UNIVERSITY OF KOTA

Syllabus and Scheme of
Semester Examination for the
Academic Year

2025-26

Master of Science

ZOOLOGY
Course Code: ZOO12200

UNIVERSITY OF KOTA
MBS MARG, NEAR KABIR CIRCLE, KOTA (RAJASTHAN) 324 005

Syllabus Edition: 2025 (as per NEP 2020)

UNIVERSITY OF KOTA, KOTA

MBS Marg, Near Kabir Circle, KOTA (Rajasthan)-324 005

Master of Science

ZOOLOGY
Course Code: ZOO12200
Faculty of Science

SCHEME OF EXAMINATIONS ANDSYLLABUS

M. Sc. Third and Fourth Semester Examinations

1. The M.Sc. Course in Zoology is a two-year full-time curriculum offered in the form of Choice-based Credit System organized in **Four Semesters**. The number of papers and maximum marks for each theory paper/practical has been shown in the syllabus. It will be necessary for a candidate to pass in the theory part as well as in the practical part (wherever prescribed) separately.
2. The course of study for M.Sc. (Zoology) examination shall be spread over a period of two years with examination at the end of each semester. There shall be F**our Semesters** in all.
3. Every semester will have four Theory papers and one practical. Syllabus of every theory paper of each semester will be divided into 5 units.
4. Scheme of examination:

Each Semester	Maximum Marks	Minimum Marks	Internal Assessment
Paper I	70	28	30
Paper II	70	28	30
Paper III	70	28	30
Paper IV	70	28	30
Practical	200	100	---

II Year: Semester III

ZOO12221T:Paper-Z-3.1 CHORDATA

ZOO12222T:Paper-Z-3.2 ANIMAL ECOLOGY

ZOO12224-28T:Paper-Z-3.3 SPECIAL PAPER

ZOO12230-34T:Paper-Z-3.4 SPECIAL PAPER

ZOO12223P:Practical -Z-3.5-I (Lab Course I)

ZOO12235P:Practical Z-3.5-II (Lab Course II)

ZOOLOGY Practical: Duration 12 Hrs; MM 200, Min 100.

Day 1: 6 Hrs. (Z-3.1 & Z-3.2) and **Day 2:** 6 Hrs (Z-3.3 & Z-3.4).

Each **theory paper:**

Teaching Hrs for each paper	Credit Points for each paper	Continuous assessment		Semester assessment		Max marks	Min. Pass marks	Paper Duration
		MM	Pass	MM	Pass			
04	04	30	12	70	28	100	40	3 Hrs.

For **Practical (Lab Course-I & Lab Course-II):** Teaching Hrs/week 16, Credit pt: 8; Max. Marks 100, Min. pass marks 50 for each day.

Total (III Semester): Teaching Hrs 32, Credit pt 24, Continuous assessment (MM 120, Min 48) Semester Assessment (MM 480, Min 212) Total **Max.Marks 600** (120+480), **Min. Pass Marks 260** (48+212).

II Year: Semester IV

ZOO12241T:Paper-Z-4.1 ANIMAL BEHAVIOUR

ZOO12242T:Paper-Z-4.2 DEVELOPMENTAL BIOLOGY OF CHORDATES

ZOO12244-48T:Paper-Z-4.3 SPECIAL PAPER

ZOO12250-54T:Paper-Z-4.4 SPECIAL PAPER

ZOO12243P:Practical-Z-4.5- I (Lab Course I)

ZOO12255P:Practical-Z-4.5- II (Lab Course II)

ZOOLOGY Practical: Duration 12 Hrs; MM 200, Min 100.

Day 1: 6 Hrs (Z-4.1 & Z-4.2) and **Day 2:** 6 Hrs (Z-4.3 & Z-4.4).

For each **theory paper:**

Teaching Hrs	Credit point	Continuous Assessment		Semester Assessment		Max Marks	Min. Pass Marks	Paper Duration
		Max. Marks	Pass	Max. Marks	Pass			
04	**04**	**30**	**12**	**70**	**28**	**100**	**40**	**3 Hrs.**

For **Practical:** Teaching Hrs16, Credit pt: 8; Max. Marks 100, Min. pass marks 50 for each day.

Total: Teaching Hrs 32, Credit pt 24, Continuous assessment (MM 120, Min 48) Semester Assessment (MM 480, Min 212) Total **Max.Marks 600** (120+480), **Min. Pass Marks 260** (48+212).

Continuous Assessment or Internal or Mid Term Assessment:

(a) The continuous or internal or mid-term assessment (30% weightage of the maximum marks) for each theory paper shall be taken by the faculty members in the Department during each semester. There will be two internal assessment tests (i.e. First Internal Assessment Test or First Mid Term Test and Second Internal Assessment Test or Second Mid Term Test) each of 15% weightage for each theory paper. Each internal assessment test shall be of one-hour duration for theory paper and shall be taken according to academic calendar which will be notified by the Department / University.

(b) For practical papers, there will be only one external or semester or end term assessment (100% weightage of maximum marks) and there will be no continuous or internal or midterm assessment.

(c) A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concerned Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be taken from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD who may permit the candidate to appear in the internal assessment after production of satisfactory evidence about the reason of his/her absence in the test(s) and deposition of the defaulter / improvement fee. A record of such candidates shall be kept in the Department.

(d) Regular attendance of the student shall be considered in the internal assessment. If the attendance / regularity factor is similar for all the students, then it may be merged with the weightage of second internal assessment test (class test / home assignment / quiz, seminar, etc.).

(e) Paper wise consolidated marks for each theory paper and dissertation / seminar (i.e. total marks obtained during various modes of internal assessment) obtained by the students (out of the 30% weightage of the maximum marks of the paper) shall be forwarded by the Head of the Department (in two copies) to the Controller of Examination of the University within a week from the date of last internal assessment test for incorporation in the tabulation register.

(f) The consolidated marks obtained by the students will also be made known to them before being communicated by the Head of the Department concerned to the University for final incorporation in the tabulation register. If any discrepancies are discovered or pointed out by the students, the same shall be looked into by the concerned faculty member and corrections made wherever necessary. The decision of the Head of the Department before the communication of marks to the University shall be final. No corrections shall be made in the internal assessment marks after the declaration of the result by the University.

(g) Consolidated marks communicated to the University shall be in whole number and not in fraction. Marks awarded for the various internal assessments in each paper shall be added up and then round off to the next whole to avoid any fraction.

University of Kota, Kota

M.Sc. Zoology

Semester wise Consolidated Common Scheme of Examinations for the Academic Session 2024-2025

Semester	Number, Code or ID and Nomenclature of Paper				Duration of Exam (in Hrs)	Teaching Hrs/Week			Distribution of Assessment Marks					
									Continuous or Internal Assessment (30%)		Semester or External Assessment (70%)		Total	
	Number of Paper	Code/ID Paper		Nomenclature of Paper		Teaching Th	Teaching Pr	Credit Point	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min. Marks
Semester III	Paper- 3.1	ZOO12221T	DCC	CHORDATA	3	4		4	30	12	70	28	100	40
	Paper- 3.2	ZOO12222T	DCC	ANIMAL ECOLOGY	3	4		4	30	12	70	28	100	40
	Paper- 3.3 (A-E)	ZOO12224T ZOO12225T ZOO12226T ZOO12227T ZOO12228T	DSE	Cell Biology-I Environmental Biology-I Entomology-I Fish Biology-I Forestry & Wildlife Management-I	3	4		4	30	12	70	28	100	40
	Paper- 3.4 (A-E)	ZOO12230T ZOO12231T ZOO12232T ZOO12233T ZOO12234T	DSE	Cell Biology-II Environmental Biology-II Entomology- II Fish Biology- II Forestry & Wildlife Management-II	3	4		4	30	12	70	28	100	40
	Paper-3.5- I	ZOO12223P	DCC	**Practical** Lab Course I	6		8	4			100	50	100	50
	Paper-3.5- II	ZOO12235 P	DSE	**Practical** Lab Course II	6		8	4			100	50	100	50
	TOTAL (SEMESTER III)				**24**	**32**		**24**	**120**	**48**	**480**	**212**	**600**	**260**
Semester IV	Paper- 4.1	ZOO12241T	DCC	ANIMAL BEHAVIOUR	3	4			30	12	70	28	100	40
	Paper- 4.2	ZOO12242T	DCC	DEVELOPMENTAL BIOLOGY OF CHORDATES	3	4			30	12	70	28	100	40
	Paper- 4.3 (A-E)	ZOO12244T ZOO12245T ZOO12246T ZOO12247T ZOO12248T	DSE	Cell Biology-I Environmental Biology-I Entomology- I Fish Biology-I Forestry & Wildlife Management-I	3	4			30	12	70	28	100	40
	Paper- 4.4 (A-E)	ZOO12250T ZOO12251T	DSE	Cell Biology- II Environmental	3	4			30	12	70	28	100	40

		ZOO12252T ZOO12253T ZOO12254T		Biology- II Entomology- II Fish Biology- II Forestry & Wildlife Management- II										
	Paper- 4.5- I	ZOO12243P	DCC	**(**Lab Course I)	6		8				100	50	100	50
	Paper- 4.5- II	ZOO12255P	DSE	**(**Lab Course II)	6		8				100	50	100	50
	TOTAL (SEMESTER IV)				**24**	**32**		**24**	**120**	**48**	**480**	**212**	**600**	**260**

SCHEME OF EXAMINATION

(Semester Assessment)

Duration of Examination: 3 hours Semester Assessment Max. Marks – 70

Note: The question paper will contain two sections as under –

There will be two sections A and B in the paper.

Section-A: There will be one question with 10 parts having two parts from each unit with no internal choice. The weight-age of each part is 2 marks; hence the total weight-age of this section is 20 marks (10 x 2= 20 marks).

Section-B: There will be 5 questions with one question from each unit with internal choice (may have sub-division), the weight of each question is of 10 marks, hence the total weight-age of the section is 50 marks (10 x 5= 50 marks).

UNIT WISE DETAILED SYLLABUS

M. Sc. Zoology II YEAR: SEMESTER III

ZOO12221T:Paper- Z-3.1 CHORDATA

UNIT – I

1. Origin and outline classification of chordates.
2. Inter-relationships of Hemichordata, Urochordata and Cephalochordata and their relations with other deuterostomes.
3. Life histories of sessile and pelagic tunicates (ascidian), Pyrosoma, Salpa, Doliolum and Oikopleura.

UNIT - II

1. Geological time scale and fossils.
2. Origin, evolution and adaptive radiations of vertebrates: Agnatha. (Ostracoderms and Cyclostomes).
3. Early gnathostomes (Placoderms).

UNIT - III

1. A general account of Elasmobranchi, Holocephali, Dipnoi and Teleostomi.
2. Adaptive radiation in bony fishes.
3. Origin, evolution and adaptive radiation of Amphibia.

UNIT - IV

1. Origin and evolution of reptiles; the conquest of land Seymouria and related forms; Cotylosauria; basic skull types and outline classification of reptiles.
2. Dinosaurs: Types and evolutionary significance.
3. Living reptiles: a brief account of Rhynchocephalia, Chelonia, Squamata & Crocodilia.

UNIT - V

1. Origin and evolution of birds; Origin of flight; flight adaptations.
2. Origin of mammals, primitive mammals (Prototheria & Metatheria). A general survey of main radiations in eutherian mammals, excluding detailed reference to individual orders.
3. Evolution of man; relationships of man with other primates; fossil record of ancestry of man.

ZOO12222T:Paper-Z-3.2 ANIMAL ECOLOGY

UNIT – I

1. Concepts of modern ecology.
2. Limiting factors: Leibig's law of minimum, Shelford's law of tolerance; combined concept of limiting factors, conditions of existence as regulatory factors.
3. Analysis of environment: The general Methods.

UNIT – II

1. Role of physical factors: temperature, light, water, atmospheric gases, media, substratum, climatology.
2. Brief review of important physical factors as limiting factor.
3. Nutrients and environment.

UNIT – III

1. Organization at the population level: (a) General properties of population. (b) Population growth form and forces shaping the population growth. (c) Measurement of population; simple numerical problems on population measurement. (d) Animal aggregation and social life.

2. Organization at the community level: (a) Biotic community concept. (b) Community structure and concept of community dominance. (c) Ecotone and concept of "edge effect".

3. Patterns in communities: Stratification, zonation, activity, food web, reproductive and social structure. (e) Community versus continuum. (f) Evolution of communities.

UNIT – IV

1. Succession in community: Basic types of succession; convergence and divergence in succession; modifications in succession; concept of climax, monoclimax versus polyclimax theory; barriers and ecesis in succession; biome.
2. Fluctuations within community: Irruptive cycle, fluctuation, causes of fluctuation, cycles.
3. Environment and animals in ecosystem: (a) Nature and constituents of ecosystem. (b) Fundamental operation of ecosystem. (c) Flow of matter and energy in ecosystem. (d) Homeostasis in the ecosystem. (e) Cycling of chemical elements in ecosystem(biogeochemical cycles).

UNIT – V

1. Concept of productivity: Productivity of land and water, measurement of productivity.

2. Organization and dynamics of ecological communities: The habitat approach: A detailed knowledge of extent, zonation, environment, biota, adaptations and communities of fresh water, marine, terrestrial and estuarine ecosystems.

3. The ecological outlook: Space ecology, nuclear radiations, human population explosion, resources; applied human ecology.

Suggested Books for Reference:

1. Modern text book of Zoology- Vertebrate by R. L. Kotpal.
2. Vertebrate Zoology by Ezra Samberg.
3. Vertebrate Zoology by E. L. Jordan.
4. Ecology by P. D. Sharma.
5. Environment and Ecology by R. Rajagopalan.
6. Ecology and Environment by P. D. Sharma.
7. Fundamentals of Ecology and Environment by Pranav Kumar and Usha Mina.
8. Ecology by Odum.

M.Sc. ZOOLOGY PRACTICAL Semester III

ZOO12223P:Paper-Z-3.5-I (Lab Course I): Practical Work Based on Paper Z-3.1 & Z-3.2 (Total No. of laboratory hrs. 240)

1. **Chordates: (a). Taxonomy**: Study of museum specimens or representative animals from all chordate groups (Protochordata to Mammalia). (b) **Anatomy:** (i) General anatomy and neural gland of Herdmania using charts and computer software. (ii) Afferent and efferent arteries, cranial nerves, membranous labyrinth, eye muscles and their innervation, brain of any fish. (iii) Study of fish anatomy through serial section of fry and fingerling stages. (iv) Limb musculature, cranial nerves and eye muscles and their innervation in frog dissection using computer software. (v) General anatomy, major blood vessels and cranial nerves of any nonpoisonous snake through charts / models / computer software. Study of differences between poisonous and non-poisonous snakes. (vi) Flight muscles, perching mechanism, air sacs and anatomy of the neck region in pigeon through charts / models / computer software. (vii) Reproductive system and anatomy of the neck region in rat. (c) **Osteology**: Comparative study of the axial and appendicular skeleton from fish to mammals, with particular reference to important skull types in amphibians, reptiles, birds and mammals. (d) **Permanent preparations**: Whole mounts of pelagic tunicates, cycloid scales, pecten and columella in pigeon, ear ossicles of rat or squirrel or any other mammal. (e) **Histology:** A detailed study of the histology of all mammalian tissues and organs through prepared slides.
2. **Ecology:** (a) Measurement of climatic factors (atmosphere, water, temperature and relative

   humidity). (b) Measurement of water and soil pH, edaphic factors of soil; preparation of soil extract, determination of humidity in microhabitat; pH, alkalinity of water, dissolved oxygen, free carbon-dioxide, chloride, salinity, temporary and permanent hardness of water, turbidity, velocity of current. (c) Measurement of population density. Numerical problems of population determination to be done. (d) A field study of any one of the

following habitats to be assigned to an individual or to a group of students: (i) Pond habitat. (ii) Marine habitat. (iii) Terrestrial habitat.

M.Sc. ZOOLOGY PRACTICAL Semester III

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100 **Duration - 6 hrs.**

1.	Study of Chordates (Major)*	10 marks
2.	Study of Chordates (Minor)*	05 Marks
3.	Permanent preparation	05 Marks
4.	Exercise on Ecology	08 Marks
5.	Numerical problems	07 Marks
6.	Spotting (Museum specimens, slides and bones) 10 spots x 2 marks	20 Marks
7.	Seminar	10 Marks
8.	Viva-voce	10 Marks
9.	Class record	10 Marks
10.	Report on field trip	15 Marks
	Total	**100 Marks**

(* Use of animal for dissection and practical work is subject to the condition that they are not banned under the Wildlife Protection Act)

ZOO12224T:Paper-Z-3.3 (A) SPECIAL PAPER: CELL BIOLOGY-I

Unit-I

1. Evolution of cell: Bimolecules of the first form cell, Prokayote to Eukaryote, Single cell to multi-cellular organism.
2. Concept of Cell theory
3. Diversity of cell: Size and shape, Viruses, Bacteria, Prokaryotes, Eukaryotes
4. Cell wall: In prokaryotes, in Fungi, in plants
5. Extracellular Matrix: in Bacteria, Plant and Animal Cell.

Unit-II

1. Biomembrane: Historical models of plasma membrane

2. Molecular organization of cell membrane
3. Lipid: Phospholipids
4. Membrane Proteins: spectrin, glycophorin, Bacteriorhodopsin, porins, cadherins, selectins & integrins
5. Carbobydrates: glycolipids and glycoproteins
6. Membrane specialization: Microvilli, Desmosomes and Junctions.
7. Transport across membrane a) Simple diffusion, facilitated diffusion and carrier molecule b) Osmosis c) Ion channel d) Active transport: uniport, symport and antiport

Unit-III

1. Cytoskeleton a) Microtubules b) Actin filaments c) Intermediate Filaments.
2. Concept of cell surface: Electro-kinetic properties of cell surface, their role in intercellular, interaction in cell fusion, Cell aggregation etc.
3. Cytoplasm: Generalized structure and chemical composition (molecular basis).

Unit-IV

1. Detailed discussion on the following cytoplasmic components with special reference to the biochemical & physiological aspect. (i) Endoplasmic reticulum (ii) Ribosomes (iii) Golgi Bodies (ii) (iv) Mitochondria (v) Peroxisomes, endosome, hydroxysome and spherosomes (vi) Centrosomes, cilia and flagella

Unit-V

1. Nucleus. Nuclear envelope (structural and functional) Structure and function of the resting nucleus, Nucleus and Nucleolus, Chemistry and biosynthesis of nucleic acids.

ZOO12230T:Paper-Z-3.4 (A) SPECIAL PAPER: CELL BIOLOGY-II

Unit-I

1. Chromosomes: Structural (Chromatid, Centromere, secondart constriction, Nucleolar organizers, Telomere) and Molecular (Histones, Nonhistones, Nucleosomes) organization in Prokaryote and Eukaryote, Karyotype, Banding patterns, Heterochromatin and Euchromatin. Extranuclear chromosome. Giant chromosomes (Polytene & Lampbrush)

Unit-II

1. Chromosomal aberrations and their significance: Numerical (Euploidy and Aneuploidy) and Structural (Deletion, Duplication, Inversion and Translocation)

Unit-III

1. Cell cycle and cell cycle check points: Molecular events, Cdks, Cyclins, Cdk inhibitors. 2. Cell division: Mitosis (stages of mitosis, mitotic spindle, mechanism of chromosome movements), Mitotic poisons and their action. Meiosis (Meiotic stages, Synaptonemal complex) Genetic consequences of meiosis, Molecular model of recombination during meiosis.

Unit-IV

1. Cell communication: Forms of signaling, Intercellular signaling and Intracellular signaling.

Signaling molecules. Receptors: Cell-surface receptors, Internal receptors, Enzyme-linked receptors, Ion channel-linked receptors, G-protein-linked receptors

Unit-V

1. Signaling Pathways:Methods of Intracellular Signaling:Phosphorylation,Second Messengers,Signal Amplification,MAP kinase pathway JAK-STAT pathway,Responses to the Signaling Pathway,Termination of Signaling Pathways.

Suggested Books for reference:

1. Cell Biology by Veer Bala Rastogi.
2. Cell Biology by Verma P.S. & Agarwal V.K.
3. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P. S. Verma and V. K. Agarwal.
4. Cell and Molecular Biology by De Robertis.

ZOO12235P:Paper-Z-3.5-II (Lab Course II): Zoology (Cell Biology) Practical Work Based on Paper Z-3.3 (A) & Z-3.4 (A) (Total No. of laboratory hrs. 240)

1. Cell structure: prokaryotic and eukaryotic cell types with the operation of light microscope
2. Study of unstained and live animal tissue by phase contrast microscopy
3. Study of stained preparations of subcellular organelles: mitochondria, Golgi complex and nucleus
4. Permeability tests using erythrocytes
5. Extraction of DNA from buccal epithelial cells.
6. Chromosomes: Slide preparation of polytene chromosomes, Barr body.
7. Study of mitotic and meiotic divisions, with special reference to the mechanism of chromosome movement.
8. Visit to Lab/Institute

M.Sc. ZOOLOGY PRACTICAL (CELL BIOLOGY) Semester III

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100 **Duration - 6 hrs.**

1. Exercise on microscopic techniques	10 Marks
2. Slide preparation and study of cell organelles	08 Marks
3. Exercise on Cytochemical/Physiological study (Cell permeability/ DNA extraction)	08 Marks
4. Squash preparation mitotic/ meiotic study	06 Marks
5. Slide preparation of chromosome (Polytene/ Barr body)	08 Marks
6. Spotting (Permanent slides, Models, Photo etc.) 5 spots x 2 marks	10 Marks
7. Seminar	15 Marks
8. Field Report	15 Marks
9. Viva-voce	10 Marks
10. Class Record	10 Marks
Total	**100 Marks**

ZOO12225T:Paper-Z-3.3 (B) SPECIAL PAPER: ENVIRONMENTAL BIOLOGY-I

UNIT - I

Basic concepts of Environmental planning: Environmental priorities in India, Urban and Rural Environmental planning. Environmental problem of urban and rural planning. National and State Environmental Policies. System Ecology and Eco-system Modelling. Impact of environment at cellular level: Cellular interaction with environment.

Unit- II

Ecology- Definition, principles and scope. Abiotic and biotic components, energy flow, food chain, food web and ecological pyramid. Concept of population and community: Ecotones and their importance. Biogeochemical cycles and regulation. Basic cycles: Hydrological, Carbon, Oxygen, Nitrogen, Phosphorus and Sulphur cycles. Nutrient cycling in forest and aquatic ecosystems.

Unit-III

Ecosystem: Structure and function. Terrestrial Ecosystem: Grassland ecosystem- Distribution and types of Grasslands, Biodiversity and Productivity in grasslands (including grazing lands). Forest: Characteristics of Alpines, Temperate and Tropical forests. Stratification, High altitude (with special reference to Himalayan ecology). Deserts: Types and ecological attributes of desert biota. Aquatic ecosystem:Fresh Water- Lakes (including salt lakes), Ponds, Streams, Springs, Rivers and Marshes. Marine: Zonation fauna. Estuaries: Ecological peculiarities and adaptations (including impact on fauna).

Unit- IV

Environmental Physiology: Basic Metabolic rate and body size; Metabolism and climatic adaptations - Hibernation and aestivation; Poikilotherms and Homeotherms; Asphyxia responses. Response to temperature and Pressure. Hematological changes, Thermal properties of water and survival limits. Acclimatization.

Unit- V

Development and evolution of ecosystems: causes and kinds of succession diversity and productivity in relation to succession and development. Urban, rural and other Man-made ecosystems, their impact on animal life. Urbanization and industrialization. Socio-ecological impacts. Law of Thermodynamics contrary to environmental studies.

ZOO12231T:Paper-Z-3.4 (B) SPECIAL PAPER: ENVIRONMENTAL BIOLOGY-II

UNIT-I

Biodiversity conservation: Definition, classification and importance of Biodiversity. Endangered and Threatened Species (Flora and fauna) of India and Rajasthan. Hotspots of Biodiversity in India (Himalayas, Western Ghats, The Indo-Burma Region and Sundalands). Role of plants in natural ecosystems and life support system (terrestrial, freshwater and marine). Role of plants in modern and traditional medicine. Role of animals in conservation of natural ecosystems.

UNIT-II

Water Pollution: Types, sources and consequences of water pollution and water quality standards. Physico-chemical and Bacteriological sampling and analysis of water quality. Sewage and waste water treatment and recycling. Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system. Coastal management.

UNIT-III

Soil Analysis: Physico-chemical and bacteriological sampling of soil. Industrial waste/effluents and heavy metals, their interactions with soil components. Soil microorganisms and their functions. Degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NPK & K) and their interactions with different components of soil. Control of Soil Pollution. Environmental Geo-chemistry: Definition, Principles and importance.

UNIT-IV

Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes, Biomedical Waste and Hazardous Waste. Sources of noise pollution, measurement of noise and indices. Effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health. Radioactive waste, radioactivity from nuclear reactors, Thermal Pollution.

UNIT-V

Environment legislation: Environmental Management Systems; Provision in Constitution of India regarding Environment (Article 48A and 51A). Environmental (Protection) Act, 1986 and Rules 1986. Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act 1987 and Rule 1982. Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988. Wildlife (Protection) Act, 1972, amended 1991. Indian Forest Act (Revised) 1982. Biodiversity Act, 2002; Bio-Medical Waste (Management and Handling) Rules- 1975; Hazardous Waste (Management and Handling) Rules- 1989.

Suggested Books for reference:

1. Ecology, Environment Science and Conservation by J. S. Singh, S. P. Singh and S. R. Gupta.
2. Fundamentals of Ecology and Environment by Pranav Kumar and Usha Mina.
3. Environment and Ecology by R. Rajagopalan.
4. Ecology and Environment by P. D. Sharma.

ZOO12235P:Paper-Z-3.5-II (Lab Course II): Zoology (Environmental Biology) Practical Work Based on Paper Z-3.3 (B) & Z-3.4 (B) (Total No. of laboratory hrs. 240)

1. Identification of wildlife and local trees of Rajasthan.
2. Identification of selected endangered wildlife species of India (eg. Asiatic Lion, Tiger, Panther, Sloth bear, Rhinoceros, vulture, black buck, flying squirrel, tree frog etc.).
3. Measurement of water: pH, alkalinity of water, dissolved oxygen, free carbon-dioxide, chloride, salinity, temporary and permanent hardness of water, turbidity, velocity of current.
4. Soil pH, edaphic factors of soil; preparation of soil extract.
5. Study and identification of Zoo-Planktons and Phyto-Plankton.
6. A field study of any one of the following habitats to be assigned to an individual or to a group of students.

   (i) Pond habitat (ii) Marine habitat (iii) Terrestrial habitat

M.Sc. ZOOLOGY PRACTICAL (ENVIRONMENTAL BIOLOGY) Semester III

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100 **Duration - 6 hrs.**

1. Exercise on analysis of water sample	10 Marks
2. Exercise on analysis of soil sample	10 Marks
3. Identification of plankton (Phyto- and Zoo-plankton)	10 Marks
5. Identification and comments on 10 spots	20 Marks
6. Viva-voce	10 Marks
7. Class Record	10 Marks
8. Seminar	15 Marks
9. Field/Project Report	15 Marks
	Total 100 Marks

ZOO12226T:Paper-Z-3.3 (C) SPECIAL PAPER: ENTOMOLOGY-I

Unit-I

1. Insect integument – structure, composition and functions
2. Moulting & biochemistry of sclerotization
3. Structure of Head, thorax, abdomen.

Unit-II

4. Appendages of insect- antenna, mouthparts, legs and wings; functions.
5. Wing venation.
6. Flight muscles and mechanism of insect flight.
7. Modification in the insect appendages.

Unit-III

8. Digestive system- Alimentary canal, Physiology of digestion
9. Circulatory system –Anatomy & Physiology
10. Composition of haemolymph
11. Sound and light producing organs

Unit-IV

12. Respiratory system – structure & physiology. Accessory respiratory organs.
13. Respiration in aquatic insects.
14. Excretory system in insects; excretory products.
15. Neuro – endocrine organs in insect.

Unit-V

16. Classification of insects upto orders and suborders
17. Comparative study of following taxa
    (i) Zygoptera and Anisoptera
    (ii) Ensifera and caelifera
    (iii) Homoptera and Heteroptera

(iv) Adephaga and polyphaga

(v) Symphyta and Apocrita

ZOO12232T:Paper-Z-3.4 (C) SPECIAL PAPER: ENTOMOLOGY-II

Unit-I

1. Effects of Physical factors, population dynamics.
2. Intraspecific and interspecific relations, host plant insect-interactions.
3. Biochemical adaptation to environmental stress, Pheromonal control of fertility in insects.

Unit-II

4. Embryology: Embryonic and post embryonic development; diapauses.
5. Types of larvae, pupae and metamorphosis
6. Role of endocrine glands in growth and development, viviparity and parthenogenesis.

Unit- III

7. General idea of damage caused by pests.
8. Principal methods of pest control: mechanical, physical, culture, legislative and quarantine.
9. Biological control.
10. Integrated pest Management.

Unit-IV

11. Insecticides: classification and types.
12. Mode of action and methods of application.
13. Drawbacks of chemical control.

Unit-V

14. A general account of chemosterilants, attractants, repellants, pheromones, growth regulators and such other compounds.
15. Development of resistance to pesticides
16. Insecticide synergists and antagonists.

ZOO12235P:Paper-Z-3.5-II (Lab Course II): Zoology (Entomology) Practical Work Based on Paper Z-3.3 (C) & Z-3.4 (C) (Total No. of laboratory hrs. 240)

1. Museum study for identification of insects from various orders (prescribed in theory syllabus).
2. Permanent Preparation: a. Whole mounts of microscopic insects. b. Different types of mouth parts, antennae, legs and wings. c. Sting apparatus and pollen basket of honey bee. d. Tympanum and spiracle of grasshopper.
3. Anatomy a. Cockroach: Digestive, circulatory, reproductive systems. b. Grasshopper: Digestive, circulatory, reproductive systems c. House cricket: Digestive, reproductive and nervous systems. d. Housefly: Digestive and nervous system e. Honey bee: Digestive and nervous systems. f. Wasp: Nervous systems.
4. Study of permanent slides.
5. A tour to visit important centers of entomological / toxicological studies/Field study.

M.Sc. ZOOLOGY PRACTICAL (ENTOMOLOGY) Semester III

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100	**Duration - 6 hrs.**
1. Permanent preparation*.	10 Marks
2. Identification of spots (6x3).	18 Marks
3. Major Dissection*	12 Marks
5. Minor Dissection*	10 Marks
6. Viva-voce	10 Marks
7. Class Record	10 Marks
8. Seminar	15 Marks
9. Field/Project Report	15 Marks
Total	**100 Marks**

(* Use of animal for dissection and practical work is subject to the condition that they are not banned under the Wildlife Protection Act)

ZOO12227T:Paper-Z-3.3 (D) SPECIAL PAPER: FISH BIOLOGY-I

UNIT-I

Origin and evolution of fishes, classification of fishes upto orders as proposed by berg (Characters of principal subdivisions Elasmobranchii, Crossopterygii and Actinopterygii). Conservation and status of Fish fauna of India with special reference to Rajasthan. Zoogeography of Fishes in India.

UNIT-II

General account and phylogenetic significance of ostracoderms and placoderms, General characters, classification, affinities and phylogenetic status of cyclostomata, Lamprey and hagfishes. Petromyzon and Ammoecoete larva.

UNIT-III

Integument: Structure and function, Fin musculature and eye museles. Exoskeleton: scales of fishes (Placoid, cycloid, ctenoid, Cosmoid and Ganoid scales). Colouration in fishes. Mechanism of colour change, significance and uses of colouration.

UNIT-IV

Structure, functions and modifications of median and paired fins. Fish locomotion: Mechanism and types. Endoskeleton: Axial skeleton, Skull, Vertebral column, ribs, fin skeleton, visceral arches, girdles and types of jaw suspension in fishes.

UNIT-V

Swim bladder: Structure and function, modification, blood supply of the bladder, structure of bladder wall, gas secreting complex, Connection with ear. Origin and functions of swim bladder. Weberrian ossicles: Structure, function and significance. Fish migration: Types, factors influencing migration and significance.

ZOO12233T:Paper-Z-3.4 (D) SPECIAL PAPER: FISH BIOLOGY-II

UNIT-I

Food, feeding habits of fishes: Carnivorous fishes, Herbivorous fishes, Omnivorous fishes, Plankton feeders. Fishes: Surface, column and bottom feeders. Alimentary canal and its modifications, physiology of digestion and absorption of food, Feeding intensity, methods for food analysis and adaptation for foraging. Artificial food.

UNIT-II

Composition of Blood, Structure of heart in Scoliodon and Teleost's, vascular system and circulation of blood, Hemoglobin and its adaptation in fishes. Respiratory organs, assessor Respiratory organs, Air breathing organs, physiology of respiration and its regulation.

UNIT-III

Excretory organs: Structure and histology, physiology of excretion, Osmoregulation in marine, fresh water and estuarine fishes, Role of hormone in excretion and osmoregulation. Nervous system: Forebrain, Midbrain Hindbrain, spinal cord and nerves, sense organs: Olfactory. Auditory and photoreceptors and lateral line system.

UNIT-IV

Endocrine glands and Neurosecretory system. General study of fish behaviour with special reference to chemical communication in fishes. Reproduction in fishes. Reproductive organs (male and female), maturation, spawning and fertilization. Reproductive behaviour: courtship and parental care, Gonadosomatic Index, Sexual dimorphism, hormonal control of reproduction, relationship of fecundity with body parameters, Fecundity and its methods.

UNIT-V

Embryonic development: Categories in fishes with respect to development, cleavage, fate maps of Blastula, Gastrulation, Larval development, viviparity hatching and Postembryonic development. Recent trends in fish study and research, fisheries economics and extension: Fishery resources as common property resources, Maximum Sustainability Yield (MSY), Minimum Economic Yield (MEY), Optimum Sustainability Yield (OSY), Fisheries extension programmes, Fish Farmer's Development Agencies (FFDAs).

Suggested Books for reference:

1. Fish Biology by S. S. Khanna.
2. Fish Biology by Pandey & Shukla.
3. Fish and Fisheries of India by V. G. Jhingran.
4. Day Volume I & II

ZOO12235P:Paper-Z-3.5-II (Lab Course II): Zoology (Fish Biology) Practical Work Based on Paper Z-3.3 (D) & Z-3.4 (D) (Total No. of laboratory hrs. 240)

1. Complete anatomy of a teleost, represented by Wallago attu or any other locally available teleost: External features, general viscera (including urino-genital organs), jaw and lateral

musculature, brain and cranial nerves, eye muscles and their innervations, membranous labyrinth, Weberian ossicle swim bladder connection.

2. Anatomy through model/photograph/chart/CD. Of the head of any cat fish.
3. Breathing organs of Anabas. Clarias, Channa and Heteropneustis showing the blood supply wherever possible.
4. Preparation of Taxonomic key for the study of local fishes upto species level.
5. Permanent preparation and study of pharyngeal denticles, cycloid and other scales.
6. Micro-technical procedures: Preparation and study of serial sections of a larval fish and representative tissues and organs of fish.
7. Field trip to study local fish fauna/common fish diseases/visit to local fish market.

M.Sc. ZOOLOGY PRACTICAL (FISH BIOLOGY) Semester III

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100 **Duration - 6 hrs.**

1.	Learning of fish anatomy	10 Marks
2.	Permanent preparation	10 Marks
3.	Study of accessory respiratory organs	10 Marks
4.	Species identification using taxonomic key	10 Marks
5.	Microtomy	10 Marks
6.	Seminar	15 Marks
7.	Viva-voce	10 Marks
8.	Class Record	10 Marks
9.	Field/Project Report	15 Marks
	Total	**100 Marks**

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ZOO12228T:Paper-Z-3.3 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT-I

Unit I

Silviculture

General Silvicultural Principles: Ecological and physiological factors influencing vegetation, natural and artificial regeneration of forests; methods of propagation, nursery techniques (layout, preparation of beds, seed sowing, tending, water budgeting, hardening, grading, etc), plantation techniques (planting in pits, direct seed sowing, cutting, planting, etc). Major Silvicultural systems (clear felling, coppice with standard system, selection system, etc).

Management of silviculture systems in temperate, subtropical, humid tropical, dry tropical and coastal tropical forests with special reference to plantations, choice of species, establishment and management of standards, intensive mechanized methods, aerial seeding, thinning.

Unit – II

Forest Types & Forest Services

Principle forest types: Introduction, classification and distribution in relation to other countries, Basis for classification, Major Forest Types of India and their distribution according to Champion and Seth's classification. Major Forest types of Rajasthan. Role of mini-forests and forest trees in overall resource management,

Forest as material and service provider: Environmentally sound forest harvesting practices; logging and extraction techniques and principles, transportation systems, storage and sale; Non-Timber Forest Products (NTFPs) - definition and scope; gums, resins, oleoresins, fibres, oil seeds nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shellac, katha and tendu leaves.

Unit- III

Forest Soil and Watershed Management

Forest Soils: Classification, factors affecting soil formation; physical, chemical and biological properties. Causes for soil erosion; types- wind and water erosion; conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes; reclamation of saline and alkaline soils, water logged and other wastelands. Role of micro-organisms in ameliorating soils; N and C cycles, Role of VAM (Vesicular arbuscular mycorrhizae); concepts of watershed; forest hydrology, watershed development in respect of torrent control, river channel stabilization, avalanche and landslide controls, rehabilitation of degraded areas.

Unit- IV

Forest Protection

Injuries to forest – abiotic and biotic, destructive agencies, insect-pest and disease, effect of air pollution on forests and forest die back. Susceptibility of forest to damage, nature of damage,

cause, prevention and protective measures; benefits due to chemical and biological control. Role of afforestation and forest regeneration in absorption of CO2, concept of carbon sequestration.

Unit- V

Forest Legislation

Indian Forest Policy, 1988 of People's involvement, Joint Forest Management, Involvement of women; Forestry policies and issues related to land use, timber and non-timber products, sustainable forest management; industrialization policies; institutional and structural changes. Forest laws, necessity; general principles, Indian Forest Act 1927; Forest Conservation Act, 1980; Wildlife Protection Act 1972 and their amendments; Application of Indian Penal Code to Forestry. Environmental Impact Assessment (EIA).

ZOO12234T:Paper-Z-3.4 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT-II

Unit- I

Biogeography

Biogeography: Continental drift, bio-geographical realms (8) Afrotropical, Antarctic, Australian, Indomalaya, Nearctic, Neotropical, Oceanic and Palearctic and 14 Biomes. Concept of Biodiversity, level of biodiversity: alpha, beta, gamma diversity, Keystone species, umbrella species, flagship species, indicator species, Indigenous and introduced / exotic species. The Biogeographic classification in India. Zoogeography of Indian Mammals. The origin of Indian fauna and flora, routes of faunal exchange and migration.

Unit- II

Habitat Ecology

Wildlife cover requirement, Edge effect and interspersion, physical and biological features of habitats. Habitat diversity: edge, ecotones, snags, cliffs, talus and caves, interspersion and juxtaposition. Niche, Niche overlap, Niche width, Territory, Home range and cruising radius. Physical and anthropogenic factors influencing terrestrial habitats; drought, flood, grazing, felling, fire.

Carrying capacity: Ecologically based and culturally based. Wildlife habitat analysis and evaluation: Availability, quality, palatability of graze and browse. Animal sign as indicator of habitat use, use of map overlay approach in habitat evaluation, corridors, eco-sensitive zone and critical tiger habitat. Habitat degradation, fragmentation and Successional changes.

Unit- III

Biology of Indian Wildlife

Review of biology of major groups of vertebrates, fish, amphibians, reptiles, birds and mammals with emphasis on importance in wildlife management. Importance of invertebrate conservation. Threats and conservation perspectives of fish biodiversity in India. Batrocology: threats and conservation measures. Role of sex determination in reptiles. Identification of venomous and non-venomous snakes, snake bite, venom and anti-venom. First Aid and Management of snake bite cases. Threats faced by avian community, causes of decline of common birds and their control. Morphological and physiological adaptations in mammals. Mammalian skin and its derivatives.

Unit- IV

Wildlife Management

Management of special habitats: riparian zones, grasslands etc. Management plan for Protected. Areas: Forest working plans and wildlife management plans. Need for wildlife management planning. Principle of planning, objectives, resource survey, analysis of surrounding region, management zones, theme plans, communications, staff and visitor amenities and monitoring. Financing protected areas. Population estimation: Meta-population. Census techniques (bird and mammal). Sampling designs for population estimation, population estimation methods: Distance based Sampling Methods, Mark-Recapture for Closed Population.

Unit- V

Wildlife Health Management

Wildlife health management, need for wildlife health management. History of wildlife diseases in India, importance of wildlife health monitoring, problems and solutions, Infectious and noninfectious diseases in fish, amphibian, reptile, birds and mammals. Review of major diseases of Indian wild mammals, birds, amphibians and reptiles. Disease transmission between domestic and wild population. Malnutrition, starvation, dehydration as disease syndrome. Management of waterholes in wildlife disease control. Quarantine and Quarantine Act.

Suggested books for reference:

1. A Textbook of Forestry and Wildlife Management- Volume 1 by S. S. Negi
2. A Textbook of Forestry and Wildlife Management- Volume 2 by S. S. Negi
3. Indian Forestry by K. Manikandan, S. Prabhu.

4. Introduction to Forestry & Agroforestry by K.T. Parthiban, N. Krishnakumar, M. Karthick.
5. Forestry: A Subjective Guide for IFS Aspirants by K.T. Parthiban, R.J. Sudhagar, S. Umesh Kanna.
6. Textbook on Social Forestry and Agroforestry by M. P. Divya;K. T. Parthiban
7. Wildlife Management by Rajesh Gopal.
8. Wildlife Management by Reena Mathur.

ZOO12235P:Paper-Z-3.5-II (Lab Course II): Zoology (FORESTRY AND WILDLIFE MANAGEMENT) Practical Work Based on Paper Z-3.3 (E) & Z-3.4 (E) (Total No. of laboratory hrs. 240)

1. Review of forest working plan and maps. Study of nearby forest and grassland under various management regimes. (Management practices will also be studied on field courses).
2. Field data collection for estimating population abundance of mammals using line transects, occupancy survey and point counts.
3. Population Estimation, data collection and use of software DISTANCE, MARK and PRESENCE.
4. Analysis of vegetation and habitat characteristics in a specific PA. Forest as material and service provider- utilization and uses.
5. Quantification of flora using vegetation sampling methods (Estimation of species dominance, frequency, density using quadrate / plot methods).
6. Zoogeography of mammals of Indian sub-continent; Distribution of (i) Primates: Rhesus macaque (ii) Carnivores: Tiger, panther, hyena, sloth bear (iii) Ungulates: Sambar, chital, wild boar.
7. Study and identification of fish and insects commonly found in any study area.
8. Horn/ Antler identification.
9. Identification of poisonous and non-poisonous snakes, venom types.
10. Bird watching and identification of resident and migratory birds (minimum 100), bird census techniques.
8. Field Visit to Zoo/Biological Park/Protected Area.
9. Project/Field report writing.

M.Sc. ZOOLOGY PRACTICAL (FORESTRY AND WILDLIFE MANAGEMENT)

Semester III

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100 **Duration - 6 hrs.**

1. Exercise on zoogeography/wildlife techniques	10 Marks
2. Exercise on vegetation sampling methods	10 Marks
3. Exercise on Forest Services (plant/animal)	10 Marks
5. Spotting (Pugmarks, Models, Photo etc.) 10 spots x 2 marks	20 Marks
6. Viva-voce	10 Marks
7. Class Record	10 Marks
8. Seminar	15 Marks
9. Field/Project Report	15 Marks
Total	**100 Marks**

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M. Sc. Zoology II YEAR: SEMESTER IV

ZOO12241T:Paper-Z-4.1 ANIMAL BEHAVIOUR

ZOO12242T:Paper-Z-4.2 DEVELOPMENTAL BIOLOGY OF CHORDATES

ZOO12244-48T:Paper-Z-4.3 SPECIAL PAPER

ZOO12250-54T:Paper-Z-4.4 SPECIAL PAPER

ZOO12241T:Paper-Z-4.4 SPECIAL PAPER

ZOO12243P:Paper-Z-4.5- I (Lab Course I)

Z-4.5- II (Lab Course II)

ZOO12255P:ZOOLOGY Practical: Duration 12 Hrs; MM 200, Min 100.

Day 1: 6 Hrs (Z-4.1 & Z-4.2) and **Day 2:** 6 Hrs (Z-4.3 & Z-4.4).

SCHEME OF EXAMINATION

(Semester Assessment)

Duration: 3 hours Max. Marks – 70

Note: The question paper will contain three sections as under –

Section-A: One compulsory question with 10 parts, having 2 parts from each unit, short answer in 20 words for each part. Total marks: 10

Section-B: 10 questions, 2 questions from each unit, 5 questions to be attempted, taking one from each unit, answer approximately in 250 words. Total marks: 30

Section-C: 04 questions (question may have sub division) covering all units and one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks: 30

UNIT WISE DETAILED SYLLABUS
M. Sc. Zoology Semester IV

ZOO12241T:Paper- Z-4.1 ANIMAL BEHAVIOUR

UNIT – I

1. Introduction of animal behaviour: definition, concept of ethology, scope and limitations.
2. Orientation: Classification of various types of taxes and kinesis.
3. Methods of studying behaviour: Brain lesions; electrical stimulation, drug administration.

UNIT – II

1. Types of behaviour and their regulation: Components of feeding behaviour: Hunger drive; directional movement, avoidance, eating, carrying and hoarding.
2. Factors influencing choice of food, Nervous regulation of food and energy intake.
3. Motivated behaviour: drive, satiation and its neurophysiological control.

UNIT – III

1. Learning: Habituation conditioned reflex; trial and error; latent learning; learning and discrimination, imprinting; neural mechanism of learning.
2. Instinctive behaviour: Concept, phyletic decent and physiology.
3. Hormones and behavior: Mammalian nervous system and involvement of hypothalamus in the regulation of behavioural patterns.

UNIT - IV

1. Social behaviour in primates: (a) Primate societies. (b) Social signals, olfactory, tactile, visual, vocal and acoustic. (c) Status: Dominance and hierarchy, territorial behaviour, courtship and mating, aggression.
2. Behaviour of domestic and zoo animals.
3. Behaviour in birds: Behaviour of Streptopelia (ring dove); homing and migration.

UNIT - V

1. Reproductive behaviour in fish (Stickle back or any other fish).

2. Behaviour in insects: Social behaviour, communications, concealment behaviour, role of pheromones.
3. Behavioural genetics: Single gene effect, multiple gene effect, behavioural variation in an individual; genetics and human behaviour.

Suggested books for reference:

1. Animal Behaviour by Reena Mathur
2. Animal Behaviour by V. K. Agarwal
3. Animal Behaviour by P. Natarajan and N. Arumugam.

ZOO12242T:Paper-Z-4.2 DEVELOPMENTAL BIOLOGY OF CHORDATES

UNIT – I

1. Theories of development: Preformation and epigenesis.
2. Gametogenesis (i). Spermatogenesis: Growth of spermatocyte and acrosome formation; Spermiogenesis. (ii). Oogenesis: (a) Growth of oocyte and vitellogenesis. (b) Organization of egg cytoplasm; role of the egg cortex. (c) Morphogenetic determination in egg cytoplasm.
3. Fertilization: Significance of fertilization in development and the essence of activation of the egg.

UNIT – II

1. Early embryonic development. Patterns of cleavage: morulation and blastulation.
2. Gastrulation in chordates (tunicates to mammals). (a) Fate maps. (b) Cell lineage. (c) gastrulation process and its significance (d) Morphogenetic movements.
3. Primary embryonic induction: (a) Concepts of potencies; prospective fates; progressive determination, totipotency and pluripotency, nuclear transfer experiment. (b) Induction of the primitive nervous system (Spemann's primary organizer) (c) Nature & regionally specific properties of inductor. (d) Competence. (e) Abnormal (heterogeneous) inductors. (f) Chemistry and mechanism of action of inducing substances.

UNIT – III

1. Cell differentiation and differential activity.
2. Organogenesis: (a) Morphogenetic processes in epithelia and mesenchyme in organ formation. (b) Morphogenesis of brain, neural crest cells and their derivatives. (c) Development of the Brain, eye & heart.
3. Maternal contributions in early embryonic development.

UNIT – IV

1. Genetic regulations of early embryo development.
2. Embryonic adaptations: (a) Evolution of cleidoic egg and its structural and physiological adaptations. (b) Development and physiology of extra-embryonic membranes in amniotes. (c) Evolution of viviparity. (d) Development, types and physiology of mammalian placenta.
3. Metamorphosis in amphibia: (a) Structural and physiological changes during metamorphosis. (b) Endocrine control of metamorphosis.

UNIT – V

1. Types of regeneration, physiological, reparative and compensatory hypertrophy, regenerative ability in chordates. (b) Morphological and histological processes in amphibian limb regeneration. (c) Origin of cells of regeneration, de-differentiation, re-differentiation, (d) pattern formation during amphibian limb generation; Reasons for failure of limb generation ability in other chordates and mammals; methods for induction of regenerations.
2. Abnormalities of Embryonic development: teratogenesis.
3. Gerontology, Senescence and ageing.

Suggested books for reference:

1. Embryology by Bejamin
2. Developmental Biology by O. P. Jangir
3. Developmental Biology by M.A. SUBRAMANIAN.
4. Developmental Biology by Scott F. Gilbert.

M.Sc. ZOOLOGY PRACTICAL Semester IV

ZOO12243P:Paper-Z-4.5-I (Lab Course I): Practical Work Based on Paper Z-4.1 & Z-4.2 (Total No. of laboratory hrs. 240)

1. **Ethology:** (a) Study of the process of learning in rat with the help of animal maize; analysis of the results with simple experiments. (b) Study of the shock and avoidance behaviour in earthworm/rat. (c) Imprinting in precocial birds. (d) Chemical communication in the earthworms. (e) Study of the food preferences and feeding behaviour of an insect pest. (f) Study of the phototactic response in Tribolium/housefly. (g) Study of habituation in chicks.

2. **Developmental biology:** (a) Study of development of frog or toad (egg, spawn, embryo, larvae and metamorphic stages). (b) Study of development of chick through: (i) Permanent whole mount of successive embryonic stages. (c) Study of chick embryos of 18, 21, 24, 33, 48, 72 and 96 hours. Identification and mounting of Blastoderm. (d) Study of the mammalian foetus and placenta.
3. **Case Study/ Field observation:** Ant behaviour, Web construction and habituation in Spider. Geo-tactic response of Earthworm or any pest. Food preference and cleaning behaviour of house-fly. Listing of all animals in and around your surroundings. Visit to a Biological Park/Sanctuary/ National Park/Tiger Reserve.

M.Sc. ZOOLOGY PRACTICAL Semester IV

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100 **Duration - 6 hrs.**

1. Exercise on Ethology *	10 marks
2. Permanent preparation*	10 marks
3. Exercise on Development Biology	10 marks
4. Spotting (Permanent slides, Models, Photo etc.) 10 spots x 2 marks	20 marks
5. Seminar	15 marks
6. Viva-voce	10 marks
7. Class Record	10 marks
8. Case study/Field trip	15 marks
Total	**100 marks**

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ZOO12244T:Paper-Z-4.3 (A) SPECIAL PAPER: CELL BIOLOGY-I

Unit I

Specialized function of cytoplasmic components in a cell with special references to the molecular mechanism (Contractibility, secretion, phagocytosis and pinocytosis) Vesicular Transport & membrane fusion.

Unit-II

Cell & Tissue Culture: - Primary and Established cell lines, Kinetics of cell growth. Behavior of cells in culture. Tissue cultures in Biomedical Research: Genetics, Virology and Cancer.

Unit-III

Culture media: types, methods and importance, Importance of cell & tissue culture. Generalized account of the mechanism of cell aggregation during development in vitro studies.

Unit-IV

Study of fixation & staining of following techniques: (a) Freeze substitution (b) Freeze drying (c) Fresh & fixed frozen section. (d) PAS (e) Metachromasia, feulgen, lipid & protein staining techniques.

Unit-V

Centrifugation & ultra-centrifugation, Single, two dimensional & column chromatography. Intravital & supravital staining. Paper, Gel, SDS-PAGE & Discontinuous electrophoresis. PCR.

ZOO12250T:Paper-Z-4.4 (A) SPECIAL PAPER: CELL BIOLOGY-II

Unit-I

Elementary concept of the principle & theory of microscopy as exemplified by the following: (a) Phase contrast microcopy (b) Interface microscopy (c) Polarizing microscopy (d) Fluorescence microscopy (e) Electron violet microscopy.

Unit-II

A general account of the effect of ionizing radiation at the cellular level. Mechanism of action of the following Enzymes at cellular level. (a) ATPase (b) Succinic dehydrogenase (c) Acid & Alkaline phosphatase (d) Hyaluronidase

Unit-III

Cellular aspects of aging: Molecular mechanism, Cellular changes during aging- Morphological, Physiological and Subcellular. Cellular aspects of immunity and virus-cell interaction. Elementary idea of the origin of following diseases (a) Glycogen storage disease (b) Familial hypercholesterolemia (c) Hunter syndrome (d)Metachromatic leukodystrophy (e) Galactosemia

Unit-IV

Genetic of cancer: Proto-oncogenes, Oncogenes & Tumor Suppressor Genes. Oncoproteins: Activation, Translocations & Amplification. Carcinogens & viruses.

Unit-V

Apoptosis: Mechanism, Intrinsic and Extrinsic pathways, Apoptosis in Caenorhabditis, Drosophila, and Cell culture, Apoptosis targeted therapies.

ZOO12255P:Paper-Z-3.5-II (Lab Course II): Zoology (Cell Biology) Practical Work Based on Paper Z-4.3 (A) & Z-4.4 (A) (Total No. of laboratory hrs. 240)

1. Care and maintenance of the microscopes.
2. Phase contrast microscopy-setting, measurements of refractive index, measurement of nuclear and cytoplasmic volume.
3. Cells isolation by sedimentation velocity.
4. Preparation of culture medium.
5. Single two dimensional & column chromatography.
6. Microtomy. Wax, fresh, frozen and fixed frozen sections, sectioning of gelatin embedded material
7. Histo-cytochemical method: a. Methyl Green Pyronin method b. Feulgen staining c. Periodic acid Schiff method d. Alcian blue method e. Bromo phenol blue method

M.Sc. ZOOLOGY PRACTICAL (CELL BIOLOGY) Semester IV

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100	**Duration - 6 hrs.**
1. Exercise on microscopic techniques/ chromatography	05 Marks
2. Exercise in Cell/ Tissue culture	07 Marks
3. Exercise in Microtomy/ Histochemistry	08 Marks
4. Spotting (Permanent slides, Models, Photo etc.)	
5 spots x 3 marks	15 Marks
5. Seminar	15 Marks
6. Class Record	10 Marks
7. Viva-voce	10 Marks
8. Dissertation	30 Marks
Total	**100 marks**

(*Project report/dissertation will be based on field work on any topic related to the syllabus*)

Suggested Books for reference:

1. Lodish et al: Molecular Cell Biology (Scientific American Books)
2. De Robertis and De Robertis: Cell and Molecular Biology (Saunders College)
3. AC Giese: Cell Physiology
4. Prescott, DM: Reproduction in eukaryotic cells (Academic Press)
5. Wilson, EB: Cell in Development and Inheritance (MacMillan)
6. Edward Gasque: Manual of Laboratory Exp. in Cell Biology (W. C. Brown Publishers)

ZOO12245T:Paper-Z-4.3 (B) SPECIAL PAPER: ENVIRONMENTAL BIOLOGY-I

UNIT- I

History and Scope of toxicology. Toxicology of aquatic and terrestrial environments. Acute and chronic toxicity. Toxicity testing in field and enclosure. Toxic dose: Approximate acute LD50 /LC50 of some representative chemical agents. The use of biomarkers in assessing the impact of environmental contaminants. Bioassay and Trophic level transfer of contaminants. Environmental Monitoring (Bioindicators as environmental quality).

UNIT- II

Toxic Chemicals in the environment-Air, Water, Pesticides in water. Bio-chemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon monoxide, Ozone and PAN Pesticides, Insecticides, Methly-isocynate, carcinogens in the air.

UNIT-III

Occupational Health: Definition, Occupational Health Hazards, Common hazards: Pneumoconiosis. Silicosis, Anthracosis, Byssinosis, Bagassosis, Asbestosis, Farmers's Lung, Lead poisoning, Occupational Cancer, Occupational Dermatitis, and Radiation Hazards. Measures for health protection of workers and Role of WHO in Occupational Health. Occupational Health in India.

UNIT IV

Impact of human activities on environment. Environmental Education and Information. Management of Natural resources, conservation and development. Environmental monitoring for Air, Water, Soil, Microbes and Radiation. Sampling procedures and analytical techniques of common Environmental parameters.

UNIT- V

Urbanization- Stress and Health. Population Ecology: Factors determining population. Factors leading to the commonness, rarity and vulnerability of extinction of a species. Human rights, Intellectual Property Rights and Community Biodiversity Register.

ZOO12251T:Paper-Z-4.4 (B) SPECIAL PAPER: ENVIRONMENTAL BIOLOGY-II

UNIT-I

Definitions and concept, reclamation, remediation, restoration and rehabilitation. Disturbance: causes and impact on the structure and functioning of terrestrial and aquatic ecosystems. Aims and strategies: Passive and active; habitat, species and ecosystem restoration; single vs. multiple end-points. Ecosystem reconstruction: Acceleration of ecological succession, physical, chemical, biological and biotechnological tools. Restoration of biological diversity: Augmentation, reintroduction and introduction of species. Degradation and restoration of natural ecosystems: Forests, grassland/savanna, wetlands and other aquatic ecosystems. Restoration of degraded soils: Restoration of contaminated soils and soil fertility, mine spoil restoration

UNIT-II

Blast fishing, Illegal, unreported and unregulated fishing, Environmental effects of over fishing, Deforestation, Invasive species, Pollinator decline, Species extinction, Poaching, Wildlife trade, Intensive farming, Overgrazing, Environmental education and awareness, role of governmental and non-governmental organizations. Current Environmental issue in Indian Context: Narmada Dam, Tehri Dam, Almetti Dam, Soil Erosion. Formation and reclamation of Usar, Waste lands and their reclamation, Floods and Drought.

UNIT - III

Environment Impact Assessment (EIA). Environmental priorities in India and sustainable development. Environmental issues with War, Genetically modified food controversies, Overpopulation and Gender Imbalance. Environmental Appraisal with particular reference to: Mining Projects Industrial Projects, Thermal Power Projects, River Valley, Multipurpose,

Irrigation and H.E. Projects. Infrastructure Development and Miscellaneous Projects. Nuclear Power Projects

UNIT-IV

Social perspectives of environment: Global and Indian issues. Sustainable development: Concept, components and strategies. Social impacts of growing human population and affluence, food security, hunger, poverty, malnutrition, famine. Social impacts of water crisis, global climate change, Ozone depletion, nuclear accidents, acid rain, consumerism and waste products. Problems related to major dams and other developmental projects, resettlement and rehabilitation. Environment and human health: epidemiological issues, women and child welfare, family welfare programme. Environmental education, Environmental ethics, public awareness, people participation in resource conservation and environmental protection.

UNIT-V

Introduction to environmental impact analysis. Environmental impact Statement and Environmental Management Plan. EIA guidelines 2006, Notifications of Government of India. Impact Assessment Methodologies, their strengths and weaknesses. Generalized approach to impact analysis. Procedure for reviewing Environmental impact analysis and statement. Guidelines and basic principles of Environmental auditing -Definition, functions, benefits and costs of Environmental Auditing. Introduction to Environmental planning. Base line information and predictions (land, water, atmosphere, energy, etc.). Land use policy for India. Urban planning for India. Rural planning and land use pattern. Concept and strategies of sustainable development. Cost-Benefit analysis

ZOO12255P:Paper-Z-4.5-II (Lab Course II): Zoology (Environmental Biology) Practical Work Based on Paper Z-4.3 (B) & Z-4.4 (B) (Total No. of laboratory hrs. 240)

1. Bioassay using LD 50 and LC 50
2. Estimation of Biological Oxygen Demand and Chemical Oxygen Demand
3. Estimation of total inorganic and organic carbon
4. Study of waste water treatment plant
5. Assessment of Biodiversity.
6. Estimation of Respirable Suspended Particulate Matter by RSPM sampler.
7. Site visit of degraded landscape or habitat (Terrestrial/Aquatic)
8. Advanced instrumental technique: (i) Flame photometry

   (ii) UV- visible spectrophotometry

9. Dissertation- (Field/ Lab based/ Case study)

M.Sc. ZOOLOGY PRACTICAL (ENVIRONMENTAL BIOLOGY) Semester IV

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100	**Duration - 6 hrs.**
1. Experimental bioassay	10 Marks
2. Exercise on pollutant effect	10 Marks
3. Estimation of Total Inorganic & Organic Carbon	05 Marks
5. Exercise on instrumentation	10 Marks
6. Viva-voce	10 Marks
7. Class Record	10 Marks
8. Seminar	15 Marks
9. Dissertation	30 Marks
Total	**100 marks**

(*Project report/dissertation will be based on field work on any topic related to the syllabus*)

ZOO12246T:Paper-Z-4.3 (C) SPECIAL PAPER: ENTOMOLOGY-I

Unit-I

1. Nervous system - structure of central, peripheral and autonomous nervous system.
2. Sense organs – chemoreceptors, mechanoreceptors photoreceptors
3. Physiology of nervous system and sense organs.
4. Reproduction system –made female reproductive organs.

Unit-II

(i) Detailed classification of following orders emphasizing selected super and families and families –order Thysanura, odonata, orthoptera, Isoptera and Hemiptera.

(ii) Economic In these orders.

Unit-III

1. Detail of following orders emphasizing selected subfamilies and families-order coleopteran, Lepidoptera, Diptera and Hymenoptera.
2. Economic importance of these orders.

Unit-IV

1. Causes of success of Insects.
2. Fossils Insects
3. Ancestry and origin of Insects
4. Evolution of Insects

Unit-V

1. Social life in termites
2. Social life in honey bee
3. Social life in Ants
4. Social life in wasps
5. Caste determination in Social Insects.

ZOO12252T:Paper-Z-4.4 (C) SPECIAL PAPER: ENTOMOLOGY-II

Unit-I

1. Life history, damage caused and control of three major pests of each of the following crops:

   (i) Wheat, paddy, maze, jowar, millet

   (ii) Sugarcane, cotton, mustard and soyabean.

Unit-II

2. Life history damage caused and control of two major pests of each of vegetables and fruits.
3. Life history, damage and control of stored grain/milled product pests: *Sitophilus, Callosobruchus, Rhizopertha, Tribolium, Trogoderma, oryzaephilus.*

Unit-III

4. Pests of veterinary and medical importance.
5. Preliminary idea of insect borne diseases.
6. Role of genetics in insect vector control.

Unit-IV

7. Life cycle of aphid and locust and their control.
8. A general idea of plant protection organization in India.
9. Forensic entomology with special reference to human and wild life.

Unit-V

10. Beneficial insects and their economic importance.

11. Importance and related industries of silkworm, honeybee and lac insect.

ZOO12255P:Paper-Z-4.5-II (Lab Course II): Zoology (Entomology) Practical Work Based on Paper Z-4.3 (C) & Z-4.4 (C) (Total No. of laboratory hrs. 240)

1. Knowledge and use of equipments for rearing, collection and preservation of insects; insect net, lulling bottle, spreading board, insect-box; devices for inflating larva; light trap etc.
2. Maintenance of insectaria.
3. Collection and preservation of insects and their different stages.
4. Collection of seasonal, nocturnal, aquatic insects, crop pests, stored grain pests, household pests and insects of veterinary and medical importance.
5. Familiarity with techniques and appliances used for insecticide treatment.
6. Bioassay experiments for testing the insecticides.
7. Study of food preference in stored grain pests.
8. Micro-technical procedures (microtomy).
9. Insect identification up to family level using taxonomic key.

M.Sc. ZOOLOGY PRACTICAL (ENTOMOLOGY) Semester IV

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100	**Duration - 6 hrs.**
1. Study and use of insecticides and insecticides appliances	06 Marks
2. Toxicological exercise/Bioassay methods /Microtomy	07 Marks
3. Insect behavior/Insect collection and preservation Techniques*	06 Marks
4. Insect taxonomic Key and Identification (4x4)*	16 Marks
5. Seminar	15 Marks
6. Record	10 Marks
7. Viva-voce	10 Marks
8. Dissertation	30 Marks
Total	**100 Marks**

(* Use of animal for dissection and practical work is subject to the condition that they are not banned under the Wildlife Protection Act)

(*Project report/dissertation will be based on field work on any topic related to the syllabus*)

ZOO12247T:Paper-Z-4.3 (D) SPECIAL PAPER: FISH BIOLOGY-I

UNIT-I

Survey of principal fisheries of India (Indian major carps, Mackerel, Sardine, Bombay Duck fisheries). Biology of Indian major carps, catfishes, Hilsa, sardine mackerel, sharks mahseer, prawns and oysters. Exotic fishes: *Cyprinus carpio*, *Hypophthalmichthys molitrix carassius*, Trout, Mosquito fish. Larvivores fishes, predatory fishes and weed fishes.

UNIT-II

Fish Marketing, Domestic fish marketing in India, Price policy and fish marketing system in India. Aquaculture and its importance with special reference to India. Role of aquaculture in rural development. Giant fish water, Prawn Culture and Oyster Culture, Different types of fish culture: Composite fish culture, Cage culture and integrated culture, factors affecting fish culture. Biota of pond water, carrying capacity of a pond Types of pond for culture, Growing or stocking pond, Kinds of fish farm, Extensive fish culture, Intensive fish culture, cultivable species.

UNIT-III

A detailed study of methods of fishing: Fishing crafts and Fishing gears in India (Spear and Harpoon, Fish traps, Nets, Types of Nets, Use of electric Current, Modernization of fishing methods). Pond management, fish seed resources and their transport, induced breeding by hormones.

UNIT-IV

Fish preservation and processing (Spoilage of fish, Rigor Mortis, causes of spoilage of fish, Preservation of fish, Chilling, Freezing, Deep freezing and freeze drying, salting, Brining, Smoking, Canning. Food poisoning by fish. Fishery resources and Economic value: Bio chemical composition of fish, fish as food. Fish and mankind, byproducts of fishing industry.

UNIT-V

Inland fisheries resources: Riverine fisheries, The Ganga River System, The Brahmaputra River System, The East coast River System. The Indus River System, Riverine resources of cold-water fishery and Reservoir fisheries, cold water Fisheries of lake. Estuarine fisheries: Open estuaries,

Embanked estuary, Principal fisheries of brackish water. Marine fisheries: Fishery resources, coastal fisheries, factors influencing fish production.

ZOO12253T:Paper-Z-4.4 (D) SPECIAL PAPER: FISH BIOLOGY-II

UNIT-I

Estimation of population number and mortality rates in fresh waters. Age and growth studies: Factors influencing growth of fish, Regulation of Growth, Growth Periodicity, Methods for determining Age and Growth, Practical utility of determining Age and Growth. Length Weight relationship and indices of condition and growth.

UNIT-II

Limnology: Definition, types of lakes/ponds, their significance, Plankton: Definition, types, diurnal variations, planktons and their significance in fisheries. Fisheries management and threat: Conservation of genetic and ecological diversity. In-situ & Ex-situ conservation; cryopreservation, application of gametes. Threats and conservation of fishes.

UNIT-III

Water pollution and fisheries: causes of water pollution, Domestic sewage, Industrial wastes and effluents, Soil erosion and Sedimentation, Fertilizers, Pesticides and Insecticides, Radioactive Waste, Thermal Waste, Oil Pollution, Acidification, Mining Wastes, effect of Pollutants on fishes. Aquatic weeds: types, habitat and their control. Aquaria setting up and maintenance.

UNIT-IV

Diseases of fishes: Causes, etiology, Symptoms, treatment and their control. Specialized organs: Bioluminescent organs, electric organs, sound producing organs, poisonous and venomous organs.

UNIT-V

Adaptations to special conditions of life: Hill stream fishes, deep sea fishes, cave dwelling fishes. Application of genetics and biotechnology in fishes, transgenic fishes and fish genomics. Aspects of fish genetics: Gene and Chromosomes Mutation: Sex chromosomes, Sex determination, Polyploidy, hybridization and mutation.

ZOO12255P:Paper-Z-3.5-II (Lab Course II): Zoology (Fish Biology) Practical Work Based on Paper Z-4.3 (D) & Z-4.4 (D) (Total No. of laboratory hrs. 240)

1. Hydro-biological exercise: (a) Analysis of water Determination of pH, free Carbon-di-oxide, dissolved Oxygen, chlorides, Calcium, total alkalinity, total salinity, BOD, COD. (b) Collection: Qualitative and quantitative analysis of planktons.
2. Biochemical/Physiological/Embryological exercise: (a) Estimation of glycogen in liver. (b) Determination of free amino acids of muscles or blood plasma through chromatography. (c) Induced spawning. (d) Study of development of teleost fish through preserved material (whole embryo or sections) or models/charts: eggs, cleavage, blastula, gastrula, external gill, mature larva, fry and fingerlings.
3. (a) Periodical visit to a local fishing farm to gain a firsthand knowledge of its pisciculture practices and fisheries activities. (b) A week's tour of an inland fisheries research station. (c) One-week tour of an important marine biological or fishery center in the country. Lab based experiments.
4. Preparation and maintenance of fresh water aquarium housed with local and exotic fishes, in your department.
5. Study of available museum specimen in Lab.

Note: A dissertation under item 03 has to be submitted compulsorily by each candidate

M.Sc. ZOOLOGY PRACTICAL (FISH BIOLOGY) Semester IV

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100 **Duration - 6 hrs.**

1.	Hydrobiological exercise	05 Marks
2.	Study and identification of Zooplanktons	05 Marks
3.	Exercise on Biochemistry/Physiology/Embryology	05 Marks
4.	Identification and comments on spots 10x2	20 Marks
5.	Seminar	15 Marks
6.	Viva-voce	10 Marks
7.	Class Record	10 Marks
9.	Dissertation	30 Marks

(*Project report/dissertation will be based on field work on any topic related to the syllabus*)

ZOO12248T:Paper-Z-4.3 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT-I

Unit I

Wildlife Conservation & Captive Breeding

Conservation Ethics and Values of Wildlife in India: Importance of Wildlife; Values of Wildlife- Positive and Negative Values. Captive breeding and Propagation: Founder population, rehabilitation, education, utilization, gene banks, Ex-situ and in-situ linkages. Conservation breeding management plans, Role of scientific institution and NGOs in Conservation Breeding Programmes. Case studies on Conservation Breeding Program of endangered wild animals in India (Asiatic Lion, Tiger, Rhino, Indian Bustard, Gharial).

Important conservation projects undertaken in India: Project Tiger, Project Elephant, Project Indian Bustard, Cheetah reintroduction, Rhino-reintroduction and Tiger-reintroduction Program.

Unit II

Wildlife Behaviour

Animal habitat interactions, pattern of habitat utilization, feeding ecology of herbivores, carnivores, insectivores and omnivores, temporal and spatial variation in food resources, animal body conditions, reproductive ecology, dispersion, pattern of growth, study of signs and symptoms of wildlife presence, role of minerals in animal health, adaptation with respect to temperature and water. Wildlife behavior – Instinct and learning Behavioral ecology, study method and significance for conservation, Group living in animals, Territory in animals, Social organization.

Unit III

Wildlife Toxicology

Exposure of wildlife to toxicants in natural habitats and manmade habitats; Metals and their exposure. Toxicity testing of wildlife exposure to toxicants; Effect of Radiations on wildlife. Various toxicological testing methods; Biological indicators of pollution exposures; Biomagnification of pesticides and heavy metals, consequences of biomagnifications.

Unit IV

Illegal trading

About TRAFFIC and Wildlife trade, Key agencies contributing to wildlife crime enforcement. Some methods of poaching in India, Illegal wildlife trade of important species and products. Convention on International Trade in Endangered species (CITES). Important Medicinal Plants

of Arid and Semi-arid zone, CITES listed species of Medicinal Plant Conservation Areas (MPCA) in Rajasthan.

Unit V

Wildlife Forensics

Wildlife Forensics: Principles of crime scene investigation and collection of physical and biological evidences (samples) from crime scene; use of different techniques in wildlife forensics with special emphasis on identification of species from different parts of reptiles, birds, mammals and plants. Molecular markers used in wildlife forensics; Wildlife forensics based on DNA analysis and morphometry.

Macro Histological: Introduction, hair types, classification of hair characteristics, Techniques to study hair structures. Protocols and setting up of infrastructure for identifying species from hair.

Suggested books for reference:

1. Indian Mammals by Prater.
2. Indian Birds by Salim Ali
3. Wildlife Crime: An Enforcement Guide by Vivek Menon, Ashok Kumar.
4. Animal Behaviour and Wildlife Management by Reena Mathur.
5. Wildlife Toxicology: Emerging Contaminant and Biodiversity by Ronald J. Kendall, Thomas E. Lacher, George C. Cobb.

ZOO12254T:Paper-Z-4.4 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT-II

Unit I

Remote Sensing & Geographical Information System (GIS)

Application of Remote sensing in wildlife management: Principals and practical application of remote sensing techniques, including aerial photography and satellite imagery.

Introduction to GIS, Spatial and non-spatial database for GIS analysis. Use of global positioning system, Data entry and processing system, Data analysis and visualization. Geographical Information Systems (GIS): Open source ArcGIS software, use of GPS and Mobile Apps.

Unit II

Wildlife Telemetry & Sono-Taxonomy

Introduction to Wildlife telemetry: Transmitters (Antenna, Power source) Transmitter attachments (General protocol, collars etc.), Radio tagging, Receivers, Relocating wildlife, Study

review of Habitat Utilization by species groups; Amphibians, Reptiles, Small mammals, Large Carnivores. Review of radio-telemetry studies in India.

Sono taxonomy- sound based identification of species with particular reference to wild life, principles of bio-acoustics and vocalization; types of calls, sound spectrum and analysis, Sound based monitoring of species. Advantage of sound-based identification and monitoring of species.

Unit III

Capture & Handling of Wild Animals

Capture and handling of animals: Restraints, Capture and Animals Barriers: Purpose, live traps, snares, pits, nets, canon (rocket) nets, net gun, mist nets, corrals, stockade, spotlighting. Animal barriers: Reasons for use; trenches, walls, stockades, mechanical fences, electric, repellents. Drug immobilization: Jabstick, blowpipe, pistol, rifle, crossbow, dart design; radio darts. Drug action, dosages, responses, side effects, effects, safety measures, complications & blind folding. Central

Zoo Authority (CZA) protocol of Handling and Transport of wild animals, designing sledge, crate and holding enclosures. Ecological restoration, Reintroduction/ Translocation of Tiger.

Unit IV

Human Wildlife Conflict

Human- Wildlife Conflicts, types of conflict, causes & prevention; Identifying the problem and possible solutions. Negative Impacts of HWC; Conflict Resolution or Management;

Management Techniques: Reducing HWC and enhancing Coexistence. Human Elephant conflict, Human- Tiger and leopard conflict, Human –Sloth bear conflict.

Unit V

Wildlife Tourism

Tourism in protected areas. Development of Interpretative facilities, visitor characteristics, expectations and motivations, sustainability in Wildlife Tourism. Wildlife based Tourism objectives, planning and economics. Ecotourism in India, positive negative aspects of Ecotourism. Physical carrying capacity of a park and percent disturbance to wildlife.

Suggested Books for reference:

1. Textbook of Wildlife Management by S. K. Singh.
2. Wildlife Management by Rajesh Gopal.

3. Forest Environment and Biodiversity by Mahesh Prasad Singh, J. K. Singh, Reena Mohanka.
4. Wildlife Population Monitoring by Marco Ferretti.
5. Manual of Wildlife Techniques for India by John Benjamin Sale, K. Berkmüller.
6. WILDLIFE BIOLOGY: AN INDIAN PERSPECTIVE by GOUTAM KUMAR SAHA, SUBHENDU MAZUMDAR.
7. Wildlife Telemetry: Remote Monitoring and Tracking of Animals by I. G. Priede, Susan M. Swift.

ZOO12255P:Paper-Z-4.5-II (Lab Course II): Zoology (FORESTRY AND WILDLIFE MANAGEMENT) Practical Work Based on Paper Z-4.3 (E) & Z-4.4 (E) (Total No. of laboratory hrs. 240)

1. Methods of behavioral observation; Instantaneous scan, focal animal, all occurrence and one zero sampling, collection and analysis of behavioral data of some common availability species, preparation of ethograms, time-activity budgets and social interaction matrices.
2. Scat analysis and Identifying species from hair. Photomicrographs and descriptions of hair characteristics of different classes of wild and domestic mammals.
3. Study on tiger reintroduction program and monitoring of tiger in Rajasthan.
4. Study on Cheetah re-introduction program in India.
5. Use of different techniques in identification of different parts and products of flora and fauna reported in wildlife trade. Biological Sampling, preservation and transport of samples. Identification of fake skin/wildlife materials. Identification of weapons.
6. Demonstration of equipment traps, net, dart gun etc. Mist netting and trapping on campus. Participation in capture operations as appropriate. Examination of various types of barrier in the field. Field identification by natural markings. Equipment and its use tags, collars, radio tracking equipment. Bird ringing.
7. Modern methods of identification of species by sono-taxanomy.
8. Drug immobilization and dosage: Jabstick, blowpipe, pistol, rifle, crossbow, dart design; radio darts and drug action.
9. Exposure to post-mortem sites.
10. Field Visit to Zoo/Biological Park/Protected Area.

11. Visit to GIS/Veterinary Laboratory.
12. Dissertation submission.

M.Sc. ZOOLOGY PRACTICAL (FORESTRY & WILDLIFE MANAGEMENT)

Semester IV

Scheme of Practical Examination and Distribution of Mark

Max. Marks: 100 **Duration - 6 hrs.**

1.	Exercise on Behaviour	05 Marks
2.	Exercise on Radio Telemetry/ Drug immobilization	06 Marks
3.	Exercise on scat analysis/Forensic	08 Marks
4.	Identification (Pugmarks, Models, Photo etc.) on spots 18x2	16 Marks
5.	Seminar	15 Marks
6.	Viva-voce	10 Marks
7.	Class Record	10 Marks
9.	Dissertation	30 Marks

(*Project report/dissertation will be based on field work on any topic related to the syllabus*)