds and components 4.0 **Ecological energetic and energy flow:** Food chains, food webs, trophic structure; concept of productivity: primary, secondary, gross and net, Energy flow models.	15
II	5.0 **Restoration Ecology** Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems. 6.0 **Population characteristics** 6.1 Introduction and concepts of population ecology 6.2 Attributes of populations 6.3 Population density, methods of population density measurement 6.4 Growth rate and growth forms 6.5 Natality, mortality, survivorship curves and life tables 6.6 Biotic potential – Generation time, net reproductive rate reproductive values 6.7 Population and distribution. 6.8 Population dispersion	15
III	7.0 **Population regulation and Interactions**	15

	7.1 Extrinsic and intrinsic mechanisms 7.2 Concept of density dependent and density independent factors in population regulation. 7.3 Concept of intra specific and inter specific population interactions 7.4 Proto-cooperation, mutualism and commensalisms 7.5 Host-parasite interactions, Life history strategies – r and k selection. 8.0 **Competition and niche theory** 8.1 Intraspecific and inter specific interactions 8.2 History of niche concepts 8.3 Gause's theory of niche	15
IV	9.0 **Predation** 9.1 Theory; predator-prey oscillations 9.2 Model of prey – predatory dynamics 9.3 Role of predation in nature 9.4 Parasitism 10.0 **Community characteristics** 10.1 Species diversity; Biodiversity indices: Diversity, dominance Similarity& dissimilarity Index 10.2 Ecological Succession 10.3 Ecological dominance 10.4 Ecotones and Edge effect 11.0 Ecological Impact Assessment	
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Understanding Evolution by Earl. D. Hanson, Oxford University Press, Oxford, New York.
2. Oxford Surveys in Evolutionary Biology Vol. I – Vol. VI, Oxford University Press, Walton, Street, Oxford.
3. Evolution by Theodose H. Eaton (Jr.) Thomes – Nolson & Sona Limited, London.
4. Evolutionary Theory: (The unfinished synthesis) by Robert G.B. Reid: Croom Helm: London & Sydney.
5. Dobzhansky, Th. Genetics and Origin of species. Columbia University Press.

Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**2**
Name of the Course	**Comparative Physiology**
Course Code	**M24-ZOO-202**
Course Type	**CC-6**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**
Course Learning Outcomes (CLO)	CLO1: An appropriate understanding of functioning of each system of different groups of animals with their comparison will be acquainted. CLO2: The students will able to explore all reasoning and queries that how animals work CLO3: The students will be able to learn that how the physiology of different groups of organisms is influenced by the different environments of their niches CLO4: Since this course also have some important practical component where interesting exercises will be conducted to perform experiment and answer various queries of animal physiology

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 Digestion 1.1 Feeding mechanisms and regulation, 1.2 Comparative physiology of digestion and absorption in different animal groups 2.0 Respiration 2.1 Respiratory organs, Types of respiration, mechanism of breathing 2.2 Transport of respiratory gases 2.3 Respiratory pigments through different phylogenetic groups. 2.4 Physiological response to oxygen deficient stress. 3.0 Excretion 3.1 Patterns of nitrogen excretion among different animal groups 3.2 Functional anatomy of renal unit; mechanisms of ultrafiltration, Counter Current mechanism, Dialysis 4.0 Osmoregulation in different animal groups 4.1 Definition and basic classification of organisms on the basis of osmoregulation 4.2 Osmotic challenges of different environments 4.3 Mechanism of Osmoregulation in fresh water, Estaurine and Marine animals 4.4 Osmoregulation in migratory organisms, Control and regulation of osmoregulation	15
II	5.0 Thermoregulation 5.1 Homeothermic animals, Poikilotherms, Hibernation and Aestivation, 5.2 Physical, chemical, neural regulation, 5.3 Physiological adaptations acclimatization & acclimation in response to	15

	high, low ambient temperature 6.0 Circulation of body fluids and their regulation among different animal groups 6.1 Systems of circulation, heart beat and blood pressure, 6.2 Cardiac cycle, Cardiac output and its regulation, 6.3 Lymphatic system 7.0 Receptor physiology – a comparative study of Mechanoreception, Photoreception, Chemoreception and Equilibrium reception 8.0 Muscle and Contractile physiology 8.1 Contractile elements, cells and tissues among different phylogenic groups; Muscle structure and function-correlation; 8.2 Electric organs and tissues	
III	9.0 Comparative testicular physiology in animals 9.1 Morphology, Differentiation, Function and its regulation 10.0 Comparative ovarian physiology and differentiation in vertebrates 10.1 Morphology, Endocrinolgy, Oogensis, vitellogensis 11.0 Neuronal physiology 11.1 Structure and classification of neurons and glial cells. 11.2 Synaptic action, dendritic properties and functional operation of spinal cord, Brain stem 11.3 Autonomic nervous system.	15
IV	12.0 Principles of synaptic transmission 12.1. Ca2+ and transmitter release; post synaptic transmission mechanism; 12.2. Diversity of neurotransmitters: acetylcholine, catecholamine, serotonin, GABA, glycine, histamine, peptides, NO, and opiods. 13.0 Physiological adaptations to different environments 13.1 Physiological adaptations acclimatization & acclimation in response to high, low ambient temperature, 13.2 Physiological adaptation at high altitude and in deep sea environment. 14.0 Stress Physiology Concept of Stress and Strain, Stress hormones and stress regulatory mechanisms.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. C.L. Prosser. Comparative Animal Physiology. W.B. Saunders & Company.
2. R. Eckert. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman & Company.
3. W.S. Hoar. General and Comparative Animal Physiology
4. Schiemdt-Nielsen. Animal Physiology: Adaptation and Environment. Cambridge.
5. C.L. Prosser. Environment and Metabolic Physiology. Wiley-Liss, New York.
6. David Randall, Warren Burggren, Kathleen French: Eckert Animal Physiology
7. Guyton, A.X., Text Book of Medical Physiology, 7th edition, Saunders Company (1986).

Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Zoology**		
Semester	**2**		
Name of the Course	**Population Genetics & Evolution**		
Course Code	**M24-ZOO-203**		
Course Type	**CC-7**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**		
Course Learning Outcomes (CLO)	CLO1: To provide students the basic insight about the mechanism of evolution and to make them able to relate different forms of life on our planet earth. It will also provide them in-depth knowledge about the changing frequency and distribution of alleles within the population. CLO2: Acquire a clear understanding about genetic equilibrium in natural populations CLO3: To know about genetics of quantitative traits in populations CLO4: Detail understanding of molecular phylogenetics and methods of construction of phylogenetic tree		
Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 Concepts of evolution and theories of organic evolution with an emphasis on Darwinism. 2.0 Emergence of Neo-Darwinism-Neutral Hypothesis 3.0 **Neo Darwinism** 3.1 Hardy-Weinberg law of genetic equilibrium 3.2 A detailed account of destabilizing forces: (i) Natural selection (ii) Mutation (iii) Genetic drift (iv) Migration (v) Meiotic drive	15
II	4.0 **Quantifying genetic variability** 4.1 Genetic structure of natural populations 4.2 Phenotypic variations 4.3 Models explaining changes in genetic structure of populations 4.4 Factors affecting human disease frequency 5.0 **Molecular population genetics** 5.1 Patterns of change in nucleotide and amino acid sequences 5.2 Ecological significance of molecular variations 6.0 **Genetics of quantitative traits in populations** 6.1 Analysis of quantitative traits 6.2 Estimation of heritability 6.3 Genotype-environment interactions	15

	6.4 Inbreeding depression and heterosis 6.5 Molecular analysis of quantitative traits 6.6 Phenotypic plasticity	
III	7.0 **Genetics of speciation** 7.1 Concept of species 7.2 Patterns and mechanisms of reproductive isolation 7.3 Modes of speciation (Allopatric, Sympatric, Parapatric, Peripatric) 8.0 **Molecular Evolution** 8.1 Gene Evolution 8.2 Evolution of gene families, Molecular drive 8.3 Assessment of molecular variations 9.0 **Origin of higher categories** 9.1 Phylogenetic gradualism and punctuated equilibrium 9.2 Major trends in 'the origin of higher categories 9.3 Micro-and Macro-evolution	15
IV	10.0 **Molecular phylogenetics** 10.1 Concept of phylogenetic trees. 10.2 Methods of construction of Phylogenetic trees. 11.0 **Population genetics and ecology** 11.1 Metapopulations 11.2 Monitoring Natural Populations 11.3 Populations size and extinction 11.4 Loss of genetic variations 11.5 Conservation of genetic resources in diverse texa	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
2. Futuyama, D.J. Evolutinary Biology, Suinuaer Associates, INC Publishers, Dunderland.
3. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.
4. Jha, A.P. Genes and Evolution. John Publication, New Delhi.
5. King, M. Species Evolution-The role of chromosomal change. The Cambridge University Press, Cambridge.
6. Merrel, D.J. Evolution and Genetics. Holt, Rinehart and Winston, Inc.
7. Smith, J.M. Evolutinary Gentics. Oxford University Press, New York.
8. Strikberger, M.W. Evolution. Jones and Bartett Publishers, Boston London.

Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**2**
Name of the Course	**Biology of Vertebrates**
Course Code	**M24-ZOO-204**
Course Type	**CC-8**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**
Course Learning Outcomes (CLO)	CLO1: 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. CLO2: Students will have acquaintance with the basic concepts, external morphology and sexual dimorphism in chordates and understand the various systems, adaptation and dentition in chordates. CLO3: Students will also Understand the Classification various classes of phylum Chordate i.e., Pisces, Reptiles, Aves and Mammals. CLO4: This core course will make students familiarize with the vertebrate diversity around them

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 **Introduction to Chordates with their general characters.** 1.1 Origin of Chordates 1.2 Concept of Protochordata or pre-vertebrates 1.3 Classification of Vertebrates upto orders 2.0 **Integument and its derivatives** 2.1 Development, general structure and functions of skin and its derivatives 2.2 Glands, scales, horns, claws, nails, hoofs, feathers and hair	15
II	3.0 **Skeletal system** 3.1 Form, function, body size and skeletal elements of the body 3.2 Comparative account of jaw suspensorium, Vertebral column 3.3 Limbs and girdles 4.1 **Digestive system** 4.1 Dentition, Stomach, Digestive Glands 4.2 Anatomy of gut in relation of to feeding habits- herbivores, carnivores and omnivores. 5.0 **Respiratory system** 5.1 Characters of respiratory tissue, Internal and External Respiration 5.2 Comparative account of respiratory organs	15
III	6.0 **General plan of circulation in various groups** 6.1 Components of Blood 6.2 General plan of circulation in reptiles, birds and mammals 6.3 Evolution of heart, aortic arches and Portal systems 7.0 **Evolution of Urinogenital system in vertebrate series** 7.1 Structure and functions of different types of kidney 7.2 Urino-genital ducts	15

	8.0 Flight adaptation in birds, Migration in fish and Birds	
IV	8.0 **Nervous system** 8.1 Comparative anatomy of the brain in relation to its functions 8.2 Comparative anatomy of spinal cord 8.3 Nerves-Cranial, Peripheral and Autonomous nervous systems 9.0 **Sense organs** 9.1 Simple receptors 9.2 Organs of Olfaction and taste 9.3 Lateral line system 9.4 Electroreception	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver and Boyd,Edinbourgh.
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.

Session: 2024-25			
Part A – Introduction			
Name of the Programme		**M.Sc. Zoology**	
Semester		**2**	
Name of the Course		**Practical based on Papers M24-ZOO-201 & M24-ZOO-202**	
Course Code		**M24-ZOO-205**	
Course Type		**PC-3**	
Level of the course		**400-499**	
Pre-requisite for the course (if any)		**Zoology as a Subject at UG Level**	
Course Learning Outcomes (CLO)	CLO1: Provide significant knowledge of biological research with safe lab practices. CLO2: Students will understand application of histological studies in clinical and medical sciences and will be able to prepare these slides CLO3: Students will be able to identify biodiversity around them and spread awareness about biodiversity conservation CLO4: This course will help the students to understand research based knowledge methods for the welfare of human.		
Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

	Practicals	**Contact Hours**
Course Contents	1. Study of various components of pond and grassland ecosystem. 2. Determination of Water quality characteristics viz: Dissolved oxygen, pH, free carbon dioxide, salinity, transparency, alkalinity, chloride and hardness. 3. Methods of population density measurements. 4. Estimation of biodiversity indices. 5. Field Visit to Aquatic, Forest and other ecosystems for identification of biota. 6. Preparation of tissues for microtomy and demonstration of cryo techniques 7. Histochemistry: Methods of fixation of different tissues. 8. 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 9. Demonstration of live gametes and their staining procedure. 10. Determination of optimum pH, temperature and concentration for optimum activity of salivary amylase, 11. To demonstrate that the optimum activity of trypsin enzyme is pH and temperature dependent. 12. Qualitative test of vitamins and Quantification of vitamin A and C. 13. Total RBC, WBC and Different WBC count 14. Estimation of Blood plasma	120

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		

• Mid-Term Exam:	15

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Podder T, Mukhopadhyay S, Das S K (2003). An Advanced Laboratory Manual of Zoology Published by Rajiv Beri for Macmillan India Limited, Rajkamal Electric Press, Delhi
2. Garg S K, Bhatnagar A, Kalla A, Johal M S(2002). Experimental Ichthyology. Ed. 1 st , CBS Publishers and Distributors, New Delhi
3. Verma P S (2021). A Manual Of Practical Zoology Chordates, Ed. 11 th , S Chand Publisher, New Delhi
4. Balakrishna Shetty, Sweekritha H Poonja (2018). Histology Practical Manual, Jaypee Brothers Medical Publishers Pvt. Limited, New Delhi
5. APHA (2017). Standard methods for the examination of water and wastewater. American Public Health association, American water Works association and Water environment Federation. Ed. 23 rd , 1 Street, NW, Washington DC
6. Baker H and Frank O (1968). Clinical Vitaminology: Methods and Interpretation

Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Zoology**		
Semester	**2**		
Name of the Course	**Practical based on Papers M24-ZOO-203 & M24-ZOO-204**		
Course Code	**M24-ZOO-206**		
Course Type	**PC-4**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**Zoology as a Subject at UG Level**		
Course Learning Outcomes (CLO)	CLO1: Students will able to understand the processes involved in the recognition of key groups of vertebrates CLO2: Students will be able to identify and classify the available specimens of vertebrate classes. CLO3: Students will have ability to prepare permanent mounts of different types of scales and hair to study the details of their structure and their role in the identification of specimens. CLO4: Will be able to elaborate the different systems of vertebrates such as fish, frog rat and pigeon.		
Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

Practicals	Contact Hours
Course Contents: 1. Demonstration of cranial nerves and aortic arches of Scoliodon, Degestive system, Nervous system, Arterial and venous system of frog, Lizard, Pigeon and rabbit. 2. Museum specimens and slides : (i) Protochordates (ii) Fishes (iii) Amphibians (iv) Reptiles (v) Birds (vi) Mammals 3. Comparative Osteology (i) Skull and lower jaw (ii) Vertebrae (iii) Girdles (iv) Limb bones 4. Temporary/Permanent mounts of Hair & Scales 5. Different types of Feathers, Scales & Hair 6. Construction of Phylogenetic tree	120

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. P S Verma (2021). A Manual Of Practical Zoology Chordates, Ed. 11 th , S Chand Publisher, New Delhi
2. S.S. Lal (2009). Practical Zoology: Vertebrate. Edition, 12. Publisher, Rastogi Publications, Delhi
3. Podder T, Mukhopadhyay S, Das S K (2003). An Advanced Laboratory Manual of Zoology Published by Rajiv Beri for Macmillan India Limited, Rajkamal Electric Press, Delhi

Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Zoology**		
Semester	**2**		
Name of the Course	**Constitutional, Human and Moral values, and IPR**		
Course Code	**M24-CHM-201**		
Course Type	**CHM**		
Level of the course (As per Annexure-I	**400-499**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1: Learn the different Constitutional Values, Fundamental rights and duties enshrined in the India Constitution. CLO-2: Understand humanism, human virtues and values, and ide of International peace. CLO-3: Grasp the basic concepts of Moral Values and Professional Conduct which are required to become a part of the civil society and for developing professionalism. CLO-4: Understand concepts of Intellectual Property Rights,Copyright, Patent, Trademark etc., and about threats of Plagiarism.		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 hours		

Part B- Contents of the Course (Will be available from common pool)

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Syllabus will be provided by central pool	
II		
III		
IV		
	Total Contact Hours	30

Suggested Evaluation Methods			
Internal Assessment: 15		**End Term Examination: 35**	
➢ **Theory**	15	➢ **Theory**	35
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	4		
• Mid-Term Exam:	7		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

Session: 2025-26			
Part A – Introduction			
Name of Programme	**M.Sc. Zoology**		
Semester	**3**		
Name of the Course	**Molecular Biology**		
Course Code	**M24-ZOO-301**		
Course Type	**CC-9**		
Level of the course	**500-599**		
Course Learning Outcomes (CLO)	CLO 1: Learn the necessary information about the chemistry of life to allow the students to understand the basis of molecules of life. CLO2: Acquire a clear understanding about protein sorting and their mechanisms CLO3: To know about Recombination and repair mechanism in DNA CLO4: Detail understanding of molecular techniques of genomes analysis		
Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 **DNA Replication** 1.1 Prokaryotic and Eukaryotic DNA replication 1.2 Mechanics of DNA replication 1.3 Enzymes and accessory proteins involved in DNA replication 2.0 **Transcription** 2.1 Prokaryotic and Eukaryotic transcription 2.2 General and specific transcription factors 2.3 Regulatory elements and mechanisms of transcription regulation 2.4 Transcriptional and post-transcriptional gene silencing. 2.5 Post-transcriptional Modifications in RNA 2.6 5'-Cap formation, 3'-end processing and polyadenylation 2.7 Splicing, Editing, Nuclear export of mRNA, mRNA stability	15
II	3.0 **Translation** 3.1 Genetic code and deciphering of genetic code 3.2 Prokaryotic and Eukaryotic translation 3.3 The translational machinery 3.4 Adaptor hypothesis, Kozak rule 3.5 Mechanisms of initiation, elongation and termination 3.6 Regulation of translation 4.0. **Transport of Protein** 4.1 Co- and Post-translational transport of proteins 4.2 Co- and Post-translational modifications of proteins 4.3 Protein trafficking/sorting	15
III	5.0 **Recombination and Repair** 5.1 Holiday junction, gene targeting, gene disruption 5.2 Cre/lox recombination 5.3 RecA and other recombinases 5.4 DNA repair mechanisms 6.0 **Antisense and Ribozyme technology** 6.1 Molecular mechanisms of antisense molecules 6.2 Inhibition of splicing, polyadenylation and translation 6.3 Disruption of RNA structure and capping	15

	6.4 Biochemistry of ribozyme; hammerhead, hairpin and other ribozymes 6.5 Strategies for designing ribozymes 6.6 Application of antisense and ribozyme technologies	
IV	7.0 **Molecular mapping of genome** 7.1 Genetic and physical maps 7.2 Physical mapping and map-based cloning 7.3 Southern and fluorescence in situ hybridization for genome analysis 7.4 Chromosome micro-dissection and micro-cloning 7.5 Molecular markers in genome analysis RFLP, RAPD and AFLP analysis and their applications 7.6 Molecular markers linked to disease resistance genes 8.0 **rDNA Technology** 8.1 Gene-cloning 8.2 Vectors 8.3 cDNA and genomic liberaries 8.4 Blotting techniques 8.5 Chromosome walking 8.6 Application of rDNA technology	15
	Total Contact Hour	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Molecular Biology of the Gene, J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A Steitz and A.M. Weiner. The Benjamin/Cummings Pub. Co., Inc., California.
2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Books, Inc., USA
3. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J,D. Watson. Garland Publishing Inc., New York.
4. Gene VI, Benjamin Lewin, Oxford University Press, U.K.
5. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A Meyers (Ed.), VCH Publishers, Inc., New York.
6. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
7. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York.
8. Molecular Biology LabFax, T.A Brown (Ed.), Bios Scientific Publishers Ltd., Oxford.

Session: 2025-26

Part A – Introduction

Name of Programme	**M.Sc. Zoology**
Semester	**3**
Name of the Course	**Molecular Endocrinology**
Course Code	**M24-ZOO-302**
Course Type	**CC-10**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: It helps in explaining hormonal synergism and antagonism at the molecular level CLO2: Students will be able to identify the organs involved in the endocrine function and an understanding of appropriate key human endocrine disorder will also be developed CLO3: Develop an in-depth comprehensive knowledge of endocrinology from a physiological, cellular, and molecular perspective. CLO4: This course will make students understand the basic structure and chemical organization of hormones and various signaling molecules.

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1. Basic concept of endocrinology, its scope and role in molecular biology. 2. **Chemical nature of hormones;** 2.1 Amino-acid derived hormones 2.2 Peptide hormones 2.3 Glyco-protein hormones, 2.4 Steroid hormones and 2.5 Prostaglandin 3. Biosynthesis of peptide hormones, transcriptional and post-transcriptional modifications 4. Biosynthesis and secretion of thyroid hormones. Thyroid hormone disorders.	15
II	5. Prostaglandin structure, type, synthesis and biological activities. 6. Mechanism of action of peptide hormones; concept of second messengers, cAMP, cGMP, Ca++, IP3, DAG, NO, signal transduction mechanisms. 7. Mechanism of action of steroid hormones; Cross talk concept, Heat shock proteins.	15
III	8. **Hormonal regulation of Metabolism:** 8.1 Role of Insulin & Glucagon in regulation of Carbohydrate metabolism 8.2 Metabolic regulatory hormones in Lipid & Protein metabolism 9. Gastrointestinal hormones and their role in regulation of metabolic activity. 10. Endocrine regulation of calcium and phosphate homeostasis in mammals.	15

IV	11. **Genetic basis of hormonal disorders.** 11.1 General principle and classification of hormonal disorders 11.2 Genetic basis of growth hormone disorder 11.3 Genetic basis of PCOS 12. **Sequence-specific DNA binding receptor proteins** 12.1 Nuclear receptor proteins 12.2 Cytosolic receptor proteins 12.3 Cell surface receptor proteins 12.4 Their role in gene transcription, cell differentiation and cell proliferation. 13.0 **Regulatory substances** –Eicosanoids, Growth factors, Thymus gland & Kinins.	15
	Total Contact Hour	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Benjamin Lewin, Genes VII, Oxford University Press.
2. Lodish et al. Molecular Cell Biology.
3. Ethan Bier. The Coiled Spring, Cold Spring Harbor Press.
4. L.P. Freedman. Molecular Biology of Steroid and Nuclear Hormone Receptors, Birkhauser.
5. G. Litwack. Biochemical Actions of Hormones, Academic Press.

Session: 2025-26	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**3**
Name of the Course	**Applied Zoology**
Course Code	**M24-ZOO-303**
Course Type	**DEC-1**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: Awareness about use of certain animals and their products for human welfare vis-à-vis animal welfare will be created. CLO2: Information regarding the animals that are responsible for economic losses will also be acquainted. CLO3: Students will able to explain the basic concepts of sericulture, apiculture, lac culture and other animal industries along with economics of pest management techniques. CLO4: Students will able to justify the animals in pharmaceutical research CLO5: Students will gain knowledge about various disease vectors and their impact on human.

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 Vertebrate and non vertebrate pests (Wheat, Rice, Sugarcane and cotton) their harmful status and economic importance. 1.1 Integrated pest management. Cultural control, Physical control, Mechanical control, Chemical control, Biological control, Herbal control and legal control andPheromones involved in pest management. 2.0 Insects of medical and veterinary importance.	15
II	**3.0 Zoonosis:** 3.1 Viral-Rabies, 3.2 Japaneses encephalitis; 3.3 Bacterial- Brucellosis, Plague; 3.4 Ricketsial- Ricketsial zoonosis, Q fever, Scrub typhus. 3.5 Protozoan Entamoeba histolytica, Plasmodium vivax and Trypanosoma gambiense), Helminth and Nematode diseases in humans (Schistosomiasis, Cestodiasis, Termatodasis, Filariasis and Ascariasis).	15
III	**Sericulture, Apiculture and Lac culture** 4.0 Sericulture : Types of silk, species of silk moth (scientific names), Silkworms and their host plants, mulberry silk worm culture, agricultural aspects of mulberry plant cultivation, extraction and reeling of silk, natural enemies and diseases of silkworm and their control. 5.0 Apiculture : Species of honey bees in India, life history of Apis cerana indica, agriculture techniques, bee products and their uses, natural enemies and diseases of honey bee and their control. 6.0 Lac culture: lac insect (Scientific name), composition of lac, strains of lac insect, cultivation of lac host plants (in brief) processing of lac and uses of lac. 7.0 Wool and fur industry, leather industry.	15

IV	8.0 Vermiculture, Poultry keeping and Dairy industry. 9.0 Prawn culture, Pearl culture. 10.0 Edible fresh water fishes and their diseases, Snakes (Haryana) and its Economic importance of snake venom 11.0 Pharmaceuticals from animals and role of animals in stem cell therapy. How to harves the technology from animals for human welfare 12.0 Animal welfare and ethics, CPCSEA guidelines and maintenance of experimental animals	15
	Total Contact Hour	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Insect Pest Management by Dent, D.
2. Agricultural Entomology by Hill, D.S., Timber Press.
3. General and Applied Entomology by David, B. V. & Ananthakrishnan, T. N., Tata McGraw-Hill Publishing.
4. Entomology and Pest Management by Pedigo L. P. Prentice Hall, India.
5. General and Applied Entomology by Nayar K. K. and T. N. Ananthkrishnan and B. V. Davis, Tata McGrew Hill Publications. New Delhi.
6. Agricultural Pests: Biology and Control Measures by B. M. Deoray and T. B. Nikam, Nirali Publication, Pune.
7. Concepts of Insect Control by Ghosh M. R. Wiley Eastern Ltd. New Delhi.
8. Economic Zoology. Shukla Upadhyay, Rastogi Publication, Meerut, India, 1998.

Session: 2025-26

Part A – Introduction

Name of Programme	**M.Sc. Zoology**
Semester	**3**
Name of the Course	**Molecular Reproduction-I**
Course Code	**M24-ZOO-304**
Course Type	**DEC-2**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: The cellular, molecular and biochemical changes in reproductive physiology CLO2: The basic and molecular concepts of spermatogenesis folliculogenesis, ovulation, follicular atresia and germ line- soma interaction. CLO3: The importance of diet, exercise, stress and yoga during ageing CLO4: Various problems of male sterility and female infertility.

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1. **Male Reproductive system**: Cytology of testis and spermatozoon, physiology of spermatogenesis, molecular bases of testicular steroidogenesis, endocrine regulation of steroidogenesis, role of male accessory sex structures. 2. **Female Reproductive System:** Structural and histochemical aspects of ovary and primordial follicles. 3. **Folliculogenesis**: Dynamics of follicular growth and maturation, intracellular dynamics of cholesterol synthesis-two cell theory, endocrine regulation of folliculogenesis.	15
II	4. **Oocyte Maturation**- Nuclear, epigenetic and cytoplasmic; oocyte granulosa interactions 5. **Ovulation**- Mechanism, Induced and spontaneous ovulators. 6. **Corpus Luteum**- Structure and functions, molecular mechanism and endocrine regulation of luteinization, luteal steroidogenesis, corpus luteum of pregnancy.	15
III	7. **Follicular atresia**: Causes, regulation and significance, factors affecting atresia, role of granulosa cells apoptosis in atresia. 8. **Male sterility**- Azoospermia, Oligozoospermia, Asthenozoospermia, Varicocele, Genetic basis for male infertility. 9. **Female infertility**- genetic and endocrinal factors, PCOD, atresia.	15
IV	10. **Female reproductive aging**: epidemiology, theories, markers, significance, implications, fertility preservation. 11. **Age-Related Reproductive disorders**- perimenopause, premenopause, post menopausal disorders, osteoporosis. 12. Effect of diet, nutrition, stress, disease, exercise and yoga on reproductive ageing.	15

		Total Contact Hour	60
Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Guraya S.S. (1998). Cellular and Molecular Biology of General development and Maturation in mammals Narosa Publishing House, New Delhi.
2. Hafez E.S.E.(1994). "Reproduction in farm animals". Lea Febighiese.
3. Gurays S.S. (2000). Comparative Cellular and Molecular Biology of Ovary in mammals I.B.H., New Delhi.
4. The Physiology of Reproduction, second edition, Vol 1 and 2, edited by Ernst Knobil and Jimmy D. Neil. Raven Press, 2014.
5. Male Reproductive Function, edited by Christina Wang. Kluwer Academic Publishers, 1999.
6. The ovary, edited by Solly Zuckerman Baron Zuckerman, Barbara J. Weir, T. G. Baker. Academic Press.
7. The ovary, edited by Peter C.K. Leung and Eli Y. Adashi, Elsevier (Academic Press), 2004.
8. Cell and Molecular Biology of Testis, edited by Claude Desjardins and Larry L. Ewing. Oxford University Press US.
9. Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management, edited by Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri. Saunders publisher.
10. Regulation of Implantation and Establishment of Pregnancy in Mammals, Editors: Rodney D Geisert, Fuller W. Bazer, ISBN 978-3-319-15856-3, Springer International Publishing, 2015.
11. Implantation and early development, Editors: Hilary Critchley, Ian Cameron and Stephan Smith, ISBN 9781107784680, Cambridge University press, 2014.
12. Implantation, Biological and Clinical Aspects, Editors: Michael G. Chapman, J. Gedis Grudzinskas, Tim Chard, ISBN 978-1-4471-3531-9, Springer-Verlag, 1988.

Session: 2025-26	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**3**
Name of the Course	**Animal Behaviour & Wildlife Conservation-I**
Course Code	**M24-ZOO-305**
Course Type	**DEC-2**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: It will boost students for betterment of diversified resources and life forms for better conservational measures with keen understanding. CLO2: Acquire a clear understanding about behavior patterns in animals CLO3: Students will be aware and understand the concept of protected area system CLO4: Detail understanding of conservational approaches and organizations

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1. **Concept of Animal behaviour**; Mile-Stones in the history of animal behaviour and scope. 2. **Stereotyped and acquired behaviour patterns:** Tropisms, Taxes, Reflexes, Instincts, learning & reasoning; Change in major modes of adaptive behaviour in phylogeny. 3. **Perception of the environment :** Mechanical, Electrical, chemical, olfactory, auditory, visual 4. **Biological rhythms** and concept of biological clock.	15
II	5. **Motivation:** Introduction, goal oriented behaviour, biological drives – Primary and Secondary drives. 6. **Concept of learning**: law of learning, types of learning – Habitation, trial & error learning, latent learning, Insight, Imprinting, Classical conditioning & Instrumental learning. 7. **Concept of Migratory behaviour**	15
III	8. **Wildlife:** Definition, significance and Biogeographic/wildlife zones of India, Bio-diversity of the Indian Subcontinent and World. 9. **Protected Area Systems:** Concept, Historical background, categories and management objectives of protected areas, world growth of protected areas, and Present status of National PA-Systems. 10. **Theory and Practice of Biosphere Reserves of the world:** Biosphere Reserves of India, Wildlife conservation techniques.	15
IV	11. **Natural Heritage Sites of the world**, Natural Heritage sites in India. Important National Park and Wildlife Sanctuaries of India 12. **Wildlife and livelihood;** Wildlife and illegal trade & control; 13. Role of WWF, IUCN, UNEP, 14. **Red Data Book;** Categories of Endangered Wildlife Species.	15

		Total Contact Hour	60
Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Techniques for wildlife Census in India by W.A. Rogers (A field manual); Wildlife Institute of India, Dehradun.
2. Wildlife Wealth of India by T.C. Majupuria; Tecpress Services, L.P., 487/42-SOL Wattenslip, Pratunam Bangkok, 10400, Thailand
3. Ali, S. Ripley S.D. Handbook of Birds of India, Pakistan 10-Vols. Oxford University Press, Bombay.
4. The Book of Indian Animals by S.H. Prater, BNHS-Publication, Bombay.
5. Wildlife in India by V.B. Saharia Natraj Publishers, Dehradun.
6. E.P. Gee, The Wildlife of India.

Session: 2025-26

Part A – Introduction

Name of Programme	**M.Sc. Zoology**
Semester	**3**
Name of the Course	**Fish, Fisheries and Aquaculture-I**
Course Code	**M24-ZOO-306**
Course Type	**DEC-2**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: Through this core elective paper student/s will learn identification of fish species using classical morphological methods CLO2: This core elective paper will generate knowledge about various methods and significance of aquaculture CLO3: It will create awareness about food security, significance of protein in diet and importance of fish in fighting protein deficiency CLO4: It will also be helpful in acquainting with methods of conserving fish diversity.

	Theory	Practical	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 Definition of Fish, Fisheries and aquaculture; Types of Aquaculture 2.0 Classification of fishes with distinguishing characters and examples of each group. 3.0 Estuarine, Marine, Riverine and wetland fisheries: characteristic species and Their exploitation. 4.0 **Culture fisheries** 4.1 Cultivable organisms for aquaculture. 4.2 Criteria of selection of cultivable fishes	15
II	5.0 Design, construction and maintenance of fish culture ponds. 6.0 Ecology of fish pond ecosystem 6.1 Physico chemical conditions of ponds water and soil 6.2 Biological conditions of waters 6.3 Weeds and their control 6.4 Productivity of fish pond 6.5 Classification of water bodies on the basis of productivity. 7.0 **Aquatic pollution:** Sources of water Pollution, Impact of pollution on aquatic organisms, Impact of exotic fish species onaquatic biodiversity, Fishes and their relationships with abiotic and biotic factors. 8.0 Aquaculture Ranching and Rational fishery.	15

III	9.0 **Fish integument:** Exoskeleton and colouration 10.0 Fins: origin, types and functions 11.0 Food and feeding habits of fishes, Digestion in fishes 12.0 Respiratory system Gill structure and functions, Accessory respiratory organs swim bladder and webberian ossicles 13.0 Osmoregulation in fishes	15
IV	14.0 **Receptors in fishes** 14.1 Chemoreceptors 14.2 Lateral line organs 14.3 Eye Ear 14.4 Pineal organ 15.0 Hormones and reproduction: Induced breeding in carps and catfishes. 16.0 Identification of different maturity stages of fishes. 17.0 Migration in fishes 18.0 Age and growth studies	15
	Total Contact Hour	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Encyclopedia of Fish Physiology. 2011. Anthony P. Farrell, E.D. Stevens, J.J. Cech& J.G. Richards (Eds). Academic Press, UK.

2. APHA (1995) Standard Methods of Examination of Water and Wastewater. American Public Health Association, AWWA, WCPF, Washington DC.

3. Bardach, JE, Ryther & McLarney, Wo (1972) Aquaculture, New York: Wiley-Interscience. 896pp.

4. Boulenger, GA & Bridge, TW (1910) Fishes (Vol. VII of the Cambridge Natural History) Cambridge Univ. Press, London.

5. Das, P, Verma, SR, Dhaje, RJ & Malik DS (2002) Coldwater Fish Genetic Resources and their Conservation. National Conservators publication, 7, 325pp.

6. Datta Munshi, JS & Srivastava, MP (1998) Natural History of Fishes and Systematics of Freshwater Fishes of Infia. Narendra Publishing house, Delhi, 403pp.

7. Jayram, KC (2013) The Freshwater Fishes of the Indian Region (Corrected 2nd Edition) Narendra Publishing house, Delhi, 616pp, XXXIX plates.

8. Lagler, KF, Bardach, JE, Miller, RR & Passino, DRM (1977) Ichthyology, 21nd Edition, New York, Wiley, 506 pp.

9. Nikolsky, GV (1963) The Ecology of Fishes, Academic Press, London.

10. Pillay, TVR (1990) Aquaculture, principles and practices. Fishing New Books. 575pp2. Fish Physiology. (Series) W.S.Hoar and D.J. Randall (Series Eds). Academic Press, UK.

11. The Physiology of Fishes. 2013. Evans, D. H. and Claiborne, J. D., Taylor and Francis Group, CRC Press, UK.

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Part A – Introduction

Name of the Programme	**M.Sc. Zoology**
Semester	**3**
Name of the Course	**Practical based on Papers M24-ZOO- 301 to M24-ZOO-303**
Course Code	**M24-ZOO-307**
Course Type	**PC-5**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: Students will be able to explain the basic principle, procedures and applications of various biological techniques that are used to study the basic biological processes. CLO2: Will understand the basic concepts of applied Zoology in human welfare CLO3: Will be able to perform electrophoresis for scope in research field. CLO4: Study of endocrinology will help the student to identify the organs involved in the endocrine function and which help in understanding human endocrine disorder.

	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 Time	0	4 hours	

Part B- Contents of the Course

Practicals	**Contact Hours**
Course Contents 1. Non-protein nitrogenous substances: qualitative estimation of serum Bilirubin serum and urine creatintine. 2. Estimation of Acid and alkaline phosphates. 3. Barr body examination from Buccal smear. 4. Sex chromatin from blood sample. 5. In-vitro study of effect of hormones. 6. Study of histological slides and endocrine glands of vertebrates 7. Blood smear preparation, Blood groups, hematin crystals, haemoglobin count, DLC, TLC etc 8. Demonstration of SDS-PAGE 9. Demonstration of Agarose gel electrophoresis and prepration of gel 10. Collection of different larva ofmosquitoes:-Culex; Anopheles; Aedes, marking out the basic morphological differences at larval level. 11. Preparation of permanent mounts of adult mosquitoes:Culex and Aedes and Anopheles - highlight differences, if any, between basic these important vectors. 12. Study of life cycle of honey bee, Lac insect, Silk worm, Cabbage butterfly. 13. Study on common household and agriculture pest.	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Practicum	**30**	**Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Session: 2025-26			
Part A – Introduction			
Name of the Programme	**M.Sc. Zoology**		
Semester	**3**		
Name of the Course	**Practical based on Papers M24-ZOO-304**		
Course Code	**M24-ZOO-308**		
Course Type	**PC-6**		
Level of the course	**500-599**		
Course Learning Outcomes (CLO)	CLO1: To develop the scientific attitude that makes the students open minded, critical observations, curiosity thinking etc CLO2: To acquire the specialized knowledge relevant to reproductive biology and biochemistry. CLO3: To understand the basic and molecular laboratory techniques in both physiology and biochemistry. CLO4: To acquire the knowledge about various male and female infertility problems		
Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

Practicals	**Contact Hours**
Course Contents 1. Demonstration of male and female reproductive systems of earthworm, grass hopper, and rat. 2. Processing of reproductive tissues for microanatomy and histochemistry 3. Study of permanent slides on mammalian reproductive tissues 4. Study of folliculogenesis and atresia in rat ovary. 5. Study of apoptosis in gonads. 6. Extraction and estimation of macromolecules such as proteins, carbohydrates, lipids, and nucleic acids. 7. Isolation of testicular cells and ovarian follicular cells. 8. Oocyte collection; aspiration and slicing method. 9. Sperm morphology, capacitation, sperm count, and sperm motility. 10. Vaginal smear preparation to examine estrous cycle and pregnancy. 11. Oocyte maturation in vitro. 12. In vitro fertilization	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Practicum	**30**	**Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Session: 2025-26

Part A – Introduction

Name of the Programme	**M.Sc. Zoology**
Semester	**3**
Name of the Course	**Practical based on Papers M24-ZOO-305**
Course Code	**M24-ZOO-308**
Course Type	**PC-6**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: It will boost students for keen understanding various behavioral activity of animal world CLO2: Students will acquire a clear practical understanding about behavior patterns in animals CLO3: Students will know about the practical approaches of protected area system in India CLO4: Detail understanding of residential and migratory nature of avian fauna

Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

	Practicals	**Contact Hours**
Course Contents	1. Designing of experiments, observations, techniques of data analysis, presentation of results and writing of laboratory report. 2 To demonstrate locomotive, explorative withdrawal and habituation behaviours in animals. 3 To demonstrate response of animals to light. 4 To demonstrate antennal grooming behaviour in cockroach. 5 Demonstration of food preferences in insects/pests 6 Investigation of habituation of diving response of mosquito larvae. 7 To study the effect of temperature on heartbeat of cockroach/ Gill movements in Fishes 8 Field study of nesting behaviour of common available avian fauna of the region. 9 Study of Migratory Birds 10 To study mobbing response of birds 11 Study of animal behavior patterns using repertoire sheets. 12 To prepare charts of wildlife zones of India and the world. 13 Field visits to local areas/Project Report	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Practicum	**30**	**Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Session: 2025-26	
Part A – Introduction	
Name of the Programme	**M.Sc. Zoology**
Semester	**3**
Name of the Course	**Practical based on Papers M24-ZOO-306**
Course Code	**M24-ZOO-308**
Course Type	**PC-6**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: Student/s will be able to identify of fish species using classical morphological methods CLO2: Students will be able to analyse physico- chemical status of water of lotic and lentic Components. CLO3: Students will be able to conduct qualitative and quantitative analysis of phyto and Zooplanktons CLO4: This practical course will also be helpful to develop personnel to develop career in organizations where water quality analysis and fish diversity studies are carried out

Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

	Practicals	**Contact Hours**
Course Contents	1. Study of Anatomy and Morphology of important group of fishes. 2. Taxonomic study of common families, genera and species of fishes . 3. Survey and Collection of fishes of Haryana . 4. Examination of skeleton of cartilaginous and bony fishes . 5. Study of histological and microscopic structure in fishes. 6. Analysis of physical and chemical properties of water: Temperature, pH, turbidity, salinity, total solids, Dissolved oxygen, Free carbon-di-oxide, hardness, chlorides, orthophosphates nitrates, ammonia 7. Qualitative and quantitative examination of Phyto and zooplanktons in a water body 8. Determination of percent composition of different groups of phyto and zoo planktons 9. Determination of species diversity of phyto and zooplanktons 10. Study of Aquatic weeds and aquatic insects	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Practicum	**30**	**Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

session: 2025-26

Part A – Introduction

Name of the Programme	M.Sc. Zoology
Semester	3
Name of the Course	Animal Diversity & Conservation
Course Code	M24- OEC- 352
Course Type	OEC (To be offered to the students of other departments)
Level of the course (As per Annexure-I	500-599
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1: Biological diversity provides immediate benefits to society such as recreation and tourism CLO-2:.It will generate initiative among students for conservation of our rich natural resources and diversified life forms CLO-3: It gives jobs opportunities for people by establish training research programmes that have been launched for conservation and sustainable use of bio diversity. CLO-4: Expand the knowledge of researchers to explore diversity of animal, its protection from extinction and their habitat from destruction

Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 hours		

Part B- Contents of the Course (Will be available from common pool)

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 Wildlife: Definition, significance 2.0 Techniques of animal counts (Examples of Tiger count)	
II	3.0 Wildlife zones of the India 4.0 Wildlife Tourism	
III	5.0 Biodiversity: Concept, threats to biodiversity, its 6.0 Conservation (objectives and strategies), biodiversity indices,	
IV	7.0 Concept and objectives of Protected areas: 8.0 Important Protected Areas of India (Biosphere reserve, National Park & Wildlife sanctuaries) 9.0 Red Data Book, IUCN Categories of wildlife species	
	Total Contact Hour	30

Suggested Evaluation Methods

Internal Assessment: 15		End Term Examination: 35	
Theory	**15**	**Theory**	**35**
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	4		
• Mid-Term Exam:	7		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Techniques for wildlife Census in India by W.A. Rogers (A field manual); Wildlife Institute of India, Dehradun.
2. Wildlife Wealth of India by T.C. Majupuria; Tecpress Services, L.P., 487/42-SOL-Wattenslip, Pratunam Bangkok, 10400, Thailand
3. The Book of Indian Animals by S.H. Prater, BNHS-Publication, Bombay.
4. Wildlife in India by V.B. Saharia. Natraj Publishers, Dehradun.
5. E.P. Gee, The Wildlife of India.

Session: 2025-26	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**4**
Name of the Course	**Developmental Biology**
Course Code	**M24-ZOO-401**
Course Type	**CC-11**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: Based on learning contents of embryology, students can have a systematic and organised learning about the knowledge and concepts of growth and development. CLO2: Developmental biology displays a rich array of material and conceptual practices that can be analysed to better understand the scientific reasoning exhibited in experimental life sciences CLO3: To understand biological processes that takes place in and between cells and in and between organisms in nature. CLO4: This understanding will make the students capable of describing and explaining both biological processes and their importance for living organisms

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1. **Introduction to animal development** 1.1 Problems of developmental biology 1.2 Developmental patterns in metazoans 1.3 Development in unicellular eukaryotes 1.4 Development in Dictyostelium 2. **Creating multicellularity** 2.1 Cleavage types and significance, Blastula, Fate maps, cell lineages 2.2 Comparative account of gastrulation 3. **Early vertebrate development:** 3.1 Neurulation and ectoderm 3.2 Mesoderm and endoderm.	15
II	4. **Cytoplasmic determinants and autonomous cell specification:** 4.1 Cell commitment and differentiation 4.2 Germ cell determinants 4.3 Germ cell migration 4.4 Progressive cell - Cell interaction and cell specification fate 4.5 Cell specification in nematodes 5. **Body pattern formation:** 5.1 Establishment of Body axis in mammals and birds 5.2 Proximate tissue interactions 5.3 Genetics of axis specification in Drosophila	15

III	6. **Hormones as mediators of development:** 6.1 Amphibian metamorphosis 6.2 Insect metamorphosis 7. **Biology of sex determination:** 7.1 Chromosomal sex determination – Mammals, Drosophila and Nematodes 7.2 Testis determining genes 7.3 Secondary sex determination in mammals 7.4 Environmental sex determination. **8. Cell death and cell renewal** 8.1 Programmed cell death 8.2 Stem cells and the maintenance of adult tissues 8.3 Embryonic stem cells and therapeutic cloning	15
IV	9 **Environmental evolution and animal development** 9.1 Environmental cues and effects 9.2 Malformations and disruptions 9.3 Changing evolution through development modularity 9.4 Developmental constraints **10. Homeobox concept in different phylogenetic groups** 10.1 Cell diversification in early animal embryo 10.2 Tetrapod limb development 10.3 Skeletal muscle regeneration 10.4 Connective tissue cell family 10.5 Blood cells formation	15
	Total Contact Hour	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. S.F. Gilbert. Developmental Biology. Sinauer Associates Inc., Massachusetts. Ethan Bier. 'The Cold Spring'. Cold Spring Harbor Laboratory Press, New York.
2. Essentials of Developmental Biology: JMW Slack [Latest edition] .
3. Principles of Development: Louis Wolpert [Latest edition].
4. An Introduction to Embryology by B.I. Balinsky, Saunders, Philadelphia (1981).
5. Major Problems in Developmental Biology by H. Urspaung, Academic Press, New York, (1972).
6. The Control of Gene Expression in Animal Development by J.B. Gurdon, Harvard University, Press, Oxford (1974).
7. Gene activity in Early Development by Davdson, E.H. Academic Press, London (1977).
8. Development Biology (Vol.II) by Browder, L.W, Saunders (1984).

Session: 2025-26	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**4**
Name of the Course	**Vertebrate Immunology**
Course Code	**M24-ZOO-402**
Course Type	**CC-12**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: How the immune system can fight infection and other diseases CLO2: The strategies to improve existing vaccines and how to approach these CLO3: Cellular and molecular basis of inflammatory response CLO4: Mechanisms involved in control of immune response

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 **Phylogeny and Ontogeny of immune system** 1.1 Innate and Acquired Immunity 1.2 Organization and structure of lymphoid organs 1.3 Cells of the immune system and their differentiation 2.0 **Nature of antigens and superantigens** 2.1 Antigenicity and immunogenicity 2.2 Factors influencing immunogenicity 2.3 Epitopes and haptens 3.0 **Structure and Functions of Antibodies** 3.1 Classes and subclasses 3.2 Gross and Fine structure 3.3 Antibody mediated effector functions 4.0 **Antigen-Ab interactions: Principles and Applications** 4.1 Cross Reactivity, Precipitation reactions, Agglutination reactions 4.2 Radioimmunoassay, ELISA, Immunoprecipitation, Immunofluorescence	15
II	5.0 **Nature of immune response** 5.1 Humoral Immune Response 5.2 Cellular Immune Response 6.0 **Cytokines** 6.1 Cytokine Properties 6.2 Cytokine receptors 6.3 Cytokines and Immune response 6.4 Cytokine Antagonists 6.5 Cytokine Related Diseases 7.0 **Cell-mediated effector functions** 7.1 Cell adhesion molecules 7.2 Effector cells and molecules 7.3 CTLs –Mechanism of action 7.4 NK cells-mechanisms of action	15

	8.0 **Hypersensitivity-Types and Mechanism.**	
III	9.0 **Complement System** 9.1 Components and functions of Complement system 9.2 Pathways of complement system 9.3 Regulation and biological consequences. 10.0 **Major Histocompatibility Complex in mouse and HLA system in human** 10.1 Class I and class II molecules 10.2 Expression and diversity 10.3 Disease susceptibility and MHC/HLA 11.0 **Organization and expression of Ig genes** 11.1 Multigene organization of Ig genes 11.2 DNA rearrangements and mechanisms 11.3 Generation of antibody diversity 11.4 Differential expression of Ig genes.	15
IV	12.0 **T-Cell Maturation, Activation and Differentiation** 12.1 T-Cell Receptors- Organization and rearrangement of TCR genes, TCR-CD3 complex 12.2 T-cell maturation and thymus 12.3 T -cell activation and differentiation 12.4 Cell death and T-cell population 13.0 **B-cell generation, activation and differentiation** 13.1 B-cell receptors 13.2 B-cell maturation, activation and proliferation 13.3 T H-B-Cell interactions 14.0 **Auto-immunity and Vaccines**- Types – subunit, conjugate and recombinant vector vaccines.	15
	Total Contact Hour	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Kuby. Immunology, W.H. Freeman, USA.
2. W. Paul. Fundamentals of Immunology.
3. I.M. Roitt. Essential of Immunology, ELBS Edition.
4. Immuno Biology- The immune system in health and disease, Janeway, Travers, Walport and Shlomchik, Garland Science Publishing [Latest edition].
5. Fundamentals of Immunology by William E. Paul, Lippincott Williams & Wilkins Publishing [Latest edition].
6. Cellular and Molecular Immunology by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, Elsevier Publishing [Latest edition].

Session: 2025-26	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**4**
Name of the Course	**Environmental Toxicology**
Course Code	**M24-ZOO-403**
Course Type	**DEC-3**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: The awareness about toxic agents, their different routes of exposure and effects on humans and their livestock will be apprised. CLO2: The students will have the knowledge about mode of transformation of toxicants CLO3: It will help in creating skilled personnel in the field of environment protection and research. CLO4: Students will have an understanding of ill-health and diseases that are related to exposure to chemicals in human everyday life

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 **Introduction to Environmental Toxicology:** 1.1 Emergence of toxicity in the environment 1.2 Classical toxicology, ecotoxicology and environmental toxicology. 1.3 Classification of toxicants. 2.0 **Toxic agents:** Pesticides, metals, solvents radiation, carcinogens, poisons, bio-toxins, petrochemicals.	15
II	3.0 **Toxicant uptake:** 3.1 Route of toxicant uptake/Absorption of toxicant at tissue and cellular level 3.2 Distribution and storage of toxicant. 3.3 Biotransformation and elimination of toxicant. 4.0 **Xenobiotics:** Definition, types and significance Target organ toxicity: 4.1 Hematotoxicity 4.2 Hepatotoxicity 4.3 Nephrotoxicity 4.4 Neurotoxicity	15
III	5.0 **Environmental Toxicology:** Food additives, air, water and soil pollutants and Bioindicators. 6.0 Effect of pollutant on ecosystem with case study of important Organo-phosphorous and Organo-chlorine pesticides and Nitrates 7.0 **Solid waste management:** Primary waste products-Solid waste, toxic biological and hospital landfills, incineration, source reduction and recycling.	15
IV	8.0 **Bioremediation,** its role and significance. 9.0 Toxicological risk assessment and management with reference to relevant case study. 10.0 Principles and significance of systematic toxicology. 11.0 **Genotoxicology:** Definition, Effects, molecular mechanisms and prevention. 12.0 Applications of toxicology anthropogenic activities and environment. 13.0 Human toxicology and medicinal ethics.	15

		Total Contact Hour	60
Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Handbook of Solid Waste Management by Wilson, Van Nostrand, Reinhold.
2. Environmental Studies by D.B. Botkin, & E.A. Keller, Martill Publising Co., Columbs, Toronto, London.
3. Bioremediation Technology by Fulekar, M.H.
4. Biotranformation: Bioremediation Technology for Health & Environmental Protection by R. D. Stapleton Jr. and V.P. Singh (Ed), Elsevier.
5. Casarett & Doull's Toxicology: The Basic Science of Poisons by Curtis Klaassen
6. Ecotoxicology: The study of pollutants in ecosystems. 3rd Ed. Elsevier by Moriarty, F.
7. Environment concerns and strategies. Ashish Pub. House, NDL by T.N. Khushoo.
8. Environmental biology. Akashdeep Pub. House by R.R. Trevedi Gurdeep Raj.
9. Textbook: A Textbook of Modern Toxicology. Third Edition by E. Hodgson (Ed.). John Wiley & Sons, Inc. (Posted on the D2L content page.)
10. Environmental Health by Monroe T. Morgan
11. Handbook of Environmental Health and Safety – principle and practices by H. Koren; Lewis Publishers
12. Principles of Environmental Toxicology by I. C. Shaw and J. Chadwick; Taylor & Francis ltd.
13. Introduction to Toxicology, 3rd Ed. Taylor & Francis, London by Timbrell, J

Session: 2025-26

Part A – Introduction

Name of Programme	**M.Sc. Zoology**
Semester	**4**
Name of the Course	**Molecular Reproduction-II**
Course Code	**M24-ZOO-404**
Course Type	**DEC-4**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: Basic and molecular concepts of reproductive physiology. CLO2: Cellular and molecular mechanisms of fertilization, implantation, pregnancy and lactation CLO3: The biological principles underlying contraceptive technology, and compare and contrast the various options for control of fertility, methods for assisted reproductive technologies to circumvent infertility. CLO4: The origin and characteristics of common congenital malformations, the maternal responses and complications of pregnancy

	Theory	Practical	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1. **Sex Determination:** Chromosomal sex determination in mammals, Autosomal testis determining genes, Hormonal regulation of sex determination. Androgen insensitivity syndrome 2. **Reproductive cycles:** Menstrual cycle and its regulation in humans, Estrous cycle in rat, Estrous behaviour in cycling animals. 3. **Molecular bases of Fertilization in mammals:** Gamete transport, fertilization competence by gametes, capacitation, acrosome reaction, oocyte-sperm interaction, oocyte activation, gamete fusion.	15
II	4. **Hormonal regulation**: Implantation, pregnancy, parturition, oxytocin- synthesis, secretion and its role in parturition, placenta and its hormones. 5. **Mammary glands-** Structure, development and physiology of lactation, milk synthesis and secretion; regulation and ejection of milk.	15
III	6. **Apoptosis:** Molecular mechanism, regulation, and significance; Apoptosis in reproductive aging. 7. **Assisted reproductive techniques-** IVF, IUI, ICSI, GIFT, ZIFT, Surrogacy, negative aspects and recent trends in ART. 8. **Contraception:** Natural method (Fertility awareness), Surgical, Physical/Barrier methods, Chemical methods, Immunocontraception.	15
IV	9. **Reproductive failure in females**-Ovarian dysfunction, estrus abnormalities, fertilization failure, Pregnancy wastage- embryonic mortality, fetal mortality, infectious and non-infectious causes, prenatal and neonatal mortality. 10. **Reproductive failure in males**-Congenital malformations-cryptorchidism, testicular hypoplasia, ejaculatory disturbances, sperm defects, fertilization failure.	15
	Total Contact Hour	60

Suggested Evaluation Methods

Internal Assessment: 30	**End Term Examination: 70**

Theory	30	Theory:	70
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Guraya S.S. (1998). Cellular and Molecular Biology of General development and Maturation in mammals Narosa Publishing House, New Delhi.

2. Hafez E.S.E.(1994)."Reproduction in farm animals". Lea Febighiese.

3. Gurays S.S. (2000). Comparative Cellular and Molecular Biology of Ovary in mammals. I.B.H., New Delhi.

4. The Physiology of Reproduction, second edition, Vol 1 and 2, edited by Ernst Knobil and Jimmy D. Neil. Raven Press, 2014.

5. Male Reproductive Function, edited by Christina Wang. Kluwer Academic Publishers, 1999.

6. The ovary, edited by Solly Zuckerman Baron Zuckerman, Barbara J. Weir, T. G. Baker. Academic Press.

7. The ovary, edited by Peter C.K. Leung and Eli Y. Adashi, Elsevier (Academic Press), 2004.
8. Cell and Molecular Biology of Testis, edited by Claude Desjardins and Larry L. Ewing. Oxford University Press US.

9. Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management, edited by Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri. Saunders publisher.

10. Regulation of Implantation and Establishment of Pregnancy in Mammals, Editors: Rodney D Geisert, Fuller W. Bazer, ISBN 978-3-319-15856-3, Springer International Publishing, 2015. 80

11. Implantation and early development, Editors: Hilary Critchley, Ian Cameron and Stephan Smith, ISBN 9781107784680, Cambridge University press, 2014.

12. Implantation, Biological and Clinical Aspects, Editors: Michael G. Chapman, J. Gedis Grudzinskas, Tim Chard, ISBN 978-1-4471-3531-9, Springer-Verlag, 1988.

Session: 2025-26	
Part A – Introduction	
Name of Programme	**M.Sc. Zoology**
Semester	**4**
Name of the Course	**Animal Behaviour & Wildlife Conservation-II**
Course Code	**M24-ZOO-405**
Course Type	**DEC-4**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: It will boost students for betterment of diversified resources and life forms for better conservational measures with keen understanding and new approaches. CLO2: Acquire a clear understanding about social behavior patterns in animals CLO3: To know about the concept of wildlife census techniques CLO4: Detail understanding of conservational approaches in wild

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 **Social behaviour:** 1.1 Aggregations and society; 1.2 Advantages of group living; 1.3 Types of social organization in animals 1.4 Group selection, kin selection, altruism, reciprocal altruism. 1.5 Territoriality and parental care 1.6 Behaviour Ecology: Habitat selection 2.0 **Social behaviour of termites, ants and primates.** 3.0 **Various means of communication in animals:** Chemical, Visual, auditory, touch etc.	15
II	4.0 **Hormones and animal Behaviour:** Hormones important to behavioural regulation; Genetic basis of behaviour 5.0 **Aggressive behaviour**; sexual attraction and sexual behaviour. 6.0 **Pheromones and animal behaviour**: types of pheromones, role of pheromones in animal behaviour; pheromones of social insects, Human Ethology	15
III	7.0 **Wildlife Census:** Planning a wildlife census, understanding sample counts, Block counts, Road side counts, Dung counts, Pugmark census, Water-hole census. 8.0 **Study of signs and symptoms:** A practice of recording field observations, Bio-telemetry, Ageing and Sexing techniques. 9.0 **Wildlife Tourism:** Definition scope and range; Popular Wildlife Tourist Sports of the world, Popular Wildlife spots in India, Sustainable use of wildlife spots.	15

IV	10.0 **Wildlife Damage,** its nature and definition, electric fences for wildlife damage control, Basic electric fence design, Trench design, live trapping, Mist netting, Rocket netting Chemical capture: Equipment, Drugs, Plan of operation. 11.0 **Poaching:** Its definition and implications, conducting anti-poaching operations, evidence in poaching cases. 12.0 **National Projects:** Project Tiger, Project elephant, Project Rhinoceros, Project Crocodiles, Project Hangul, Manipur Brow Antlered Deer.	15
	Total Contact Hour	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Theory	**30**	**Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Techniques for wildlife Census in India by W.A. Rogers (A field mannual); Wildlife Institute of India, Dehradun.
2. Wildlife Wealth of India by T.C. Majupuria; Tecpress Services, L.P., 487/42-SOLWattenslip, Pratunam Bangkok, 10400, Thailand
3. Ali, S. Ripley S.D. Handbook of Birds of India, Pakistan 10-Vols. Oxford University Press, Bombay.
4. The Book of Indian Animals by S.H. Prater, BNHS-Publication, Bombay.
5. Wildlife in India by V.B. Saharia Natraj Publishers, Dehradun.
6. E.P. Gee, The Wildlife of India.

Session: 2025-26

Part A – Introduction

Name of Programme	**M.Sc. Zoology**
Semester	**4**
Name of the Course	**Fish, Fisheries and Aquaculture-II**
Course Code	**M24-ZOO-406**
Course Type	**DEC-4**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: The students will learn the techniques using biotechnological approach to improve fish Stock and will also understand ethics involved in it. CLO2: This core elective paper will help in learning culture techniques of aquatic organisms CLO3: This will help in developing skilled personnel in techniques of improving the fish Stock and yield of aquaculturally important aquatic organisms. CLO4: The study of culture techniques of various aquatic organisms helps in the production of healthy food for human consumption in a sustainable manner and also in employment generation.

Credits	Theory	Practical	Total
	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 Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	1.0 Introduction to fish biotechnology 2.0 Selection and hybridization 3.0 Androgenesis and Gynogenesis – natural and induced 4.0 Polyploidy techniques 5.0 Sex reversal and sterility	15
II	6.0 Transgenesis, transgenes and application 7.0 Cryopreservation of gametes and embryo 8.0 Fish-by products 9.0 Fish preservation process. 10.0 Nutritive aspect of fish meat and oil.	15
III	11.0 Different systems for aquaculture: pond culture, cage culture, raceway culture. 12.0 Culture of important fish species (Major carps, common carps, Chinese carps, cat fish culture and Tilapia culture). 13.0 Integrated Aquaculture and waste water aquaculture 14.0 Pearl Culture 15.0 Frog culture	15
IV	16.0 Prawn culture-Fresh and brackish water 17.0 Impact of Aquaculture on Environment 18.0 Methods of Fishing : Crafts and gear technology 19.0 Fish diseases and their control 20.0 Nutrition in Aquaculture 20.1 Nutrient and non-nutrient diet components 20.2 Preparation and processing of feed, feed formulae, 20.3 Natural and supplementary feed and their utilization	15
	Total Contact Hour	60

Suggested Evaluation Methods

Internal Assessment: 30		End Term Examination: 70	
Theory	30	Theory:	70
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

Ponniah, AG, Das, P & Verma SR (Ed.) (1998) Fish Genetics and Biodiversity Conservation. Nature Conservators, Muzaffarnagar, India 474pp.

Bardach, JE, Ryther, JH & Mclarnely, OW (1972) Aquaculture. Wiley Interscience

Boyd, CE (1988) Water quality management for pond fish culture. Developments in Aquaculture and Fisheries Sciences. I. Elsevier Scientific Publishing Company, Amsterdam.

Delince, G (1992) The Ecology of the fish pond system. Kluwer Academic Publishers, Netherlands, 230 pp.

Hepher, B (1975) Supplementary feeding in fish culture. In: Nutrition and Production of Fishes. Vol. 3 S. Karger, Basel : 183-198

Hoar, WS, Randall, DJ & Donaldson, ME (1983) Fish Physiology. Vol. IXA & IXB. Reproduction. Academic Press, London.

Jhingran, VG (1983) Fish and Fisheries of India. Hindustan Publishing Corporation (India) 954 pp

Tandon, KK & Johal, MS (2006) Age and Growth in Indian Freshwater Fishes.Narendra Publishing House Delhi, 232 pp.

Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, New Delhi. 755 pp.

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Part A – Introduction

Name of the Programme	**M.Sc. Zoology**
Semester	**4**
Name of the Course	**Practical based on Papers M24-ZOO-401 to M24-ZOO-403**
Course Code	**M24-ZOO-407**
Course Type	**PC-7**
Level of the course	**500-599**

Course Learning Outcomes (CLO)	CLO1:	Students will know the principle and various techniques of embryology.
	CLO2:	Students will be able to identify the various stages involved in the developing embryo of chick.
	CLO3:	They will able to demonstrate basic principles in sediment chemistry and qualitative analysis of genotoxicity.
	CLO4:	Students will able to prepare the histological slides of different tissues for clinical studies and for research purpose.

Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

Practicals

		Contact Hours
Course Contents	1. Permanent preparation of chick embryo developmental stages. 2. Studies of different types of eggs with reference to their yolk contents 3. To study internal morphology of chick egg 4. Study of development in Dictyostelium 5. Determination of various parameters of chick egg 6. To study the permanent slides of frog embryo developmental stages 7. Antigen-antibody interaction in vitro. 8. ELISA (Demonstration). 9. Phagocytosis in vitro. 10. Immunological diagnosis of pregnancy/infection/cancer. 11. To study permanent slides of Lymphoid and endocrine glands 12. Studies on vaginal smears during different stages of estrous cycle. 13. Bioassay to demonstrate toxicological effect : Micronuclei Assay and demonstration of Single Cell Gel electrophoresis to elucidate toxicological effect 14. Determination of sediment chemistry a. Moisture b. Carbonate c. Nitrate d. pH e. Phosphate f. Texture	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Practicum	**30**	**Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

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Part A – Introduction			
Name of the Programme	**M.Sc. Zoology**		
Semester	**4**		
Name of the Course	**Practical based on Papers M24-ZOO-404**		
Course Code	**M24-ZOO-408**		
Course Type	**PC-8**		
Level of the course	**500-599**		
Course Learning Outcomes (CLO)	CLO1: To develop the scientific attitude that makes the students open minded, critical observations, curiosity thinking etc. CLO2: To acquire the specialized knowledge relevant to reproductive biology and biochemistry. CLO3: To understand the basic and molecular laboratory techniques in both physiology and biochemistry. CLO4: To acquire the knowledge about various male and female infertility problems		
Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

Practicals		**Contact Hours**
Course Contents	1. Effects of pesticides, drugs, and xenobiotics on granulosa cells in vitro. 2. Effects of pesticides, oxidants, and free radicals on testicular tissue in vitro. 3. Morphological changes during spermatogenesis. 4. Effects of environmental endocrine disruptors on the fertility after exposure in vitro. 5. Estimation of catalase from reproductive tissues 6. Determination of Glutathione peroxides, glutathione reductase from reproductive tissues. 7. Lipid peroxidation by MDA method. 8. Impact of Vitamin C & E and other antioxidants on pesticides induced cytotoxicity on reproductive tissues in vitro. 9. Isolation of genomic DNA 10. Agarose Gel Electrophoresis: Practical demonstration 11. Age related changes in sperm characteristics. 12. Demonstration of Single Cell Gel electrophoresis/COMET Assay to elucidate toxicological effect.	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Practicum	**30**	**Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

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Part A – Introduction

Name of the Programme	**M.Sc. Zoology**
Semester	**4**
Name of the Course	**Practical based on Papers M24-ZOO-405**
Course Code	**M24-ZOO-408**
Course Type	**PC-8**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: It will boost students for keen understanding various population estimation methods in animal world. CLO2: Students will acquire a clear practical understanding about behavior repertoire sheets CLO3: Students will understand the practical approaches of diversity indices CLO4: Will have detail understanding of reported avifaunal status in the field

Credits	Theory	Practical	Total
	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 Time	0	4 hours	

Part B- Contents of the Course

Practicals	**Contact Hours**
Course Contents 1. To study the effect of temperature on gill movement in fishes. 2. To study nesting behaviour of squirrels in different habitats vis., urban environment, grainmarket-area, roadside plantations, orchards gardens etc. 3. Field study of burrowing behaviour of common available rodent fauna of the region. 4. Study of morphological changes in common avian species during breeding season. 5.Preparation of charts of endangered amphibians, reptiles and mammals with ecological remarks. 6. Animal behaviour patterns using Photostat sheets/ repertoire sheets. 7. Analysis of standard pug marks of large sized wild mammals. 8. Study of Migratory Birds. 9. Study of Diversity indices : use of software in calculating diversity indices. 10. Study of beaks and claws of different bird species. 11. Field visit to a zoo or wildlife part/sanctuary and preparation of field report. 12.Preparation of field diary on the basis of observations regarding habitat, habits of common available avian and rodent fauna of the region.	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Practicum	**30**	**Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

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Part A – Introduction

Name of the Programme	**M.Sc. Zoology**
Semester	**4**
Name of the Course	**Practical based on Papers M24-ZOO-406**
Course Code	**M24-ZOO-408**
Course Type	**PC-8**
Level of the course	**500-599**
Course Learning Outcomes (CLO)	CLO1: The students will be able to formulate and process fish feed using different ingredients for sustainable fish culture CLO2: This practical paper will make students capable of quantifying proximate composition of fish feed. CLO3: This will develop skilled personnel in techniques of making pituitary extract and estimating primary productivity CLO4: This will develop students capable of using different fish nets and gears for capturing fishes and also of conducting small projects.

	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 Time		4 hours	

Part B- Contents of the Course

		Contact Hours
	Practicals	120
Course Contents	1. Fish Feed formulation and processing. 2. Proximate analysis of fish feed (Determination of moisture, protein, fat, ash carbohydrate, fiber and energy). 3. Taking out of pituitary gland, preservation and preparation of extract. 4. Estimation of primary productivity 5. Study of benthic macroinvertebrates in natural water bodies. 6. Identification of eggs, spawn, fry and fingerlings of cultivable fishes of India. 7. Determination of length weight relationship. 8. Determination of age of fish using hard parts 9. Analysis of fecundity, Gonado somatic index (GSI), Hepatosomatic index (HIS) in some fishes. 10. Study of crafts and gear and method of operation (Models can also be used). 11. Visit to fish farm and fish market and preparation of report. 12. A small experimental project	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
Practicum	30	**Practicum**	70
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

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Part A – Introduction			
Name of the Programme	**M.Sc. Zoology**		
Semester	**4**		
Name of the Course	**Entrepreneurship Approaches in Zoology**		
Course Code	**M24-ZOO-409**		
Course Type	**EEC**		
Level of the course (As per Annexure-I	**500-599**		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1: CLO-2:. CLO-3: CLO-4:		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 hours		

Part B- Contents of the Course (Will be available from common pool)

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I		
II		
III		
IV		
	Total Contact Hour	30

Suggested Evaluation Methods

Internal Assessment: 15		**End Term Examination: 35**	
Theory	15	**Theory**	**35**
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	4		
• Mid-Term Exam:	7		

Part C-Learning Resources

Recommended Books/e-resources/LMS: