

*Syllabus and Course Scheme*

*Academic year 2020-21*



## **Master of Science- Zoology**

**III and IV Semester Examination, 2020-21**

**UNIVERSITY OF KOTA**

**MBS Marg, Swami Vivekananda Nagar,  
Kota - 324 005, Rajasthan, India**

**Website: *uok.ac.in***

## II YEAR: III SEMESTER

Paper-Z-11 CHORDATA

Paper-Z-12 ANIMAL ECOLOGY

Paper-Z-13 SPECIAL PAPER

Paper-Z-14 SPECIAL PAPER

Paper-Z-15 ZOOLOGY Practical: Duration 10 Hrs; MM 100, Min 50.

Day 1- based on Z-11 &Z-12 ;5 hrs; 50 marks.

Day 2-based on Z-13 &Z-14 ;5 hrs; 50 marks.

### Paper-Z-11 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.

### **PAPER Z -12: 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, monocl意思 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 (bio-geo-chemical 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.

#### **Paper-Z-15 ZOOLOGY Practical (Based on Z – 11, Z – 12)**

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.

### **Scheme of M.Sc. III Semester Zoology: Practical (General papers Z – 11, Z – 12 )**

#### **Examination**

#### **Distribution of Marks**

**Time: 5 hrs**

**Max Marks: 50**

SN Exercise

Marks

1. Learning of anatomy\*

07 marks

2. Permanent preparation\*

05 marks

3. Exercise on Ecology

08 marks

4. Spotting (Museum specimens, bones and slides) 5 spots x 2 marks

10 marks

5. Seminar

05 marks

6. Viva-voce

05 marks

7. Class Record

10 marks

**Total**

**50 marks**

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

### **PAPER Z – 13 (A) SPECIAL PAPER: PAPER- CELL BIOLOGY**

#### **Unit-I**

1 Concept of cell Theory

- 1.1 Cell shape, Cell size, Cell Number
- 1.2 Prokaryotic & eukaryotic cell
2. Cell Types; Detailed structure of different types of cell:
  - (a) Nerve cell    (b) Muscle cell    (c) Gland cell    (d) Blood cells
3. Cell wall & extra cellular Matrix
  - 3.1 Extra cellular Matrix in Bacteria & plant cells.
  - 3.2 Extra cellular Matrix in animal cells.
4. Cytoskeleton: Microtubules, Actin filaments & Intermediate filaments.

## Unit-II

5. Cell Membrane:

Membrane Models.

Membrane Portions- spectrum, glycoprotein, Bacteriorhodopsin, porins, cadherins, selectins & integrins Molecular structure of the specialized modifications of the cell membrane cilia, flagella, myelin sheath.

## Unit-III

Concept of cell surface: electro kinetic properties of cell surface, their role in intra cellular interaction in cell fusion, cell aggregation etc. Cell adhesions & cell functions.

Cell membrane:- Transport system & permeability, Properties & functions. Membrane excitability (Neurotransmission and ion channels).

## Unit-IV

Cytoplasm: Generalized structure & composition of cytoplasm .

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      (vi) Centrosomes

### **Unit-V**

Nucleus:- Structure & function of the nuclear membrane.

Structure & chemical organization of the resting nucleus.

Nucleus & Nucleolus.

Chemistry & biosynthesis of Nucleic acids.

## **PAPER –Z 13 (B) ENVIRONMENTAL BIOLOGY**

### **UNIT - I**

Basic concepts of Environmental planning; Environmental priorities in India; urban planning; Environmental problem of urban planning; Rural Environmental planning; National and State environmental policies. System analysis including models in environmental Biology. 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; Hydrologic, Carbon, Oxygen, Nitrogen, Phosphorus and Sulphur cycles. Nutrient cycling in forest and aquatic ecosystems.

### **Unit-III**

Ecosystem: structure and function-Terrestrial Ecosystems: Grasslands (including grazing lands), Forests: characteristics of alpine, 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, Estuarine: 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; Asphyxic responses. Response to temperature and Pressure. Haematological changes, Thermal properties of water and survival limits. Acclimatization. Aquatic Ecosystems.

#### **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 industrialisation. Socio-ecological impacts.

### **Paper-Z-13 (C) SPECIAL PAPER: - ENTOMOLOGY**

#### **Unit-I**

1. Insect integument – structure, composition and functions
2. Moulting & biochemistry of sclerotisation
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) Adepnaga and polyphaga
  - (v) Symphyta and Apocrita

### **PAPER- Z -13 (D): FISH BIOLOGY**

#### **UNIT- I**

1. Geographical distribution: Characters and Classification of fishes, with distinguishing characters of principal subdivisions (Elasmobranchii, Crossopterygii and Actinopterygii). 2. Conservation and Status of fish fauna of India with special reference to Rajasthan.

#### **UNIT-II**

3. General account and phylogenetic significance of Ostracoderms and Placoderms. 4. General Characters, classification, affinities and phylogenetic status of cyclostomata, Lamprey and Hagfishes. Petromyzon and Ammocoete larva.

#### **UNIT-III**

5. Integument: Structure and Function, fin musculature and eye muscles. 6. Exoskeleton: Scales of fishes (Placoid, Cycloid, Ctenoid, Cosmoid and Ganoid scales), Colouration of fishes (Change in colour, Mechanism of colour change, significance and uses of colouration).

#### **UNIT-IV**

7. Structure, modification and functions of median and paired fins, Theories of origin of median and paired fins. 8. Fish Locomotion, Fish Migration: Definition, types, symptoms and significance. 9. Structure and Function of Swim Bladder: Structural modification, Blood supply of the air bladder, Structure of bladder wall, Gas secreting complex, connection with the ear, Respiratory function, Sound production, auditory function, sensory function, as a hydrostatic organ, origin of swim bladder.

#### UNIT-V

10. Endoskeleton: Axial skeleton, Skull, vertebral column, Ribs, fin skeleton. Visceral arches, Pectoral and Pelvic girdles and types of jaw suspension in fishes. 11 . Weberian apparatus and its significance

### **Paper-Z-13 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT**

#### **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 CO<sub>2</sub>, 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)

**Paper-Z-14 (A) SPECIAL PAPER: CELL BIOLOGY**

## **Unit-I**

Chromosomes (a) structure, chemical & functional organization of different types of chromosomes (autosomes, giant chromosomes, Sex chromosomes, supernumerary etc).

Bacterial & plasmid genome.

## **Unit-II**

Cell division- meiosis & mitosis; mitotic poisons & their action molecular basis of division cycle.

## **Unit-III**

Chromosomal aberrations :-

Polyploidy, Polysomy

variation & evolution of chromosome number

Mutations and mutagens

## **Unit-IV**

Gametogenesis - Cytological, cytochemical & endocrinological study on the developing male female germ cell, structure & physiology of ovum & spermatozoon.

## **Unit-V**

Physiology of fusion of gametes & acrosome reaction, prevention of polyspermy, egg metabolism during fertilization.

parthenogenesis.

### **Cell Biology Practical Syllabus based on Paper Z-13, Z-14 (A)**

1. Cytological, cytochemical and physiological study on the cells.
2. Study of cell division study of mitotic and meiotic divisions, with special reference to the mechanism of chromosome movement.

3. Chromosomes: study and slide preparation of normal and giant (lamp brush and polytene) chromosomes.
4. Study of various microscopy techniques.
5. Study of various cell organelles.

### **Scheme of M.Sc. III Semester Zoology: Practical (Cell Biology) Examination**

#### **Distribution of Marks**

**Time : 5 hrs**

**Max Marks: 50**

1. Exercise on techniques	05 marks
2. Permanent preparation (cell organelles/cell division)*	05 marks
3. Exercise on Cytochemical/physiological study	08 marks
4. Spotting (Permanent slides, Models, Photo etc.) 5 spots x 2 marks	10 marks
5. Seminar	05 marks
6. Viva-voce	05 marks
7. Class Record	10 marks
<b>Total</b>	<b>50 marks</b>

#### **PAPER – Z 14 (B) ENVIRONMENTAL BIOLOGY**

##### **UNIT-I**

Biodiversity conservation- Definition, classification and importance of Biodiversity; Endangered and Threatened Species (Flora and fauna) of India and Rajasthan, Hotspots of Biodiversity. 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. Physico-chemical and Bacteriological sampling and analysis of water quality. Sewage and waste water treatment and recycling. Water quality standards. Marine: Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system, coastal management.

##### **UNIT-III**

Soil; Physico-chemical and bacteriological sampling and analysis of soil quality. 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 (NP & K) and their interactions with different components of soil. Soil Pollution Control.

#### **UNIT-IV**

Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes (Hospital Wastes and Hazardous Wastes); 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 and radioactivity from nuclear reactors; Thermal Pollution. Impacts of large-scale utilization of Solar, Wind, Hydro and Ocean energy.

#### **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 and Rules 1975. 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.

**PRACTICAL PAPER –Z 15 (B) ENVIRONMENTAL BIOLOGY based on Z 13 (B) & 14 (B)**

1. Identification of wild life 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 climatic factors (atmosphere, water, temperature and relative humidity).
4. 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 carbondioxide, chloride, salinity, temporary and permanent hardness of water, turbidity, velocity of current.
5. Measurement of noise
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

**Scheme of M.Sc. (Semester – III) Zoology Examination: Environmental Biology (Special Paper)**

Distribution of Marks

**Time : 5 hrs.**

**Max Marks: 50**

- |  |          |
|--|----------|
| 1. Exercise on analysis of water sample                | 06 marks |
| 2. Exercise on analysis of soil sample                 | 06 marks |
| 3. Noise measurement                                   | 04 marks |
| 4. Identification of plankton (Phyto- and Zooplankton) | 04 marks |
| 5. Identification and comments on 5 spots              | 10 marks |
| 6. Viva-voce   | 05 marks |
| 7. Class Record, Field Trip and Project Report         | 10 marks |
| 8. Seminar (internal)                                  | 05 marks |

**Total 50 marks**

## **PAPER-Z – 14 (C) : ENTOMOLOGY**

### **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.



### **Entomology Practical Z 15 (C) Syllabus based on Paper Z-13 (C) & Z-14 (C)**

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.

### **Scheme of M.Sc. III Semester Zoology: Practical (Entomology) Examination**

#### **Distribution of Marks**

**Time : 5 hrs**

**Max Marks 50**

1. Permanent preparation*.	06 marks
2. Identification of spots (6x2).	12 marks
3. Major Dissection*	08 marks
4. Minor Dissection*	04 marks
5. Record and Report on fieldtrip	10 marks S
6. Seminar (internal)	05 marks
7. Viva-voce	05 marks
<b>Total</b>	<b>50 marks</b>

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

## **PAPER- Z -14 (D): FISH BIOLOGY**

### UNIT- I

1. Food, feeding habits of fishes: Carnivorous fishes, Herbivorous fishes, Omnivorous fishes, Plankton feeders. Fishes: Surface, column and bottom feeders. 2. 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

3. Composition of Blood, Structure of heart in Scyliorhinus and Teleosts, vascular system and circulation of blood, Haemoglobin and its adaptation in fishes. 4. Respiratory organs, accessory Respiratory organs, Air breathing organs, physiology of respiration and its regulation.

### UNIT- III

5. Excretory organs: Structure and histology, physiology of excretion, Osmoregulation in marine, fresh water and estuarine fishes, Role of hormone in excretion and osmoregulation 6. Nervous system: Forebrain, Midbrain, Hindbrain, spinal cord and nerves, sense organs: Olfactory, Auditory and photoreceptors and lateral line system.

### UNIT- IV

7. Endocrine glands and Neurosecretory system. 8. General study of fish behavior with special reference to chemical communication in fishes. Reproduction in fishes: Reproductive organs (male and female), maturation, spawning and fertilization. Reproductive behavior: courtship and parental care. Gonadosomatic Index, Sexual dimorphism, hormonal control of reproduction, relationship of fecundity with body parameters, Fecundity and its methods.

### UNIT- V

9. Embryonic development: Categories in fishes with respect to development, cleavage, fate maps of Blastula, Gastrulation, Larval development, viviparity, hatching and Postembryonic development. 10. 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).

## **Fish Biology Practical Syllabus Z-15(D) based on Paper Z-13 (D) & Z-14 (D)**

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, including blood supply, afferent and efferent branchial blood vessels, 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. Permanent preparations and study of pharyngeal denticles, cycloid and other scales.
5. Micro-technical procedures: Preparation and study of serial sections of a larval fish and representative tissues and organs of fish.
6. Local fishes and their identification upto the species level, study of the available museum specimens.

### **Scheme of M.Sc. III Semester Zoology: Practical (Fish Biology) Examination**

#### **Distribution of Marks**

**Time : 5 hrs**

**Max Marks: 50**

SN	Exercise	Marks
1.	Learning of fish anatomy*	07 marks
2.	Permanent preparation*	05 marks
3.	Species identification using taxonomic key	08 marks
4.	Microtomy	10 marks
5.	Seminar	05 marks
6.	Viva-voce	05 marks
7.	Class Record	10 marks
<b>Total</b>		<b>50 marks</b>

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

## **Paper-Z-14 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT**

### **Unit- I**

#### **Biogeography**

Biogeography: Continental drift, bio-geographical realms (8) Afrotropical, Antarctic, Australian, Indomalayan, 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 interspersions, physical and biological features of habitats. Habitat diversity: edge, ecotones, snags, cliffs, talus and caves, interspersions 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. Batroecology: 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 non-infectious 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.

### **Paper Z-15 (E) - FORESTRY AND WILDLIFE MANAGEMENT PRACTICAL BASED ON Z-13 (E) & Z-14 (E)**

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 quadrat / 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. Study and identification of fish and insects commonly found in any study area. Horn/Antler identification. Identification of poisonous and non-poisonous snakes, venom types.
7. Bird watching and identification of resident and migratory birds (minimum 100), bird census techniques.
8. Field Visit to Zoo/Biological Park/Protected Area.
9. Field report writing.

### **Scheme of M.Sc. III Semester Zoology: Practical (Forestry and Wildlife Management)**

#### **Examination**

#### **Distribution of Marks**

**Time: 5 hrs.**

**Max Marks: 50**

1. Exercise on zoogeography/wildlife techniques	<b>05 marks</b>
2. Exercise on vegetation sampling methods	<b>05 marks</b>
3. Exercise on Forest Services (plant & animal)	<b>05 marks</b>
4. Spotting (Pugmarks, Models, Photo etc.) 5 spots x 2 marks	<b>10 marks</b>
5. Field report	<b>10 marks</b>
7. Viva-voce	<b>05 marks</b>
7. Class Record	<b>10 marks</b>
	<b>Total 50 marks</b>

## II YEAR: IV SEMESTER

Paper-Z-16 ANIMAL BEHAVIOUR

Paper-Z-17 DEVELOPMENTAL BIOLOGY OF CHORDATES

Paper-Z-18 SPECIAL PAPER

Paper-Z-19 SPECIAL PAPER

Paper-Z-20 ZOOLOGY Practical

Day 1; 5 Hrs (Z-16 & Z-17)

Day 2; 5 Hrs (Z-18 & Z19).

### **Paper-Z-16 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 kineses.
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.

### **Paper-Z-17 DEVELOPMENTAL BIOLOGY OF CHORDATES**

#### UNIT – I

1. Theories of development: Preformation and epigenesis.
2. Gametogenesis (i). Spermatogenesis: Growth of spermatocyte and acrosome formation; spermeogenesis. (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) Mechanics of gastrulation (c) Morphogenetic movements. (d) and significance of gastrulation.
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 eye, heart, alimentary canal and its accessory organs.
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;
2. Reasons for failure of limb generation ability in other chordates and mammals; methods for induction of regenerations.
3. Abnormalities of Embryonic development: teratology.

### **Paper-Z-20 ZOOLOGY Practical (General)**

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 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 through: (i) Formalin preserved or living material (egg, spawn, embryo, larvae and metamorphic stages). (ii)

Permanent microscopic slides of sections through successive embryonic and larval stages. (b) Study of development of chick through: (i) Permanent whole mount of successive embryonic stages. (ii) Permanent microscopic slides of section through representative regions of successive embryonic stages. (Note: Special emphasis should be laid on organogenesis and morphogenesis). (c) Removal of chick embryos of 18,21,24,33,72 and 92 hours from the egg and their study and identification in the living state; permanent whole mounts of these embryos using living states. (d) Study of (i) formalin preserved fetuses with placenta and (ii) histology of the placenta of any mammal.

**Scheme of M.Sc. IV Semester Zoology: Practical (General papers Z – 16 & Z – 17)**

**Examination**

**Distribution of Marks**

**Time : 5 hrs**

**Max Marks: 50**

SN	Exercise	Marks
1.	Exercise on Ethology *	07 marks
2.	Permanent preparation*	05 marks
3.	Exercise on Development Biology	08 marks
4.	Spotting (Permanent slides, Models, Photo etc.) 5 spots x2 marks	10 marks
5.	Seminar	05 marks
6.	Viva-voce	05 marks
7.	Class Record	10 marks
<b>Total</b>		<b>50 marks</b>

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

**PAPER-SPECIAL PAPER Z – 18 (A) CELL BIOLOGY**

**Unit-I**

Specialized function of S components in a cell with special reference to the molecular mechanism (contractibility, secretion, phagocytosis & pinocytosis).

Vesicular Transport & membrane fusion.

## Unit-II

Cell & Tissue Culture:-

- (a) Behaviour of cells in culture
- (b) Primary & established cell lines kinetics of cell growth.

## Unit-III

Natural & defined media for culture.

Importance of cell & tissue culture.

Generalized account of the mechanism of cell aggregation during development in vitro studies.

## Unit-IV

Study of fixation & staining & discussion on the 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 & disc electrophoresis.

## PAPER –Z 18 (B) ENVIRONMENTAL BIOLOGY

### 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. Trophic level transfer of contaminants. Bioindicators of environmental quality.

## **UNIT- II**

Toxic Chemicals in the environment--Air, Water: Pesticides in water. Bio-chemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon monoxide, O<sub>3</sub> and PAN Pesticides, Insecticides, MIC, 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. Management of Environmental Natural resources: their conservation and development. Classification of pollutants: Physical treatment principles, Chemical treatment principles, Biological treatment principles and Sludge treatment and disposal Systems analysis for Environmental problems. Environmental monitoring for Air, Water, Soil, Radiation and Microbiology: Common parameters, sampling procedures and analytical techniques

## **UNIT- V**

Population growth, variation among nations, global population growth, population explosion, Urbanization , Population Ecology: Factors determining population. Factors leading to the commonness, rarity and vulnerability of extinction of a species. Environmental and human health, Environmental health , Climate and health, human rights, Equity , Nutrition, health and human rights, Intellectual Property Rights and Community Biodiversity Registers , Human heritage, Equitable use of Resources, Common Property Resources, Ecological degradation.

## **PAPER- Z-18 (C) : ENTOMOLOGY**

### **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 –male and 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**

- (i) Detail of following orders emphasizing selected subfamilies and families-order Coleoptera, Lepidoptera, Diptera and Hymenoptera
- (ii) 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**

- (i) Social life in termites
- (ii) Social life in honey bee
- (iii) Social life in Ants
- (iv) Social life in wasps
- (v) Caste determination in Social Insects.

## **PAPER- Z-18(D): FISH BIOLOGY**

### **UNIT-I**

1. Survey of principal fisheries of India (Indian major carps, Mackerel, Sardine, Bombay Duck fisheries).
2. Biology of Indian major carps, catfishes, Hilsa, sardine mackerel, sharks, mahaseer, prawns and oysters.

### **UNIT-II**

3. Exotic fishes: *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella*, *Tinca tinca*, *Tilapia mossambica*, *Osphronemus Goramy*, *Carassius carassius*, Trout, Mosquito fish. larvivorous fishes, predatory fishes and weed fishes. 4. Fish Marketing, Domestic fish marketing in India, Price policy and fish marketing system in India. 5. Aquaculture and its importance with special reference to India. Role of aquaculture in rural development. Giant freshwater Prawn Culture and Oyster Culture, Different types of fish culture: Composite fish culture, Cage culture and integrated culture, factors affecting fish culture. 6. Biota of pond water, carrying capacity of a pond, 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

7. 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). 8. Pond management, fish seed resources and their transport, induced breeding by hormones.

#### UNIT-IV

9. 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, Brinning, Smoking, Canning. Food poisoning by fish. 10. Fishery resources and Economic value: Bio-chemical composition of fish, fish as food. 11. Fish and mankind, byproducts of fishing industry.

#### UNIT-V

12. 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. 13. Estuarine fisheries: Open estuaries, Embanked estuary, Principal fisheries of brackish water. 14. marine fisheries: Fishery resources, coastal fisheries, factors influencing fish production.

### **Paper-Z-18 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT**

#### **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, 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.

## **Paper-Z- 19 (A) CELL BIOLOGY**

### **Unit-I**

Elementary concept of the principle & theory of microscopy as exemplified by the foll:

- (a) Phase contrast microscopy
- (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 foll. Enzymes at cellular level.

- (a) ATP ase
- (b) Suceinic dehydrogenase
- (c) Acid & Alkaline phosphatas
- (d) Hyalnronidase

### **Unit-III**

Cellular aspects of the process of aging.

Cellular aspects of immunity and virus-cell interaction.

Elementary idea of the origin of foll diseases (a) Glycogen storage disease (b) AIDS

### **Unit-IV**



Cancer – Carcinogens & viruses.

Proto- Oncogenes.

Oncogenes & Tumor Suppressor Genes.

Oncoproteins, Activation, Translocations & Amplification.

### Unit-V

Apoptosis : Cell death

Apoptosis in Coenorhabditis

Cell death in Mammals

Apoptosis in Drosophila

Purpose of cell death

Mechanism of cell death

Apoptosis targeted therapies.

### M.Sc. IV Semester - Zoology Cell Biology Practical Z-18 (A)&19A

1. Study of “fixation” and “staining” techniques.
2. Study of microscopy techniques.
3. Single two dimensional & column chromatography.
4. Paper, gel, SDS-PAGE and disc electrophoresis.
5. Permanent slide preparation (Cell organelles etc.)
6. Elementary ideas of the origin of diseases: AIDS, Cancer and aging.

### Scheme of M.Sc. IV Semester Zoology: Practical (Cell Biology) Examination

#### Distribution of Marks

Time : 5 hrs

Max Marks: 50

- |  |          |
|--|----------|
| 1. Exercise on techniques  | 05 marks |
| 2. Permanent preparation (cell organelles/cell division)*            | 05 marks |
| 3. Exercise on Cell and tissue culture                               | 08 marks |
| 4. Spotting (Permanent slides, Models, Photo etc.) 5 spots x 2 marks | 10 marks |

5. Seminar	05 marks
6. Viva-voce	05 marks
7. Class Record	10 marks
<b>Total</b>	<b>50 marks</b>

## **PAPER –Z 19 (B) ENVIRONMENTAL BIOLOGY**

### **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**

Environmental priorities in India and sustainable development. Environmental issues with War, Genetically modified food controversies, Overpopulation and Gender Imbalance. Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic). 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, O<sub>3</sub> 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.). Landuse policy for India. Urban planning for India. Rural planning and landuse pattern. Concept and strategies of sustainable development. Cost-Benefit analysis

#### **PRACTICAL PAPER –Z 20 (B) ENVIRONMENTAL BIOLOGY based on 18 (B) & 19 (B)**

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. Designing of waste water treatment plant
5. Estimation of Biodiversity.
6. Determination of particle size using Respirable Dust Sampler.
7. Estimation of Respirable Suspended Particulate Matter by RSPM sampler.
8. Site visit of degraded landscape or habitat as terrestrial and aquatic
9. GPS: Application in field
10. Advanced instrumental technique: (i) Flame photometry  
(ii) UV- visible spectrophotometry

11. Visit to single or multipurpose project of state or national level importance.
12. Social perspectives of environment: Case study of food security, hunger, poverty, malnutrition, famine and water crisis. (Area should be selected according state prescribed for social welfare schemes)
13. Case study related to pollution monitoring, treatment and control
14. Case study of EIA

**Scheme of M.Sc. (Semester – IV) Zoology Examination: Environmental Biology (Special Paper)**

Distribution of Marks

**Time: 5 hrs.**

**Max Marks: 50**

- |  |          |
|--|----------|
| 1. Experimental bioassay                       | 06 marks |
| 2. Exercise on pollutant effect                | 04 marks |
| 3. Determination of particle size              | 06 marks |
| 5. Exercise on instrumentation                 | 04 marks |
| 6. Estimation of Microbial diversity           | 04 marks |
| 7. Viva-voce                                   | 08 marks |
| 8. Class Record, Field Trip and Project Report | 10 marks |
| 9. Seminar (internal)                          | 08 marks |

**Total 50 marks**

**PAPER- Z-19 (C) : ENTOMOLOGY**

**Unit-I**

1. Life history, damage caused and control of three major pests of each of the following crops:
  - (i) Wheat, paddy, maize, 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, oryzaeophilus.

### **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.

### **Entomology Practical Syllabus based on Paper Z-18 (C) & Z-19 (C)**

1. a. 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. b. Maintenance of insectaria.
2. Collection and preservation of insects and their different stages.
3. Collection of seasonal, nocturnal, aquatic insects, crop pests, stored grain pests, household pests and insects of veterinary and medical importance.
4. Familiarity with techniques and appliances used for insecticide treatment.
5. Bioassay experiments for testing the insecticides.
6. Study of food preference in stored grain pests.

7. Micro-technical procedures (microtomy).
8. Insect identification up to family level using taxonomic key.

### **Scheme of M.Sc. IV Semester Zoology: Practical (Entomology) Examination**

#### **Distribution of Marks**

**Time : 5 hrs**

**Max Marks: 50**

1. Study and use of insecticides and insecticides appliances	05 marks
2. Toxicological exercise/Bioassay methods /Microtomy	05 marks
3. Insect behavior/Insect collection and preservation Techniques*	05 marks
4. Insect taxonomic Key and Identification (5)*	15 marks
5. Record and Insect collection*	10 marks
6. Seminar	05 marks
7. Viva-voce	05 marks
<b>Total</b>	<b>50 marks</b>

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

### **PAPER- Z -19 (D): FISH BIOLOGY**

#### UNIT-I

1. Estimation of population number and mortality rates in fresh waters. 2. 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

3. Limnology: Definition, types of lakes/ponds, their significance, Plankton: Definition, types, diurnal variations; planktons and their significance in fisheries. 4. Fisheries management and conservation: Conservation of genetic and ecological diversity. Measures for fish conservation, In situ conservation, Ex situ conservation, cryopreservation of gametes, applications of cryopreserved sperm.

#### UNIT-III

5. 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 6. Pollutants on fish, precautions. Aquatic weeds: types, habitat and their control. 7. Aquaria: setting up and maintenance.

#### UNIT-IV

8. Diseases of fishes: Causes, etiology, Symptoms and treatments, fish parasite and their control. 9. Specialized organs: Bioluminescent organs, electric organs, sound producing organs, poisonous and venomous organs.

#### UNIT-V

10. Adaptations to special conditions of life: Hill stream fishes, deep sea fishes, cave dwelling fishes. 11. Application of genetics and biotechnology in fishes, transgenic fishes and fish genomics 12. Aspects of fish genetics: Chromosomes, Gene and Chromosomes Mutation, Sex chromosomes, Sex determination, Polyploidy, hybridization.

#### **M.Sc. - Zoology Fish Biology Practical based on paper Z -18(D) & Z -19(D)**

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 visits 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) A week's tour of an important marine biological or fishery centre in the country.
4. Preparation and maintenance of fresh water aquarium housed with local and exotic fishes, in your department.

Note: A record of the work done under item 03 and 04 has to be submitted compulsorily by each candidate.

### **Scheme of M.Sc. IV Semester Zoology: Practical (Fish Biology) Examination**

#### **Distribution of Marks**

**Time: 5 hrs**

**Max Marks: 50**

SN	Exercise	Marks
1.	Hydrobiological exercise	07marks
2.	Exercise on Biochemistry/Physiology/Embryology	05 marks
3.	Identification and comments on 8 spots	16 marks
3.	Assignment work	06 marks
4.	Viva-voce	05 marks
5.	Field Trip and Project Report	06 marks
6.	Seminar (internal)	05 marks
<b>Total</b>		<b>50 marks</b>

### **Paper-Z-19 (E) SPECIAL PAPER: FORESTRY AND WILDLIFE MANAGEMENT**

#### **Unit I**

#### **Remote Sensing & Geographical Information System (GIS)**

Application of Remote sensing in wildlife management: Principles 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 Eco-tourism. Physical carrying capacity of a park and percent disturbance to wildlife.

**Forestry and Wildlife Management Practical Z-20 (E): based on Paper Z-18 (E) & 19 (E)**

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. 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.
5. 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.
6. Modern methods of identification of species by sono-taxonomy.
7. Drug immobilization and dosage: Jabstick, blowpipe, pistol, rifle, crossbow, dart design; radio darts and drug action.
8. Exposure to post-mortem sites.
9. Visit to GIS Laboratory.
10. Field report writing.

**Scheme of M.Sc. IV Semester Zoology: Practical (Forestry and Wildlife Management)**

**Examination**

**Distribution of Marks**

**Time: 5 hrs.**

**Max Marks: 50**

**1. Exercise on Behaviour**

**05 marks**

**2. Exercise on Radio Telemetry/ Drug immobilization**

**05 marks**

3. Exercise on scat analysis/Forensic	05 marks
4. Spotting (Pugmarks, Models, Photo etc.) 5 spots x 2 marks	10 marks
6. Field report	10 marks
7. Viva-voce	05 marks
7. Class Record	10 marks
	<b>Total 50 marks</b>

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