Chaudhary Bansi Lal University, Bhiwani

(A State University established under Haryana Act No. 25 of 2014)

Department of Zoology

Syllabus and Examination Scheme

For

M.Sc. Zoology

In accordance with NEP-2020

w.e.f. 2025-2026

(2025-26)

Chaudhary Bansi Lal University, Bhiwani

(A State University established under Haryana Act No. 25 of 2014)

Evaluation Scheme
of
M.Sc. Zoology
Summary

Programme : M.Sc. in Zoology
Duration : Two year (Four Semesters)
Maximum Durations : Four Years
Minimum Attendance Required : 75%
Total Credits :100
Total Marks : 2100 (Option I in IVth Sem.)
: 2200 (Option II in IVth Sem.)

Medium of Instructions and Examinations : English

Assessment/Evaluation of Theory examination:

Internal Marks	Major Test (End Semester Exam) Marks	Total Marks
30	70	100
15	35	50

Internal Evaluation:

Minor Test Marks	Attendance Marks	Assignment/ Quiz Marks	Total Marks
15	05	10	30
07	04	04	15

Duration of Examination:

Minor Test (Internal)	Major Test
1 hour for 15 Marks and 30 minutes for 7 marks	3 hours for 70 marks and 2 hours for 35 marks

Passing Criteria: *The pass percentage will be 40 percent (Grade 'P'), both for theory and practical and end term examinations. A student has to obtain minimum 40% marks (Grade 'P') in aggregate (Sum of internal assessment and end term examination marks) and in the end term examinations separately to qualify a course.*

The IKS is 5% in the syllabus of Zoology including Assignments.

For other details: See Ordinance for PG Programme

SEMESTER-II **CREDTS:26** **MARKS: 550**

Sr. No	Paper Code	Subjects	Type of Course	Contact hours per week			Credits			Examination Scheme			
				Theory	Practical	Total	Theory	Practical	Total	Theory	Internal Assessments	Practical	**Total**
1	25ZOO201	Diversity of Vertebrates	CC-5	04	-	04	04	-	04	70	30	-	100
2	25ZOO202	Molecular Biology	CC-6	04	-	04	04	-	04	70	30	-	100
3	25ZOO203	Parasitology	CC-7	04	-	04	04	-	04	70	30	-	100
4	25ZOO204 OR 25ZOO205	Biosystematics and Biosafety OR Genomics and Proteomics	D.E.C.-1 OR D.E.C.-2	04	-	04	04	-	04	70	30	-	100
5	25ZOO206	**Lab course I**	PC-3	-	08	08	-	04	04	-	-	50	50
6	25ZOO207	**Lab course II**	PC-4	-	08	08	-	04	04	-	-	50	50
7	25ZOO208	Environmental studies and Sustainable development	VAC/IKS (Opt any one)	02	-	02	02	-	02	-	50	-	50
8	25ZOO209	Indian Knowledge Systems in Biology											
	TOTAL			**18**	**16**	**34**	**18**	**8**	**26**	**315**	**135**	**100**	**550**

CC =Core Course VAC =Value Added Course IKS= Indian Knowledge System DEC = Discipline Elective Courses PC= Practical Course

MOOC courses might also be adopted after discussion with the MOOC coordinator of the department.

Programme Learning Outcomes (PLOs) of the M.Sc. Zoology, Department of Zoology, CBLU

PLO1 Students will have knowledge and skills and in-depth acquaintance of animal species, their life biology, evolution, interaction with the environment at organismal, cellular and molecular level

PLO2 Students will understand the challenges of society and the country that falls into the realms of Zoology, such as Aquaculture, Reproductive health, Animal Behavior, Cancer Biology, Micro biome and their roles in health and diseases, Bioremediation of pollutants and pesticides.

PLO3 Students will be trained to identify, review, and analyze complex situations of living forms and develop commitment to professional ethics, responsibilities and norms of the work practice related to biological systems.

PLO4 Students will be made capable of applying knowledge-based methods with development of problem-solving expertise and robust communication skills.

PLO5 This Programme will develop personnel who can function effectively as an individual or leader in diverse teams, and in multidisciplinary settings with deep understanding of Zoology.

PLO6 This Programme will develop students with excellence in Zoology for career in teaching, research, industry, entrepreneurship etc.

PLO7 Students will develop a strong understanding of Biodiversity Conservation, Ecosystem functioning, Environmental Sustainability, Wild life protection and climate change, along with the knowledge of relevant environmental laws and policies, enabling them to contribute effectively to conservation and sustainable development and initiatives.

M.Sc. Zoology
Semester II
25ZOO201 Diversity of Vertebrates

Maximum Marks: 100 **Theory Examination: 70**
Time: 3 hrs **Internal Assessment: 30**

Objectives:

1. This paper deals with the comparative and evolutionary trends in structure and function of the organ systems of the vertebrate series.
2. To understand what are the general characters and different categories of chordates animal.
3. To understands the level of organization in chordate subphylum.
4. To understand the origin and evolutionary relationship in different subphylum of chordates.

Outcomes:

CO1 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.

CO2 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.

CO3 Students will also Understand the Classification various classes of phylum Chordate i.e., Pisces, Reptiles, Aves and Mammals.

CO4 This core course will make students familarise with the vertebrate diversity around them

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of seven short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit-I

Origin of Chordates: introduction with general characters and classification upto orders of phylum Protochordata, hemichordate, urochordata& chordate, General structure and function of vertebrate integument and its derivatives, Glands, scales, horns, claws, feathers and hairs

Unit –II

Comparative account of jaw suspensorium, Digestive system: Comparative account of Dentition, Stomach, Digestive organs & Glands Respiratory system: Internal and External Respiration, Comparative account of respiratory organs in vertebrates

Unit –III

Evolution of heart and aortic arches and Portal systems of vertabrates, Evolution of Urinogenital system in vertebrate, Flight adaptation in birds, Migration in fish and Birds, parental care in all chordates.

Unit –IV

Comparative account structure of brain & spinal cord in vertebrates, Comparative account of hearing and Vision in Vertebrates, Lateral line system, Evolution of Man, Horse, and Elephant.

Suggested Readings:

Text Books:

1. Sedgwick, A. A Students Text Book of Zoology, Vol. II.
2. Kotpal R.L. modern text book of zoology Vertebrates, Rastogi publications

Reference Books:

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. Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates. Central Book Depot, Allahabad.
4. Kent, C.G. Comparative anatomy of vertebrates.
5. Milton Hilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
6. Walters, H.E. and Sayles, L.D. Biology of vertebrates. MacMillan & Co., New York.
7.Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn. McGraw Hall Book Co., New York.

Teaching-Learning Process

- Lectures: Supported by power point presentations and related videos
- Assignments and exercises
- Test: Knowledge of the students is tested through surprise tests, quiz & session tests.

Course mapping

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CO1	√	√	√	×	√	√	√
CO2	√	×	√	×	√	√	√
CO3	√	√	√	√	√	√	√
CO4	√	√	√	√	√	√	√

M.Sc. Zoology
Semester II
25ZOO202 Molecular Biology

Maximum Marks: 100 **Theory Examination: 70**
Time: 3 hrs **Internal Assessment: 30**

Objective: To make students understand the complex molecular mechanisms occurring in cell and the applications of molecular technologies.

Outcomes:

CO1 Learn the necessary information about the chemistry of life to allow the students to understand the basis of molecules of life.
CO2 Acquire a clear understanding about protein sorting and their mechanisms
CO3 To know about Recombination and repair mechanism in DNA
CO4 Detail understanding of molecular techniques of genomes analysis

Note: There shall be nine questions in all. Question no. 1 shall be compulsory; consisting of seven short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit-I

DNA Replication: Mechanism of DNA replication in Prokaryotic and Eukaryotic cells. Enzymes and accessory proteins involved in DNA replication and DNA repair. Transcription: Prokaryotic & Eukaryotic transcription, RNA polymerase, General and specific transcription factors & their regulation, Transcriptional and post-transcriptional gene silencing, Modifications in RNA: 5'-Cap formation, Transcription termination, 3'-end processing and Polyadenylation, Splicing, Editing, Nuclear export of mRNA & its stability.

Unit -II

Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping Translation: Prokaryotic and Eukaryotic translation, Regulation of translation, genetic code, co-and post translational modifications of proteins.

Unit -III

Biochemistry of ribozyme; hammer head & their designing strategies, hairpin and other ribozymes, Homologous Recombination: Holliday junction, excision repair, RecA and other recombinases and. DNA repair mechanisms. Molecular gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination,

Unit -IV

Genome Sequencing: Genome sizes, organelle genomes, Genomic libraries, YAC, BAC libraries, Packaging, transfection and recovery of clones, Application of Sequencing: sequence information for identification of defective genes

Suggested Readings:

Text Books:

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. Gene XI, Benjamin Lewin, Oxford University Press, U.K.

Reference Books:

1. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
2. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed.), VCH Publishers, Inc., New York.
3. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
4. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York.
5. Molecular Biology Lab Fax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford

Teaching-Learning Process

- Lectures: Supported by power point presentations and related videos
- Assignments and exercises
- Test: Knowledge of the students is tested through surprise tests, quiz & session tests.

Course mapping

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CO1	√	√	√	×	×	×	√
CO2	√	×	√	×	√	√	√
CO3	√	√	√	√	×	√	√
CO4	√	√	×	√	√	√	√

M.Sc. Zoology
Semester II
25ZOQ203 Parasitology

Maximum Marks: 100 **Theory Examination: 70**
Time: 3 hrs **Internal Assessment: 30**

Objective:

1. To explore in detail the biology of various parasitic diseases and their transmission in human and animal population.
2. To understand modes of infection, life cycles of parasite and vector, host - parasite interactions, infectivity pattern, treatments to parasitic diseases and vector control measures.

Outcomes:

CO1 To understand about host preference of various disease causing parasites.
CO2 To understand morphology, life cycles and mode of infection of various parasites.
CO3 To have detailed knowledge of various insect vectors and their life cycle.
CO4 To understand ecology and evolution of parasitism.

Note: There shall be nine questions in all. Question no. I shall be compulsory, consisting of seven short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit-I

Introduction to Parasitology, different types of animal associations: definitions; Parasitism, Mutualism, Hyperparasitism. Hosts: host types, regular hosts, irregular hosts, intermediate hosts. Endoparasite and Ectoparasite, Obligate parasites, Facultative parasites, accidental, or incidental parasite, Oioxenous, Stenoxenous, and Euryxenous Parasite, Host Specificity: Kinds of parasite host specificity, specificity factors related to infection and growth, Host-parasite interaction, parasitic adaptation, Types of Vaccination: duration, doses and health education.

Unit-II

Parasitic Morphology: Protozoa, Helminths, Nematodes and Arthropods. Life cycles of Plasmodium, Parasitic Tapeworm, Dengue, Leishmania, Trypanosoma, Nematodes, Schistosomiasis and Ascariasis. Their mode of Infection

Unit-III

Vectors - Brief account of various insect vectors and their life cycle (Mosquitoes: *Anopheles, Aedes* and *Culex*; vectors of *Leishmania, Trypanosoma*, Blood fluke, mites, etc.) Parasite Transmission in vector host: Introduction, mechanism, Zoonosis: viral; rabies, *Japanese encephalitis*. Parasitic: Hydatid disease

Unit-IV

Natural parasite habitats: Soil, water, air and animals, clinical and molecular diagnostics of parasite, Host immune response to protozoan and helminthes parasites, Ecology of parasites: Ecological niche, evolution of parasitism: Origin of parasitism, progressive and retrogressive evolution.

Suggested Readings:

Text Books:

1. Parasitology: The Biology of Animal Parasites, 5th edition by Noble, E.R. and Noble, G.A.,Lea & Febiger, Philadelphia; 1982.
2. Physiology of Parasites by Chapell, L.H., Blackie, Glosgow, London; 1979.
3. Human Parasitology by Fatik Baran Mandal, PHI Learning, Private Limited, New Delhi.

Reference Books:

1. Immunology of Infection by Kaufmann, S., Academic Press; 1999.
2. An Introduction to Animal Parasitology by Smyth, J.D., Hodder& Stoughton, London; 1976.
3. TB1: Cox, F. E. G., "Modern Parasitology", 2nd Edition, Blackwell Science, 2004.
4, Bogitsh, B.J., Carter, C.E., Oeltmann, T.N., "Human Parasitology", Elsevier, 3rd Ed., 2005.

Teaching-Learning Process

- Lectures: Supported by power point presentations and related videos
- Assignments and exercises
- Test: Knowledge of the students is tested through surprise tests, quiz & session tests.

Course mapping

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CO1	√	√	√	√	×	×	√
CO2	√	√	√	√	×	×	√
CO3	√	√	√	√	√	×	√
CO4	√	√	√	√	√	×	√

M.Sc. Zoology
Semester II
25ZOO204 Biosystematics and Biosafety

Maximum Marks: 100 **Theory Examination: 70**
Time: 3 hrs **Internal Assessment: 30**

Objectives:

1. This paper deals with nomenclature, taxonomy and preservation of organism, assigning names to organisms using nomenclature and classifying species into larger groups that have biological meaning.
2. It imparts understanding about fundamental concepts in biosafety and their application lab safety with focus on biosafety of GMOs and other ethical issues.

Outcomes:

CO1 Knowledge of Taxonomy helps in classifying and identifying biodiversity and biologist study the well understood relationships by making phylogenetic trees.
CO2 It will help to understand the overall biodiversity of the world and their application in all the fields of biological sciences.
CO3 Knowledge of biosafety is essential to work in lab with biological organisms.
CO4 Able to know the biosafety of GMOs and ethical issues related with GMOs.

Note: Nine questions will be set in all. Question No. 1 will be compulsory consisting of seven short answer type questions covering the entire syllabus. The remaining eight questions will be set with two questions from each unit.

Unit-I

Definitions and perspectives of systematics, classification and taxonomy, goals and importance of taxonomy, Principle and theories of Biological Classification, Hierarchy of classification, Taxonomic Key and its significance

Unit-II

History and theories of classification; International code of Zoological nomenclature-principles, objectives and rules for nomenclature, type system and priority for different taxa, Polytypic species, race, variety, cline, subspecies, Species concepts - Typological species concept, nominalistic species concept, biological species concept, evolutionary species concept, Difficulties in applying biological species concept, Chemotaxonomy, cytotaxonomy and Molecular taxonomy

Unit III

Introduction to bioethics: Bioethical issues related to genetically-modified organisms and gene therapy/gene editing; international bioethics advisory committees and their tasks (IBC, IBA, IBS etc.); ethical issues in human cloning; ethics for using animals in research; social and ethical implications of biological weapons.

Unit IV

Introduction to biosafety; biological safety cabinets; primary containment for biohazards; biosafety levels for microorganisms, infectious agents and infected animals; biosafety guidelines of Government of India; GMOs & LMOs; Indian regulations of GMOs: EPA act and rules, guidelines; regulatory framework RCGM, GEAC, IBSC etc.

Suggested Readings:

Text Books:

1. Genetics and the origin of species by T. Dobzhansky, Columbia University Press;1951.
2. Principles of Systematic Zoology by E. Mayr, Tata McGraw Hill Publishing Co. Ltd., New Delhi; 1976
3. IPR, Biosafey and Bioethics by Deepa Goel and Somini Prashar, Pearson.

References Books:

1. Taxonomy by R.E. Blackwelder; John Wiley & Sons, New York; 1967.
2. Organic Evolution by Lull, MacMillan Co., New York; 1947.
3. Time, life and Man by R.A. Stirton, John Wiley and Sons, New York; 1959.
4. Evolution of the Vertebrates by E.H. Colbert, Willy Eastern Ltd., New Delhi;1969.
5. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology by Padma Nabisan, Elsevier Publishing

Teaching-Learning Process

- Lectures: Supported by power point presentations and related videos
- Assignments and exercises
- Test: Knowledge of the students is tested through discussion, surprise tests, quiz & session tests.

Course mapping

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CO1	√	√	√	√	√	√	√
CO2	√	√	√	√	√	√	√
CO3	×	×	√	×	×	√	√
CO4	×	×	√	×	×	√	√

M.SC Zoology
Semester II
25ZOO205 Genomics and Proteomics

Maximum Marks: 100 **Theory Examination: 70**
Time: 3 hrs **Internal Assessment: 30**

Objectives:

1. The goal of genomic to study about gene and their products that are focal points of proteomics studies.
2. The goal of proteomics is to identify or compare the proteins expressed in a given genome under specific condition, study the interaction between the proteins and use this information to predict cell behavior and develop drug targets.

Outcomes:

CO1 To provide the knowledge and practical skills of functional genomics and proteomics
CO2 To teach the techniques used in functional genomics such as microarrays, NGST, mRNA expressionand miRNA expression.
CO3 To give knowledge on gene manipulation, gene expression, etc which prepares them for further studies in the area of genetic engineering
CO4 To learn advance understanding of life

Note: Nine questions will be set in all. Question No. 1 will be compulsory consisting of seven short answer type questions covering the entire syllabus. The remaining eight questions will be set with two questions from each unit.

Unit-I

Genomics: Genome sequencing strategies and programs, new technologies for high throughput sequencing, methods for sequence alignment and gene annotation; Approaches to analyze differential expression of genes -ESTs, SAGE, microarrays and their applications; gene tagging; gene and promoter trapping; knockout and knock-down mutants; dynamic modulation of protein structure and function

Unit-II

Comparative genomics of model plants and related crop species; Recombination-based cloning techniques; RNAi and gene silencing, genome imprinting, small RNAs and their biogenesis, role of small RNAs in heterochromatin formation and gene silencing, genomic tools to study methylome and histone modifications.

Unit –III

Analysis of proteins by different biochemical and biophysical procedures like CD (Circular Dichroism), NMR, UV/Visible and fluorescent spectroscopy, protein identification and analysis on ExPASy server, other protein related databases, 1-D and 2-D gel electrophoresis for proteome analysis, Sample preparation, gel resolution and staining; Mass spectrometry-based method for protein identification like PMF (protein mass fingerprinting) and LCMS.

Unit-IV

Image analysis of 2D gels: Data acquisition, spot detection & quantitation, gel matching, data analysis, presentation, databases, conclusions; DIGE (Differential In Gel Electrophoresis), alternatives to 2-DE for protein expression analysis; Analysis of post-translational modifications and protein-protein interactions; protein chips and arrays, future directions in proteomics, scope of functional proteomics.

Suggested Readings:

Text Books:

1. Ruchi Singh, Bioinformatics: Genomics and Proteomics, Vikas Publication House, 2014.
2. Lieber DC (2006) Introduction to Proteomics: Tools for New Biology; Humana Press, NJ.

Reference Books:

1. Buchanan B, Gruissem G, and Jones R (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
2. Hammes GD (2005) Spectroscopy for the Biological Sciences; Wiley Interscience, USA.
3. Harlow and Lane D (Eds.) (1988) Antibodies –A Laboratory Manual; Cold Spring Harbor Laboratory, USA.
4. Pennington SR, Dunn MJ (Eds.) (2002) Proteomics: From Protein Sequence to Function, BIOS Scientific Publishers, United Kingdom.
5. Sambrook J and Russell DW (2001). Molecular Cloning –A Laboratory Manual, Vols I –III, Cold Spring Harbor Laboratory, USA.

Teaching-Learning Process

- Lectures: Supported by power point presentations and related videos
- Assignments and exercises
- Test: Knowledge of the students is tested through surprise tests, quiz & session tests.

Course mapping

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CO1	√	×	√	√	×	√	×
CO2	√	×	√	×	√	√	×
CO3	√	×	√	×	√	√	×
CO4	√	×	√	×	√	√	×

M.Sc. Zoology
Semester II
25ZOO208 Environmental Studies and Sustainable Development

Total credits: 02 Max Time 2hr **Maximum Marks: 50**

Note: The course will be evaluated based on the study report (50 marks) and seminars/presentations/viva, etc. (50 marks). The report will be focused on local studies that remain centered on the fieldwork/project work related to soil/air/water pollution/best out of waste theme-based work/bioremediation/or any other relevant topic related to the environment, including those mentioned below. In addition, students will also participate in environment-related activities through debate, declamation, group discussions, poster competition, seminars/ conferences/paper/poster presentation, and nuked natak at the university/local/state/national levels. Paper/article publication in state/national/level journals, newspaper/conference/seminar proceedings remains a mandatory part of the curriculum.

Objectives: This course will provide fundamental knowledge about the environment and related issues that have a direct impact on the human population.

Course outcomes (CO): The students will understand the environmental challenges, realize their role, and be motivated to protect the environment. This learning will prepare the students to develop their queries and ideas for a healthy environment.

CO1. Understanding water resource management and the concept of green energy.
CO2. Understanding the different types of waste and their management.
CO3. To develop awareness of environmental laws and policies.
CO4. Understanding wildlife protection and environmental impact assessment.

Unit-I

Water Resources Management: coordinated development and management of water, land, and related resources. Revival of Water Bodies: enumeration, protection, and management of water bodies in their respective States. Energy & Green Technologies: Renewable and Alternative energies such as Solar, Wind, Tidal, etc.

Unit-II

Waste Management: Solid/Liquid/Plastic/C&D/Electronic/Bio-medical/Hazardous wastes. Sanitation & Hygiene: Methods of Garbage collection, industrial/ hazardous waste management, Methods of wastewater treatment and disposal.

Unit-III

Environmental Laws & Policies and Legal Proceedings: Legislation, regulations, policies, and permits related to protecting the environment such as The National Green Tribunal Act, 2010, Water Prevention And Control of Pollution Act, 1974, Cess Act, 1974, Air Prevention And Control Of Pollution Act, 1977, Forest Conservation Act, 1980, Environmental Protection Act, 1986, Public Liability Insurance Act 1991, Government Missions for Environment Protection & Conservation (as per National Environment Policy NEP-2020) and Ministry of Environment and Forests (MoEF).

Unit-IV

Wildlife Protection & Conservation: habitat conservation, endangered and keystone species protection, ex-situ efforts, and poaching prevention. Environmental Impact Assessment: Water Environment, Biological Environment, Land Environment, Air Environment, Noise Environment, Socio-economic and Health Environment. Environment Management Plan.

Suggested readings:

1. Fundamentals of Ecology: E. P. Odum, W.B. Saunders Co
2. Environmental Science. Jr. G. T. Mille R, Wadsworth Pub. Co
3. Fundamentals of Environmental Science: Dhaliwal GS, Sangha GS and Raina PK.Kalyani Publication
4. Environmental Science Systems & solutions, M.L. Mac-Kinney, & RM Schoch, Web-enhanced edition.
5. Environmental Chemistry: A. K. De, Wiley Eastern Ltd.
6. Journal publications

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Course mapping

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CO1	√	√	√	√	×	×	√
CO2	×	×	×	√	√	×	√
CO3	√	√	√	√	×	×	√
CO4	√	√	√	×	×	×	√

M.Sc. Zoology
Semester II
25ZOO209 Indian Knowledge Systems in Biology -

Total credits: 02 Time: 2h. **Maximum Marks: 50**

Note: The course will be evaluated based on the study report (30 marks) and seminars/presentations/viva, etc. (20 marks). The report will be focused on studies that remain centered on the relevant topic related to the IKS, including those mentioned below. In addition, students will also participate in debate, declamation, group discussions, or poster competition.

Objectives: This course introduces students to the integration of Indian Knowledge Systems (IKS) with modern biology, focusing on Ayurvedic medicinal applications and biodiversity conservation. It aims to provide insights into traditional practices and their relevance to contemporary biological advancements.

Course Outcomes:
CO1: Understand the application of Ayurvedic principles in modern biotechnology, particularly in drug discovery and bioprocessing.
CO2: Gain knowledge of traditional ecological practices for biodiversity conservation and environmental biology.
CO3: Students will develop skills to apply IKS-based approaches in sustainable agriculture and ecological management.
CO4: Students will be prepared for research careers integrating traditional and modern biological methods.

Unit I

Ayurveda and Medicinal Biology: Overview of Ayurvedic principles in biology: Insights from ancient texts (Sushruta Samhita, Charaka Samhita) on plant and animal-based healing processes. Use of fermentation for herbal drugs and enzyme-based therapies. Case studies of traditional practices in modern medicinal contexts.

Unit II

Pharmacology and Bioprocessing in IKS: Pharmacology of bio-active compounds: Rasayana formulations and their relevance to drug discovery, bioprocessing, and secondary metabolite production. Integration of traditional fermentation (Asava-Arishta) with modern bioprocess technologies for producing antibiotics, vitamins, and enzymes.

Unit III

Ethno-biology and Biodiversity: Ethno-biology: Vrikshayurveda and its contributions to microbial diversity, biofertilizers (e.g., Rhizobium symbiosis), and sustainable crop improvement. Indigenous methods for genetic diversity in crops (e.g., Vavilov's centers in Indian contexts). Role of ethnozoology and ethnobotany in biodiversity conservation.

Unit IV

Sustainable Practices in Environmental Biology: Traditional ecological knowledge in resource management: Bioremediation using herbs, vermicomposting, and phytoremediation for pollution control. Applications of IKS in sustainable agriculture and ecosystem management. Case studies on traditional practices for environmental sustainability.

Suggested Readings:

1. Sushruta Samhita, translated by Kaviraj Kunjalal Bhishagratna, Chowkhamba Sanskrit Series.
2. Charaka Samhita, translated by P.V. Sharma, Chaukhambha Orientalia.
3. Vrikshayurveda: The Science of Plant Life by Surapala, translated by Nalini Sadhale, Asian Agri-History Foundation.
4. Ethnomedicine and Pharmacognosy by V.K. Singh and J.N. Govil, Studium Press.
5. Biotechnology and Traditional Knowledge by S.K. Jain, Oxford & IBH Publishing.
6. Environmental Biotechnology by Bimal C. Bhattacharyya, Oxford University Press.
7. Indian Ethnobotany: Emerging Trends by A.K. Jain, Scientific Publishers.

Please note: The latest edition of these books is proposed or as recommended by the concerned faculty.

Course mapping

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CO1	√	√	√	√	×	×	√
CO2	×	×	×	√	√	×	√
CO3	√	√	√	√	×	×	√
CO4	√	√	√	×	×	×	√

M.Sc. Zoology
Semester II
Lab Course I (PC-3) (25ZOO206) (based on paper 25ZOO201 & 25ZOO202)

Total Marks: 50 **Time: 4 hours**

Evaluation scheme in examination:

Practical Performance & Evaluation	Viva-voce	Practical Record/File
35	10	05

Objective:

1. This paper deals with the comparative and evolutionary trends in structure and function of the organ systems of the vertebrate series.
2. To thorough understanding of practice of taxonomic arrangement and classification of animal diversity, and biosafety of GMOs and other ethical issues

Outcomes:

CO1 To understand various biological functions, the evolution of life from most primitive to most advanced form with respect to their habit and habitat.
CO2 For understanding the overall biodiversity of the world and their application in all the fields of biological sciences.
CO3 To understand biosafety while in lab.
CO4 To identify various species.

Course contents:

Museum specimens and slides:

1. Chondrichthyes: *Zygaena, Pristis, Narcine, Trygon, Rhinobatus, Chimaera.*
2. Actinopterygii: *Polypterus, Acipenser, Lepidosteus, Muraena, Mystus, Catla. Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Tetradon, Echeneis and Solea.Dipneusti(Dipnoi): Protopterus*(Lung fish)
3. Amphibia: *Uraeotyphlus, Necturus, Amphiuma, Ambystoma and its Axolotl larva. Triton,Salamandra, Hyla, Rhacophorus.*
4. Reptilia: Hemidactylus, *Calotes, Draco, Varanus, Phrynosoma, Chamaeleon. Typhlops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis, Chelone* and*Testudo.*
5. Aves: *Casuarius, Ardea, Anas, Milvus, Pavo, Eudynamis, Tyto* and *Alcedo.*
6. Mammalia:*Ornithorhynchus, Echidna, Didelphis, Macropus, Loris, Macaca, Manis, Hystrix, Funambulus, Panthera, Canis, Herpestes, Capra, Pteropus.*

a. Demonstration of dissection of Labeo/Chick/Rat through video clipping/models/charts showing Digestive, arterial, venous and urinogenitalsystems

7. Study of the histology of different organs of frog and rat/rabbit through permanent stained slides.
8. Study of the skeleton of Rana, Gallus &Oryctolagus.
9. Isolation of Genomic and plasmid DNA.
10. Isolation of RNA.
11. Quantitative analysis of DNA.
12. Restriction digestion of DNA.
13. Ligation of DNA fragments.
14. Molecular weight analysis using agarose gel electrophoresis.
15. Preparation of competent cell
16. Blotting techniques.

Course mapping

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CO1	√	√	√	√	√	×	√
CO2	√	√	√	√	√	√	√
CO3	×	×	√	√	×	√	√
CO4	√	√	×	×	√	√	√

M.Sc. Zoology
Semester II
Lab Course II (PC-4) (25ZOO207)
(Based on Core- 25ZOO203 and any One of DEC-1 or DEC-2)

Total Marks: 50 **Time: 4 hours**

Evaluation scheme in examination

Practical Performance & Evaluation	Viva-voce	Practical Record/File
35	10	05

Objective:

1. To make students understand the complex molecular mechanisms occurring in cell and the applications of molecular technologies.
2. To explore in detail the biology of various parasitic diseases and their transmission in human and animal population. Modes of infection, life cycles of parasite and vector, host - parasite interactions, infectivity pattern, treatments to parasitic diseases and vector control measures

Outcomes:

CO1 To know about the chemistry of life to allow the students to understand the basis of life.
CO2 To discover the complex instruments and elaborate techniques by which scientific discoveries can be made.
CO3 To understand about diseased caused by Protozoa, Helminths, Nematodes, Arthropods and viruses at molecular level.
CO4 To understand parasite physiology, life cycle and their mode of infection.

Course contents: Parasitology

1. Identification of parasites through PCR
2. Dissection of mosquitoes and isolation of midgut
3. To study the protozoans and helminth parasites infecting frog, toad and common household insects through slides/charts.
4. Counting of parasites from stained blood smears - *Leishmania, Plasmodium* and *Trypanosoma*.
5. Rearing the vectors of different parasitic infections and differentiation of vectors through slide preparation (Mosquitoes/ ticks/ sandfly etc.).

Biosystematics and Biosafety

1. Use of key to identify the fishes of the region, representing different families.
2. Methods of describing common insects representing different orders, with particular reference to the recording of taxonomic characters.
3. Preparation of charts based on biosafety and bioethics.
4. Good lab practices: sterilization, gloves, lab coat use/not use
5. Case study and plagiarism check.
6. Study of molecular identification with reference to insects.
7. Study of insect mouthparts and their use in identification.
8. Submission of a report on insect collection/photograph.
9. Field Visit to Zoological sites/Parks/ Anthropology/Science museums/ Research Labs/Biosafety Labs/ Wild Life Institutes/ Sanctuaries/ or any site of Zoological Interest. Submission of Project report/presentation by the students.

Genomics and Proteomics

1. RNA extraction and preparation of cDNA preparation
2. SDS- PAGE.
3. 2-D Gel electrophoresis
4. Quantification of DNA
5. Southern hybridization of genomic DNA
6. Site-directed mutagenesis.
7. Gateway cloning
8. BLAST Analysis
9. Protein extraction and Quantification
10. If feasible Field Visit to Zoological sites/Parks/ Anthropology/Science museums/Research Labs/Biosafety Labs/ Wild Life Institutes/ Sanctuaries/ or any site of Zoological Interest. Submission of Project report/presentation by the students.

Course mapping

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CO1	√	√	√	√	×	×	√
CO2	×	×	×	√	√	×	√
CO3	√	√	√	√	×	×	√
CO4	√	√	√	×	×	×	√