

Kurukshetra University, Kurukshetra

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("A++" Grade, NAAC Accredited)



**Syllabus
for
Post Graduate Programme**

M.Sc. ZOOLOGY

**as per NEP 2020
Curriculum and Credit Frame work for Postgraduate Programme**

**With CBCS-LOCF
With effect from the session 2025-26**

**DEPARTMENT OF ZOOLOGY
FACULTY OF LIFE SCIENCES**

KURUKSHETRA UNIVERSITY, KURUKSHETRA-136119

HARYANA, INDIA

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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
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. CLO 2: Acquire a clear understanding about protein sorting and their mechanisms CLO 3: To know about Recombination and repair mechanism in DNA CLO 4: 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. 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. 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. 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. 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. Recombination and Repair		15
	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. 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		
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. Molecular mapping of genome		15
	7.1	Genetic and physical maps	
	7.2	Physical mapping and map-based cloning	
	7.3	Southern and fluorecence <i>in situ</i> 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. rDNA Technology:		
	8.1	Gene-cloning	
	8.2	Vectors	
	8.3	cDNA and genomic libraries	
	8.4	Blotting techniques	
	8.5	Chromosome walking	
	8.6	Application of rDNA technology	
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 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		
Pre-requisite for the course (if any)	B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: It helps in explaining hormonal synergism and antagonism at the molecular level CLO 2: 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 CLO 3: Develop an in-depth comprehensive knowledge of endocrinology from a physiological, cellular, and molecular perspective. CLO 4: 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 ⁺⁺ , IP ₃ , 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 mammal	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 11.3Genetic basis of PCOS 12. Sequence-specific DNA binding receptor proteins 11.4 Nuclear receptor proteins 11.5 Cytosolic receptor proteins 11.6Cell surface receptor proteins 12.4 Their role in gene transcription, cell differentiation and cell proliferation. 13. Regulatory substances –Eicosanoids, Growth factors, Thymus gland & Kinins.	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.	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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: Awareness about use of certain animals and their products for human welfare <i>vis-à-vis</i> animal welfare will be created. CLO 2: Information regarding the animals that are responsible for economic losses will also be acquainted. CLO 3: Students will able to explain the basic concepts of sericulture, apiculture, lac culture and other animal industries along with economics of pest management techniques. CLO 4: Students will able to justify the animals in pharmaceutical research. CLO 5: 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. 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 and Pheromones involved in pest management. 2. Insects of medical and veterinary importance.			15
II	3. Zoonosis: 3.1 Viral-Rabies, 3.2 Japaneses encephalitis; 3.3 Bacterial- Brucellosis, Plague; 3.4 Rickettsial- Rickettsial zoonosis, Q fever, Scrub typhus. 3.5 Protozoan <i>Entamoeba histolytica</i> , <i>Plasmodium vivax</i> and <i>Trypanosoma gambiense</i>), Helminth and Nematode diseases in humans (Schistosomiasis, Cestodiasis, Termatodasis, Filariasis and Ascariasis).			15
III	Sericulture, Apiculture and Lac culture 4. 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. Apiculture : Species of honey bees in India, life history of <i>Apis cerana indica</i> , agriculture techniques, bee products and their uses, natural enemies and diseases of			15

	honey bee and their control.	
	6. 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. Wool and fur industry, leather industry.	
IV	8. Vermiculture, Poultry keeping and Dairy industry. 9. Prawn culture, Pearl culture. 10. Edible fresh water fishes and their diseases, Snakes (Haryana) and its Economic importance of snake venom 11. Pharmaceuticals from animals and role of animals in stem cell therapy. How to harvest the technology from animals for human welfare 12. Animal welfare and ethics, CPCSEA guidelines and maintenance of experimental animals	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.	Insect Pest Management by Dent, D.	
2.	Agricultural Entomology by Hill, D.S., Timber Press.	
3.	General and Applied Entomology by David, B. V. & Ananthkrishnan, 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 McGraw 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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: The cellular, molecular and biochemical changes in reproductive physiology CLO 2: The basic and molecular concepts of spermatogenesis folliculogenesis, ovulation, follicular atresia and germ line- soma interaction. CLO 3: The importance of diet, exercise, stress and yoga during ageing CLO 4: 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. Follicular atresia: Causes, regulation and significance, factors affecting atresia, role of granulosa cells apoptosis in atresia. 11. Male sterility- Azoospermia, Oligozoospermia, Asthenozoospermia, Varicocele, Genetic basis for male infertility. 12. Female infertility- genetic and endocrinal factors, PCOD, atresia.			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:			
• Guraya S.S. (1998). Cellular and Molecular Biology of General development and Maturation in mammals Narosa Publishing House, New Delhi. • Hafez E.S.E.(1994). “Reproduction in farm animals”. Lea Febighiese. • Gurays S.S. (2000). Comparative Cellular and Molecular Biology of Ovary in mammals. I.B.H., New Delhi. • The Physiology of Reproduction, second edition, Vol 1 and 2, edited by Ernst Knobil and Jimmy D. Neil. <i>Raven Press</i>, 2014. • Male Reproductive Function, edited by Christina Wang. <i>Kluwer Academic Publishers</i>, 1999. • The ovary, edited by Solly Zuckerman Baron Zuckerman, Barbara J. Weir, T. G. Baker. <i>Academic Press</i>. • The ovary, edited by Peter C.K. Leung and Eli Y. Adashi, Elsevier (Academic Press), 2004. • Cell and Molecular Biology of Testis, edited by Claude Desjardins and Larry L. Ewing. <i>Oxford University Press US</i>. • Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management, edited by Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri. <i>Saunders publisher</i>. • 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. • Implantation and early development, Editors: Hilary Critchley, Ian Cameron and Stephan Smith, ISBN 9781107784680, Cambridge University press, 2014. • Implantation, Biological and Clinical Aspects, Editors: Michael G. Chapman, J. Geddis 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 and Wildlife Conservation – I		
Course Code	M24-ZOO-305		
Course Type	DEC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: It will boost students for betterment of diversified resources and life forms for better conservational measures with keen understanding. CLO 2: Acquire a clear understanding about behavior patterns in animals CLO 3: Students will be aware and understand the concept of protected area system CLO 4: 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 behavior	15	

III	8. ildlife: Definition, significance and Biogeographic/wildlife zones of India, Bio-diversity of the Indian Subcontinent and World. 9. roTECTED 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. heory and Practice of Biosphere Reserves of the world: Biosphere Reserves of India, Wildlife conservation techniques.	15
IV	11. atural Heritage Sites of the world, Natural Heritage sites in India. Important National Park and Wildlife Sanctuaries of India 12. ildlife and livelihood; Wildlife and illegal trade & control; 13. ole of WWF, IUCN, UNEP, 14. ed Data Book; Categories of Endangered Wildlife Species.	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. 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		
Pre-requisite for the course (if any)	B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: Through this core elective paper student/s will learn identification of fish species using classical morphological methods CLO 2: This core elective paper will generate knowledge about various methods and significance of aquaculture CLO 3: It will create awareness about food security, significance of protein in diet and importance of fish in fighting protein deficiency CLO 4: It will also be helpful in acquainting with methods of conserving fish diversity.		
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. Definition of Fish, Fisheries and aquaculture; Types of Aquaculture 2. Classification of fishes with distinguishing characters and examples of each group. 3. Estuarine, Marine, Riverine and wetland fisheries: characteristic species and their exploitation 4. Culture fisheries 4.1 Cultivable organisms for aquaculture. 4.2 Criteria of selection of cultivable fishes	15	
II	5. Design, construction and maintenance of fish culture ponds. 6. 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. Aquatic pollution: Sources of water Pollution, Impact of pollution on aquatic organisms, Impact of exotic fish species on aquatic biodiversity, Fishes and their relationships with abiotic and biotic factors. 8. Aquaculture Ranching and Rational fishery.	15	

III	9.	Fish integument: Exoskeleton and colouration	15	
	10.	Fins: origin, types and functions		
	11.	Food and feeding habits of fishes, Digestion in fishes		
	12.	Respiratory system Gill structure and functions, Accessory respiratory organs swim bladder and webberian ossicles		
	13.	Osmoregulation in fishes		
IV	14.	Receptors in fishes 14.1 Chemoreceptors 14.2 Lateral line organs 14.3 Eye Ear 14.4 Pineal organ	15	
	15.	Hormones and reproduction: Induced breeding in carps and catfishes.		
	16.	Identification of different maturity stages of fishes.		
	17.	Migration in fishes		
	18.	Age and growth studies		
	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. Ponniah, AG, Das, P & Verma SR (Ed.) (1998) Fish Genetics and Biodiversity Conservation. Nature Conservators, Muzaffarnagar, India 474pp.				
2. Bardach, JE, Ryther, JH & Mclarnely, OW (1972) Aquaculture. Wiley Interscience				
3. Boyd, CE (1988) Water quality management for pond fish culture. Developments in Aquaculture and Fisheries Sciences. I. Elsevier Scientific Publishing Company, Amsterdam.				
4. Delince, G (1992) The Ecology of the fish pond system. Kluwer Academic Publishers, Netherlands, 230 pp.				
5. Hoar, WS, Randall, DJ & Donaldson, ME (1983) Fish Physiology. Vol. IXA & IXB. Reproduction. Academic Press, London.				
6. Jhingran, VG (1983) Fish and Fisheries of India. Hindustan Publishing Corporation (India) 954 pp				
7. Tandon, KK & Johal, MS (2006) Age and Growth in Indian Freshwater Fishes.Narendra Publishing House Delhi, 232 pp.				
8. Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, New Delhi. 755 pp.				

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-301 to M24-ZOO-303			
Course Code		M24-ZOO- 307			
Course Type		PC-5			
Level of the course		500-599			
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology			
Course Learning Outcomes (CLO)	CLO 1: 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. CLO 2: Will understand the basic concepts of applied Zoology in human welfare. CLO 3: Will be able to perform electrophoresis for scope in research field. CLO 4: Study of endocrinology will help the student to identify the organs involved in the endocrine function and which help in understanding human endocrine disorder.				
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. 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. <i>In-vitro</i> 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 preparation of gel 10. Collection of different larva of mosquitoes:- <i>Culex</i> ; <i>Anopheles</i> ; <i>Aedes</i> , marking out the basic morphological differences at larval level. 11. Preparation of permanent mounts of adult mosquitoes: <i>Culex</i> and <i>Aedes</i> and <i>Anopheles</i> - 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		
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: 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			
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology			
Course Learning Outcomes (CLO)	CLO 1: To develop the scientific attitude that makes the students open minded, critical observations, curiosity thinking etc. CLO 2: To acquire the specialized knowledge relevant to reproductive biology and biochemistry. CLO 3: To understand the basic and molecular laboratory techniques in both physiology and biochemistry. CLO 4: 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 <i>in vitro</i> . 12. <i>In vitro</i> 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		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
• Guraya S.S. (1998). Cellular and Molecular Biology of General development and Maturation in mammals Narosa Publishing House, New Delhi. • Hafez E.S.E.(1994). “Reproduction in farm animals”. Lea Febighiese. • Gurays S.S. (2000). Comparative Cellular and Molecular Biology of Ovary in mammals. I.B.H., New Delhi. • The Physiology of Reproduction, second edition, Vol 1 and 2, edited by Ernst Knobil and Jimmy D. Neil. <i>Raven Press</i>, 2014. • Male Reproductive Function, edited by Christina Wang. <i>Kluwer Academic Publishers</i>, 1999. • The ovary, edited by Solly Zuckerman Baron Zuckerman, Barbara J. Weir, T. G. Baker. <i>Academic Press</i>. • The ovary, edited by Peter C.K. Leung and Eli Y. Adashi, Elsevier (Academic Press), 2004. • Cell and Molecular Biology of Testis, edited by Claude Desjardins and Larry L. Ewing. <i>Oxford University Press US</i>. • Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management, edited by Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri. <i>Saunders publisher</i>. • 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. • Implantation and early development, Editors: Hilary Critchley, Ian Cameron and Stephan Smith, ISBN 9781107784680, Cambridge University press, 2014. • Implantation, Biological and Clinical Aspects, Editors: Michael G. Chapman, J. Geddis Grudzinskas, Tim Chard, ISBN 978-1-4471-3531-9, Springer-Verlag, 1988. •			

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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: It will boost students for keen understanding various behavioral activity of animal world CLO 2: Students will acquire a clear practical understanding about behavior patterns in animals CLO 3: Students will know about the practical approaches of protected area system in India CLO 4: 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. 1. To demonstrate locomotive, explorative withdrawal and habituation behaviours in animals. 2. To demonstrate response of animals to light. 3. To demonstrate antennal grooming behaviour in cockroach. 4. Demonstration of food preferences in insects/pests 5. Investigation of habituation of diving response of mosquito larvae. 6. To study the effect of temperature on heartbeat of cockroach/ Gill movements in Fishes. 7. Field study of nesting behaviour of common available avian fauna of the region. 8. Study of Migratory Birds 9. To study mobbing response of birds. 10. Study of animal behavior patterns using repertoire sheets. 11. To prepare charts of wildlife zones of India and the world. 12. 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		
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 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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: Student/s will be able to identify of fish species using classical morphological methods CLO 2: Students will be able to analyse physico- chemical status of water of lotic and lentic Components CLO 3: Students will be able to conduct qualitative and quantitative analysis of phyto and Zooplanktons CLO 4: 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		
Part C-Learning Resources			
Recommended Books/e-resources/LMS:			
1. Ponniah, AG, Das, P & Verma SR (Ed.) (1998) Fish Genetics and Biodiversity Conservation. Nature Conservators, Muzaffarnagar, India 474pp.			
2. Bardach, JE, Ryther, JH & Mclarnely, OW (1972) Aquaculture. Wiley Interscience			
3. Boyd, CE (1988) Water quality management for pond fish culture. Developments in Aquaculture and Fisheries Sciences. I. Elsevier Scientific Publishing Company, Amsterdam.			
4. Delince, G (1992) The Ecology of the fish pond system. Kluwer Academic Publishers, Netherlands, 230 pp.			
5. Hoar, WS, Randall, DJ & Donaldson, ME (1983) Fish Physiology. Vol. IXA & IXB. Reproduction. Academic Press, London.			
6. Jhingran, VG (1983) Fish and Fisheries of India. Hindustan Publishing Corporation (India) 954 pp			
7. Tandon, KK & Johal, MS (2006) Age and Growth in Indian Freshwater Fishes.Narendra Publishing House Delhi, 232 pp.			
8. Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, New Delhi. 755 pp.			

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 by students of other Departments)		
Level of the course (As per Annexure-I)	500-599		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) :	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			
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. Wildlife: Definition, significance 2. Techniques of animal counts (Examples of Tiger count)		7.5
II	3. Wildlife zones of the India 4. Wildlife Tourism		7.5
III	5. Biodiversity: Concept, threats to biodiversity, its 6. Conservation (objectives and strategies), biodiversity indices,		7.5
IV	7. Concept and objectives of Protected areas: 8. Important Protected Areas of India (Biosphere reserve, National Park & Wildlife sanctuaries) 9. Red Data Book, IUCN Categories of wildlife species		7.5
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: 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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: Based on learning contents of embryology, students can have a systematic and organised learning about the knowledge and concepts of growth and development. CLO 2: 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 CLO 3: To understand biological processes that takes place in and between cells and in and between organisms in nature. CLO 4: 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			15

	5.2 Proximate tissue interactions 5.3 Genetics of axis specification in <i>Drosophila</i>	
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, <i>Drosophila</i> 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 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 .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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: How the immune system can fight infection and other diseases CLO 2: The strategies to improve existing vaccines and how to approach these CLO 3: Cellular and molecular basis of inflammatory response CLO 4: 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. 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. Nature of antigens and superantigens 2.1 Antigenicity and immunogenicity 2.2 Factors influencing immunogenicity 2.3 Epitopes and haptens 3. Structure and Functions of Antibodies 3.1 Classes and subclasses 3.2 Gross and Fine structure 3.3 Antibody mediated effector functions 4. Antigen-Ab interactions: Principles and Applications 4.1 Cross Reactivity, Precipitation reactions, Agglutination reactions 4.2 Radioimmunoassay, ELISA, Immunoprecipitation, Immunofluorescence			15
II	5. Nature of immune response 5.1 Humoral Immune Response 5.2 Cellular Immune Response 6. Cytokines 6.1 Cytokine Properties 6.2 Cytokine receptors 6.3 Cytokines and Immune response 6.4 Cytokine Antagonists			15

	6.5 Cytokine Related Diseases	
	7. 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	
	8. Hypersensitivity -Types and Mechanism.	
III	9. Complement System 9.1 Components and functions of Complement system 9.2 Pathways of complement system 9.3 Regulation and biological consequences. 10. 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. 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. 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. 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. Auto-immunity and Vaccines - Types – subunit, conjugate and recombinant vector vaccines.	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. 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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: The awareness about toxic agents, their different routes of exposure and their effects on humans and their livestock will be apprised. CLO 2: The students will have the knowledge about mode of transformation of toxicants CLO 3: It will help in creating skilled personnel in the field of environment protection and research. CLO 4: 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. 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. Toxic agents: Pesticides, metals, solvents radiation, carcinogens, poisons, bio-toxins, petrochemicals.			15
II	3. 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. Xenobiotics: Definition, types and significance Target organ toxicity: 4.1 Hematotoxicity 4.2 Hepatotoxicity 4.3 Nephrotoxicity 4.4 Neurotoxicity			15
III	5. Environmental Toxicology: Food additives, air, water and soil pollutants and Bio-indicators. 6. Effect of pollutant on ecosystem with case study of important Organo-phosphorous and Organo-chlorine pesticides and Nitrates 7. Solid waste management: Primary waste products-Solid waste, toxic biological and hospital landfills, incineration, source reduction and recycling.			15

IV	8. Bioremediation, its role and significance. 9. Toxicological risk assessment and management with reference to relevant case study. 10. Principles and significance of systematic toxicology. 11. Genotoxicology: Definition, Effects, molecular mechanisms and prevention. 12. Applications of toxicology anthropogenic activities and environment. 13. Human toxicology and medicinal ethics.	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.	Handbook of Solid Waste Management by Wilson, Van Nostrand, Reinhold.	
2.	Environmental Studies by D.B. Botkin, & E.A. Keller, Martill Publisng 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		
Pre-requisite for the course (if any)	B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: Basic and molecular concepts of reproductive physiology. CLO 2: Cellular and molecular mechanisms of fertilization, implantation, pregnancy and lactation CLO 3: 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. CLO 4: The origin and characteristics of common congenital malformations, the maternal responses and complications of pregnancy.		
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. 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.	15	
	10. Reproductive failure in males -Congenital malformations-cryptorchidism, testicular hypoplasia, ejaculatory disturbances, sperm defects, fertilization failure		
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.	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. <i>Raven Press</i> , 2014.		
5.	Male Reproductive Function, edited by Christina Wang. Kluwer <i>Academic Publishers</i> , 1999.		
6.	The ovary, edited by Solly Zuckerman Baron Zuckerman, Barbara J. Weir, T. G. Baker. <i>Academic Press</i> .		
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. <i>Oxford University Press US</i> .		
9.	Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management, edited by Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri. <i>Saunders publisher</i> .		
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		4		
Name of the Course		Animal Behaviour and Wildlife Conservation – II		
Course Code		M24-ZOO-405		
Course Type		DEC-4		
Level of the course		500-599		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1:	It will boost students for betterment of diversified resources and life forms for better conservational measures with keen understanding and new approaches.		
	CLO 2:	Acquire a clear understanding about social behavior patterns in animals		
	CLO 3:	To know about the concept of wildlife census techniques		
	CLO 4:	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. 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. Social behaviour of termites, ants and primates. 3. Various means of communication in animals: Chemical, Visual, auditory, touch etc.			15
II	4. Hormones and animal Behaviour: Hormones important to behavioural regulation; Genetic basis of behaviour 5. Aggressive behaviour; sexual attraction and sexual behaviour. 6. Pheromones and animal behaviour: types of pheromones, role of pheromones in animal behaviour; pheromones of social insects, Human Ethology			15

III	7. Wildlife Census: Planning a wildlife census, understanding sample counts, Block counts, Road side counts, Dung counts, Pugmark census, Water-hole census. 8. Study of signs and symptoms: A practice of recording field observations, Bio-telemetry, Ageing and Sexing techniques. 9. 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. 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. Poaching: Its definition and implications, conducting anti-poaching operations, evidence in poaching cases. 12. National Projects: Project Tiger, Project elephant, Project Rhinoceros, Project Crocodiles, Project Hangul, Manipur Brow Antlered Deer.	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.	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-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.	
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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		
Pre-requisite for the course (if any)	B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: The students will learn the techniques using biotechnological approach to improve fish stock and will also understand ethics involved in it. CLO 2: This core elective paper will help in learning culture techniques of aquatic organisms CLO 3: This will help in developing skilled personnel in techniques of improving the fish Stock and yield of aquaculturally important aquatic organisms. CLO 4: 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. Introduction to fish biotechnology 2. Selection and hybridization 3. Androgenesis and Gynogenesis – natural and induced 4. Polyploidy techniques 5. Sex reversal and sterility		15
II	6. Transgenesis, transgenes and application 7. Cryopreservation of gametes and embryo 8. Fish-by products 9. Fish preservation process 10. Nutritive aspect of fish meat and oil.		15
III	11. Different systems for aquaculture: pond culture, cage culture, raceway culture. 12. Culture of important fish species (Major carps, common carps, Chinese carps, cat fish culture and Tilapia culture). 13. Integrated Aquaculture and waste water aquaculture		15

	14. Pearl Culture 15 Frog culture	
IV	16.Prawn culture-Fresh and brackish water 17. Impact of Aquaculture on Environment 18. Methods of Fishing : Crafts and gear technology 19. Fish diseases and their control 20. 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 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. Ponniah, AG, Das, P & Verma SR (Ed.) (1998) Fish Genetics and Biodiversity Conservation. Nature Conservators, Muzaffarnagar, India 474pp.		
2. Bardach, JE, Ryther, JH & McLarnely, OW (1972) Aquaculture. Wiley Interscience		
3. Boyd, CE (1988) Water quality management for pond fish culture. Developments in Aquaculture and Fisheries Sciences. I. Elsevier Scientific Publishing Company, Amsterdam.		
4. Delince, G (1992) The Ecology of the fish pond system. Kluwer Academic Publishers, Netherlands, 230 pp.		
5. Hepher, B (1975) Supplementary feeding in fish culture. In: Nutrition and Production of Fishes. Vol. 3 S. Karger, Basel : 183-198		
6. Hoar, WS, Randall, DJ & Donaldson, ME (1983) Fish Physiology. Vol. IXA & IXB. Reproduction. Academic Press, London.		
7. Jhingran, VG (1983) Fish and Fisheries of India. Hindustan Publishing Corporation (India) 954 pp		
8. Tandon, KK & Johal, MS (2006) Age and Growth in Indian Freshwater Fishes.Narendra Publishing House Delhi, 232 pp.		
9. Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, New Delhi. 755 pp.		

Session: 2025-26				
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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: Students will know the principle and various techniques of embryology. CLO 2: Students will be able to identify the various stages involved in the developing embryo of chick. CLO 3: They will able to demonstrate basic principles in sediment chemistry and qualitative analysis of genotoxicity. CLO 4: 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 5. Antigen-antibody interaction in vitro. 6. ELISA (Demonstration). 7. Phagocytosis <i>in vitro</i> . 8. Immunological diagnosis of pregnancy/infection/cancer. 9. To study permanent slides of Lymphoid and endocrine glands 10. Studies on vaginal smears during different stages of estrous cycle. 11. Bioassay to demonstrate toxicological effect: Micronuclei Assay and demonstration of Single Cell Gel electrophoresis to elucidate toxicological effect 12. 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		
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. An Introduction to Embryology by B.I. Balinsky, Saunders, Philadelphia (1981). 3. Major Problems in Developmental Biology by H. Ursprung, Academic Press, New York, (1972). 4. The Control of Gene Expression in Animal Development by J.B. Gurdon, Harvard University, Press, Oxford (1974). 5. Gene activity in Early Development by Davdson, E.H. Academic Press, London (1977). 6. Kuby. Immunology, W.H. Freeman, USA. 7. Fundamentals of Immunology by William E. Paul, Lippincott Williams & Wilkins Publishing [Latest edition]. 8. Cellular and Molecular Immunology by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, Elsevier Publishing [Latest edition]. 9. Bioremediation Technology by Fulekar, M.H. 10. Ecotoxicology: The study of pollutants in ecosystems. 3rd Ed. Elsevier by Moriarty, F. 11. Handbook of Environmental Health and Safety – principle and practices by H. Koren; Lewis Publishers 12. Introduction to Toxicology, 3rd Ed. Taylor & Francis, London by Timbrell, J.			

Session: 2025-26				
Part A – Introduction				
Name of the Programme		M.Sc. Zoology		
Semester		4		
Name of the Course		Practical based on Papers M24-ZOO-404/ M24-ZOO-408		
Course Code		M24-ZOO-408		
Course Type		PC-8		
Level of the course		500-599		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: To develop the scientific attitude that makes the students open minded, critical observations, curiosity thinking etc. CLO 2: To acquire the specialized knowledge relevant to reproductive biology and biochemistry. CLO 3: To understand the basic and molecular laboratory techniques in both physiology and biochemistry. CLO 4: 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 <i>in vitro</i> . 2. Effects of pesticides, oxidants, and free radicals on testicular tissue <i>in vitro</i> . 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 <i>in vitro</i> . 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		
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. <i>Raven Press</i> , 2014.		
5.	Male Reproductive Function, edited by Christina Wang. <i>Kluwer Academic Publishers</i> , 1999.		
6.	The ovary, edited by Solly Zuckerman Baron Zuckerman, Barbara J. Weir, T. G. Baker. <i>Academic Press</i> .		
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. <i>Oxford University Press US</i> .		
9.	Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management, edited by Samuel S. C. Yen, Robert B. Jaffe, Robert L. Barbieri. <i>Saunders publisher</i> .		
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. Geddis Grudzinskas, Tim Chard, ISBN 978-1-4471-3531-9, Springer-Verlag, 1988.		

Session: 2025-26				
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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: It will boost students for keen understanding various population estimation methods in animal world. CLO 2: Students will acquire a clear practical understanding about behavior repertoire sheets CLO 3: Students will understand the practical approaches of diversity indices CLO 4: 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, grain-market-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		
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-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 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		
Pre-requisite for the course (if any)		B.Sc. Honours with Zoology/ Honours with Research in Zoology/PG Diploma in Zoology after UG, Zoology		
Course Learning Outcomes (CLO)	CLO 1: The students will be able to formulate and process fish feed using different ingredients for sustainable fish culture CLO 2: This practical paper will make students capable of quantifying proximate composition of fish feed CLO 3: This will develop skilled personnel in techniques of making pituitary extract and estimating primary productivity CLO 4: This will develop students capable of using different fish nets and gears for capturing fishes and also of conducting small projects .			
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. 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 macro-invertebrates 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			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. Ponniah, AG, Das, P & Verma SR (Ed.) (1998) Fish Genetics and Biodiversity Conservation. Nature Conservators, Muzaffarnagar, India 474pp.			
2. Bardach, JE, Ryther, JH & McLarnely, OW (1972) Aquaculture. Wiley Interscience			
3. Boyd, CE (1988) Water quality management for pond fish culture. Developments in Aquaculture and Fisheries Sciences. I. Elsevier Scientific Publishing Company, Amsterdam.			
4. Delince, G (1992) The Ecology of the fish pond system. Kluwer Academic Publishers, Netherlands, 230 pp.			
5. Hepher, B (1975) Supplementary feeding in fish culture. In: Nutrition and Production of Fishes. Vol. 3 S. Karger, Basel : 183-198			
6. Hoar, WS, Randall, DJ & Donaldson, ME (1983) Fish Physiology. Vol. IXA & IXB. Reproduction. Academic Press, London.			
7. Jhingran, VG (1983) Fish and Fisheries of India. Hindustan Publishing Corporation (India) 954 pp			
8. Tandon, KK & Johal, MS (2006) Age and Growth in Indian Freshwater Fishes.Narendra Publishing House Delhi, 232 pp.			
9. Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, New Delhi. 755 pp.			

Session: 2025-26			
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		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) :	CLO 1: Enhance the skills like innovativeness, creativity to enhance the business performance. CLO 2: Student will be able to assess their readiness or ability for entrepreneurship. CLO: 3: Student are able to create presentations and business plans CLO 4: Enable students to identify and make the most opportunities, overcome and learn from setbacks.		
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			
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	Introduction to Zoological Entrepreneurship 1. Concept and scope of entrepreneurship in biological sciences 2. Role of a zoologist as an entrepreneur 3. Types of zoology-based ventures: profit, non-profit, and social enterprises 4. Government schemes and startup support (Make in India, Startup India, MSME)	7.5	
II	Wildlife and Eco-Tourism Enterprise 4. Basics of eco-tourism and its ecological implications 5. Designing nature-based tourism: safaris, trails, herping, birdwatching 6. Legal and ethical considerations (Wildlife Protection Act, 1972) 7. Case studies: Gir National Park, Kaziranga, Great Himalayan National Park	7.5	
III	Bio-products, Animal Farming, and Biotechnology 8. Sustainable use of animal resources: sericulture, aquaculture, apiculture 9. Insect-based products (e.g., biofertilizers, food products) 10. Fish Farming, ornamental fish breeding, vermiculture, Butterfly farming 11. Wildlife forensics, DNA barcoding, Bioinformatics and biotech service startups,. AI and Machine learning techniques for studying animal behavior	7.5	

IV	Enterprise Development & Zoological Communication • Basic business planning: idea to implementation • Marketing and outreach strategies for Zoological enterprise • Fundraising, proposal writing, and networking with NGOs/CSR agencies • Media, digital platforms, and content creation (blogs, YouTube, reels)	7.5	
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:			

DISSERTATION

(Note : If A Candidate Is Offered Dissertation Course, Then He/ She Will Also Study CC-11, Dec-4 & EEC From Above Courses Of Semester4)

4	Dissertation/ Project work	M24- ZOO- 410	Dissertation/ Project work	D	12	26	0	0	0	-	0	300	300	-
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Course Learning Outcomes (CLO)

Students will be able to

CLO 1:Formulate a focused research question and design a robust, methodologically sound investigation to address it.

CLO 2:Employ appropriate experimental, analytical, or field techniques to collect, analyze, and interpret botanical data effectively.

CLO 3:Critically evaluate research findings in light of existing theories, and communicate results clearly through well-structured scientific writing and presentations.

CLO 4;Exhibit independence, time management, and scientific integrity throughout the research process, while responding thoughtfully to feedback and defending

Description

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Each student is required to undertake a research project in a relevant area of Zoology. The outcome of this research will be compiled into a dissertation and submitted for evaluation at the end of the semester. Students will also present their dissertation before an external examiner. Both internal and external assessments of the project and training will be conducted as per the prescribed evaluation criteria.

Assessment Structure

Internal Assessment:

- Submission of Dissertation
- One Mid-Semester Progress Report and/or Presentation

External Assessment:

- Final Project Report (Dissertation)
- Viva-Voce Presentation before an External Examiner

Dissertation Report Submission Guidelines

1. Structure of the Dissertation Report:

The dissertation should include the following components in order:

- Cover page
- Certificate signed by the student and supervisor
- Table of contents
- Introduction
- Objectives
- Literature review
- Methodology
- Results and Discussion
- Conclusion
- References

2. Formatting Requirements:

- Paper size: A4
- Font: Times New Roman, size 12
- Line spacing: 1.5 (one and a half spacing)
- Printing: Double-sided (print on both sides of the paper)
- Length: The written portion should be between 40 to 60 pages

3. Submission Requirements:

- Students must submit **three hard-bound copies** of the dissertation along with a **CD** containing a soft copy, to the department by the specified deadline.

4. Evaluation and Presentation:

- The student will be required to **defend the dissertation/project work** through a formal **presentation before an external examiner** at the end of the semester.
- Marks will be awarded based on both the written report and the oral presentation.