

M.Sc. (Final) ZOOLOGY
(Scheme for Examination) – 2014

Paper	Duration	Max. Marks	Min. Pass Marks
V	3 Hours	100	25
VI	3 Hours	100	25
VII	3 Hours	100	25
VIII	3 Hours	100	25
Practical (General)	5 Hours	100	36
Practical (Special Paper)	5 Hours	100	36

* **Note : Overall 36% marks are required to pass M.Sc. Final examination.**

**PAPER-V : CHORDATA AND DEVELOPMENTAL
BIOLOGY OF CHORDATES**

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT - I

1. Origin and outline classification of chordates.
2. Interrelationships of Hemichordata, Urochordata and Cephalochordata and their relations with other deuterostomes.
3. Life histories of sessile and pelagic tunicates (ascidian), *Pyrosoma*, *Salpa*, *Doliolum* and *Oikoplpeura*.
4. Origin, evolution and adaptive radiations of vertebrates :
 - (a) Geological time scale and fossils.
 - (b) Origin, evolution and general characters of Agnatha.(Ostracoderms and Cyclostomes).
 - (c) Early gnathostomes (Placoderms).
 - (d) A general account of Elasmobranchi, Holocephali, Dipnoi and Teleostomi.
 - (e) Adaptive radiation in bony fishes.

UNIT - II

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

7. Origin of mammals, primitive mammals (Prototheria & Metatheria)
8. A general survey of main radiations in eutherian mammals, excluding detailed reference to individual orders.
9. Evolution of man; relationships of man with other primates; fossil record of ancestry of man.

UNIT - III

1. Theories of development : Preformation and epigenesis.
2. 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.
4. Early embryonic development.
 - (a) Patterns of cleavage, blastulation and gastrulation in chordates (tunicates to mammals).
 - (b) Fate maps.
 - (c) Morphogenetic movements.
 - (d) Mechanics and significance of gastrulation.
5. Causal basis of development and 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 - IV

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.
4. Genetic regulations of early embryo development.

UNIT - V

1. 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.
2. Metamorphosis in amphibia :
 - (a) Structural and physiological changes during metamorphosis.
 - (b) Endocrine control of metamorphosis.
3. 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, redifferentiation, pattern formation during amphibian limb regeneration; reasons for failure of limb regeneration ability in other chordates and mammals; methods for induction of regenerations.

PAPER-VI : ANIMAL ECOLOGY AND ETHOLOGY

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

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 :
 - (a) The general environment.
 - (b) Role of physical factors: temperature, light, water, atmospheric gases, media, substratum, climatology.
 - (c) Brief review of important physical factors as limiting factor.
 - (d) Nutrients and environment.

UNIT - II

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".
 - (d) Patterns in communities : Stratification, zonation, activity, food web, reproductive and social structure.
 - (e) Community versus continuum.
 - (f) Evolution of communities : Palaeoecology; community structure in past ages.
3. Ecological regulations :
 - (a) Succession in community : Basic types of succession; convergence and divergence in succession; modifications in succession; concept of climax, monocl原因 versus polyclimax theory; barriers and ecesis in succession; biome.
 - (b) Fluctuations within community : Irruptive cycle, fluctuation, causes of fluctuation, cycles.

UNIT - III

1. 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.
 - f. 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.

UNIT - IV

1. Introduction of animal behaviour.
2. Orientation :
 - (a) Classification of various types of taxes and kineses.
 - (b) Flight orientation in locust.
3. Methods of studying behaviour : Brain lesions; electrical stimulation, drug administration.
4. Types of behaviour and their regulation :
 - (a) Components of feeding behaviour : Hunger drive; directional movement, avoidance, eating, carrying and hoarding.
 - (b) Factors influencing choice of food.
 - (c) Nervous regulation of food and energy intake :
 - i. Motivated behaviour ; drive, satiation and its neurophysiological control.
 - ii. Feeding behaviour.
 - iii. Learning : Habituation conditioned reflex; trial and error; latent learning; learning and discrimination, imprinting; neural mechanism of learning.
 - iv. Instinctive behaviour: Concept, phyletic decent and physiology.
 - v. Hormones and behaviour. Mammalian nervous system and involvement of hypothalamus in the regulation of behavioural patterns.

UNIT - V

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.
4. Reproductive behaviour in fish (Stickle back or any other fish).
5. Behaviour in insects : Social behaviour, communications, concealment behaviour, role of pheromones.
6. Behavioural genetics: Single gene effect, multiple gene effect, behavioural variation in an individual; genetics and human behaviour.

PRATICAL SYLLABUS BASED ON PAPER V & VI

Total No. of Lect. Hours : 240

Duration : 5 Hours

Max. Marks : 80

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. 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 mounts 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.

3. 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.

4. 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 *Triboleum*/housefly.
- (g) Study of habituation in chicks.

(Note : Use of animals for practical work is subject to the condition that they are not banned under the wild life protection act.)

**Scheme of M.Sc. (Final) Zoology : Practical (General) Examination
Distribution of Marks**

1.	Dissection (Major)	16 marks
2.	Dissection (Minor)/Permanent preparation	08 marks
3.	Exercise in developmental biology	08 marks
4.	Exercise in Ecology	07 marks
5.	Ethology	07 marks
6.	Identification and comments on 8 spots	24 marks
7.	Viva-voce	10 marks
8.	Class Record	10 marks
9.	Seminar (internal)	10 marks

Duration : 5 Hours

Total 100 marks

PAPER-VII (A) : CELL BIOLOGY

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks :

Unit - I

- Concept of Cell Theory**
- Cell Types :** Detailed structure of the different types of cells.
(a) Nerve Cell (b) Muscle Cell (c) Gland Cell (d) Blood Cell
- Cell Membrane :**
 - Study of various models of the molecular structure of the cell membrane as suggested by Devson & Danielli, obertson & Green : Other recent views on the subject.
 - Molecular structure of the specialized modifications of the cell membrane (Cilia, flagella, myelin, sheath etc.).
 - Concept of cell surface : Electro kinetic properties of cell surface their role in intercellular, inter-action in cell fusion, Cell aggregation etc.
 - Properties & functions of the cell membrane, with special reference to permeability.

Unit- II

- Cytoplasm :**
 - Generalized structure & composition of the cytoplasm.
 - Detailed discussion on the following cytoplasmic componets with special reference to the biochemical and physiological aspects.
(i) Endoplasmic reticulum (ii) ibosomes (iii) Golgi body (iv) mitochondria (v) Lysosomes, peroxisomes & other related particles (xi) Centrosomes.

Unit- III

- Nucleus:**
 - Structure & functions of the nuclear enyelop .
 - Structure and chemical organization of the resting nucleus.
 - Nucleus & Nucleolar extrusions.
 - Chemistry and biosynthesis of nucleic acids.

- Chromosomes :**
 - Structural, chemical and functional organization of the different types of chromosomes (autosomes, giant chromosomes, sex chromosomes supernumerary, chromosomes etc.).
 - Chromosomal aberration.
 - Variation and evolution of chromosome numbers.

Unit- IV

- Cell Division :**
 - Detailed structural, chemical & physiological study of mitotic and mciotic divisions, with

special reference to the mechanism of chromosome movement and organization of the spindle apparatus.

- (b) Mitotic poisons and their action.
- (c) Polyploidy
- (d) Polysomy

Unit- V

3. Gametogenesis:

- (a) Cytological cytochemical and endocrinological study on the developing male & female germ cells.
- (b) Physiology of ovum and spermatozoan.
- (c) Physiology of the union of gametes and the acrosome reaction.

PAPER-VII (B) : ENVIRONMENTAL BIOLOGY

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT : I

- 1. System analysis including models in environmental Biology.
- 2. Impact of environment at cellular level : Cellular interaction with environment.

Unit- II

- 1. Environmental Physiology:
 - Basic Metabolic rate and body size
 - Metabolism and climatic adaptations -
 - Hibernation and aestivation
 - Poikilotherms and Homeotherms Asphyxic responses.
- 2. Response to temperature and Pressure.
 - Haematological changes
 - Thermal properties of water and survival limits. Acclimatization.

Unit-III

- 1. A detailed study of different ecosystems. (Study with including abiotic and biotic components and their interrelationship, productivity and adaptations of animals).
- 2. Terrestrial Ecosystems :
 - 1. Grasslands (including grazing lands)
 - 2. Forests : characteristics of alpins, temperate and tropical forests. Stratification, high altitude (with special reference to Himalayan ecology)
 - 3. Deserts : Types and ecological attributes of desert biota.
 - 4. Tundra : Extent and ecological peculiarities
 - 5. Tundra : Extent and ecological peculiarities

Unit- IV

- 1. Aquatic Ecosystems :

1. Fresh Water : Lakes (including salt lakes) Ponds streams, springs, rivers and marshes.
 2. Marine : Zonation fauna
 3. Esturine : Ecological peculiarities and adaptations (including impact on fauna)
2. A general knowledge of Biogeography

Unit- V

1. Development and evolution of ecosystems : causes and kinds of succession diversity and productivity in relation to succession and development.
2. Urban, rural and other Man-made ecosystems, their impact on animal life. Urbanization and industrialisation. Socio-ecological impacts.

PAPER-VII (C) : ENTOMOLOGY (Morphology, Physiology and Systematics)

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT : I

1. Insect integument : Structure, composition and functions.
2. Biochemistry of sclerotisation.
3. Functional morphology : Head, thorax, abdomen and appendages, head segmentation, wing venation.
4. Muscular system and its functions.

UNIT : II

1. Digestive system : Alimentary canal and physiology of digestion.
2. Circulatory system : Anatomy, physiology; composition of haemolymph.
3. Respiratory system : Structure and physiology.
4. Excretory system : Functional architecture.

UNIT : III

1. Nervous system : Structure and physiology.
2. Neuro endocrine system.
3. Sense organs : Chemoreceptors, mechanoreceptors, photoreceptors, sound and light producing organs, visual organs and physiology of vision.
4. Reproductive system : Structure and physiology.

UNIT : IV

1. Classification of insects upto order and suborders.
2. Comparative study of wing venation in Orthoptera, Hymenoptera (*Apis*), Diptera (mosquito) and Homoptera (Aphid).
3. Introduction to primitive insects and fossil insects, cause of success of insects.

4. Origin and evolution of insects.

UNIT : V

1. Detailed classification of the following orders emphasizing selected superfamilies and families : Orthoptera, Isoptera, Coleoptera, Homoptera, Hemiptera, Lepidoptera, Diptera and Hymenoptera.
2. Economic importance of these orders.
3. Social life in Isoptera and Hymenoptera.
4. Caste determination in social insects.

PAPER-VII(D) : FISH BIOLOGY

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT- I

1. Geographical distribution: Classification of fishes, with distinguishing characters of principal subdivisions.
2. Status and conservation of fish fauna of India with special reference to Rajasthan.
3. General account and phylogenetic significance of Ostracoderms and Placoderms.
4. Origin and adaptive radiation of various groups.
5. Body form and locomotion.

UNIT-II

6. Integument, exoskeleton and colouration of fishes.
7. Structure, modification and functions of median and paired fins.
8. Theories of origin of median and paired fins.
9. Musculature: Lateral musculature, jaw and respiratory musculature, fin musculature and eye muscles.

UNIT-III

10. Endoskeleton: Neurocranium and visceral arches, vertebral column, fin skeleton and girdles, types of jaw suspension in fishes.
11. Food, feeding habits, alimentary canal and physiology of digestion.
12. Blood, heart, vascular system and circulation of blood. Haemoglobin and its adaptation in fishes.
13. Respiratory organs, physiology of respiration and its regulation. Air breathing organs.

UNIT-IV

14. Excretory organs and physiology of excretion. Osmoregulation in marine, fresh water and estuarine fishes.
15. Structure, function and physiology of swim-bladder.
16. Weberian apparatus and its significance.
17. Nervous system and sense organs, lateral line system.

UNIT-V

18. Endocrine glands and their hormones.
19. Reproduction in fishes: Reproductive organs (male and female), reproductive behaviour, courtship and parental care, general study of fish behaviour, hormonal control of reproduction.
20. Embryogenesis: Ontogenic development in fishes, categories of fishes with respect to development; viviparity; molecular aspect of yolk formation.
21. Recent trends in fish study and research, recombinant DNA technology in fish research.

PAPER-VIII (A) : CELL BIOLOGY

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

Unit- I

1. Specialized function of cytoplasmic components in a cell with special references to the molecular mechanism (Contractibility, secretion, phagocytosis and pinocytosis).
2. Cell and tissue culture :
 - (a) Behaviour of cells in culture.
 - (b) Primary and established cell lines; kinetics of cell growth.
 - (c) Natural and defined media for culture.
 - (d) Importance of cell and tissue culture.
3. Generalized account of the mechanism of cell aggregation during development; in vitro studies.

Unit-II

1. Chemical basis of “fixation” and “staining” and a discussion on the following techniques.
 - a. Freeze substitution b. Freeze drying
 - c. Fresh and fixed frozen sections
 - d. PAS, Metachromasia, Feulgen, lipid and protein staining techniques.
 - e. Centrifugation and ultra-centrifugation.
 - f. Single two dimensional & column chromatography.
 - g. Intra-vital and supra-vital staining.
 - h. Paper, gel and disc electrophoresis.

Unit- III

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

Unit- IV

1. A general account of the effect of ionizing radiation at the cellular level.
2. Ole and mechanism of action of the following enzymes at the cellular level
 - (a) AT Pase
 - (b) Succinic dehydrogenase
 - (c) Acad and alkaling phosphatases
 - (d) Hyaluronidase.

Unit-V

3. Elementary ideas of the origin of following diseases :
 - (a) Cancer
 - (b) Glycogen storage disease
 - (c) AIDS
4. Cellular aspects of the process of aging
5. Cellular aspects of immunity and virus – cell interaction .

PAPER-VIII (B) : ENVIRONMENTAL BIOLOGY

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT : I

1. History of man and his cultural evolution in relation to impact on environment.
2. Management of Environment Natural resources : their conservation and development.

UNIT- II

1. Management of -
 1. agriculture and forestry including best management
 2. wild life resources
 3. mineral resource s
 4. aquaculture (Fresh water and marine)
 5. energy resources
 6. river basin
2. Pollution - monitoring, sources effect and control

UNIT-III

1. Water pollution, Air pollution and land pollution
2. Thermal, noise and radiation pollution

UNIT-IV

1. Environment and Health -
Urban health problems, impact of urbanization stress, Health status and health problems. Rural health problems
2. Socio- pollution impact of weather, natural disasters, pollution, water availability, food resources in relation to human health.

UNIT- V

1. Environmental Toxicology : Natural and man-made toxicants occurring in the environment and their impact on animal life in different ecosystems. safely measures.
2. Methodology for environmental analysis :
 - a. monitoring
 - b. analysis of physical and chemical factors
 - c. statistical analysis
 - d. bioassay techniques.

PAPER-VIII (C) : ENTOMOLOGY (Ecology and Applied Entomology/Toxicology)

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

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.
4. Embryology : Embryonic and post embryonic development ; diapause, types of larvae, pupae and metamorphosis. Role of endocrine glands in growth and development, viviparity and parthenogenesis.

UNIT : II

1. General idea of damage caused by pests.
2. Principal methods of pest control.
3. Insecticides : Types, mode of action and methods of application.
4. General idea of appliances used in the insecticide treatment and their safe handling.

UNIT : III

1. A general account of chemosterilants, attractants, repellents, pheromones, growth regulators and such other compounds.
2. Development of resistance to pesticides.
3. Insecticide synergists and antagonists.

UNIT : IV

1. Life history, damage caused and control of three major pests of each of the following crops : Wheat, paddy, maize, jowar, millet, sugarcane, cotton, mustard and soyabean.
2. Stored grain and milled product pests :
Sitophilus, Callosobruchus, Rhizopertha, Tribolium, Trogoderma, Oryzaephilus.
An elementary idea of storage.
3. Pests of veterinary and medical importance; preliminary idea of insect borne diseases.

4. Life cycle of aphid and locust and their control.

UNIT : V

1. A general idea of plant protection organisations in India; forensic entomology with special reference to human and wild life.
2. Beneficial insects : Silk worm, honey bee, lac insect; their economic importance and industries related to them.
3. Role of genetics in insect vector control.
4. An elementary idea of IPM.

Entomology Practical Syllabus based on Paper VII (C) and VIII (C)

Duration : 5 Hours

Maximum Marks : 100

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. 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 insectary.
4. Collection and preservation of insects and their different stages.
5. Collection of seasonal, nocturnal, aquatic insects, crop pests, stored grain pests, household pests and insects of veterinary and medical importance.
6. Dissections :
 - a. Cockroach - Digestive, circulatory, reproductive systems and neuroendocrine complex.
 - b. Grasshopper - Digestive, circulatory, reproductive systems and neuroendocrine complex.
 - c. House cricket - Digestive, reproductive and nervous systems.
 - d. Bug - Digestive and nervous systems.
 - e. Butterfly - Digestive and nervous systems.
 - f. Housefly - Digestive and nervous systems.
 - g. Honey bee - Digestive and nervous systems.
 - h. Wasp - Nervous systems.
 - i. Beetle - Nervous systems.
7. Familiarity with techniques and appliances used for insecticide treatment.
8. Bioassay experiments for testing the insecticides.
9. Microtechnical procedures (microtomy).
10. Study of food preference in stored grain pests.
11. A tour to visit important centres of entomological / toxicological studies.

Scheme of M.Sc. (Final) Zoology : Practical (Entomology) Examination

Distribution of Marks

1.	Dissection	16 marks
2.	Permanent preparation	05 marks
3.	Identification of 4 insects using taxonomic keys	12 marks
4.	Microtomy	10 marks
5.	Exercise in Applied Entomology (Toxicology)	05 marks
6.	Identification and comments on 8 spots	16 marks
7.	Viva-voce	08 marks
8.	Class Record	10 marks
9.	Field Trip and Project Report	08 marks
10.	Seminar (internal)	10 marks
Total		100 marks

PAPER-VIII(D): FISH BIOLOGY

Duration : 3 hours

Max. Marks – 100

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 : 50

Section-C : 04 questions (question may have sub division) covering all units but not more than one question from each unit, descriptive type, answer in about 500 words, 2 questions to be attempted. Total marks : 40

UNIT-I

1. A general survey of world's fisheries, survey of principal fisheries of India (riverine, reservoir, estuarine and marine fisheries).
2. Biology of Indian major carps, catfishes, *Hilsa*, sardine mackerel, sharks, mahaseer, prawns and oysters.
3. Exotic fishes, larvivorous fishes, predatory and weed fishes.
4. Prawn culture in lakes and ponds of fresh and brackish water of Rajasthan.

UNIT-II

5. Pisciculture and its importance with special reference to India.
6. Different types of fish cultures viz. composite fish culture, paddy culture, sea food fish culture, cage culture, air breathing fish culture, carnivorous fish culture and ornamental fish culture.
7. A detailed study of methods of fishing (crafts and gears) in fresh water of India.
8. Fisheries: Management, growth, productivity and expansion.
9. Management of fish marketing and impact of fisheries on state economy.

UNIT-III

10. Fish preservation and processing.
11. Bio-chemical composition of fish, fish as food.
12. Fish and mankind, byproducts of fishing industry.
13. Ecological factors affecting the life of fishes in various ecosystems.

14. Estimation of population number and mortality rates in fresh waters.
15. Age and growth studies.

UNIT-IV

16. Limnology: Definition, types of lakes/ponds, their significance in fishery practice.
17. Plankton in relation to fisheries.
18. Water pollution and fisheries with special reference to India.
19. Aquatic weeds and their control.
20. Aquaria and their uses, setting up and maintenance of aquaria.

UNIT-V

21. Diseases of fishes: Symptoms, etiology and treatment.
22. Specialized organs: Bioluminescent organs, electric organs, sound producing organs, poisonous and venomous glands.
23. Fish migration, its causes and significance.
24. Adaptations to special conditions of life: Hill stream fishes, deep sea fishes, cave dwelling fishes, arctic and antarctic fishes.
25. Fish culture and cytogenetics. General diversity of fishes of India, transgenic fishes and fish genomics.

M.Sc. (FINAL) - ZOOLOGY FISH BIOLOGY PRACTICAL BASED ON PAPER VII(D) AND VIII(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. Dissection of the head of any cat fish
3. Dissection of the breathing organs of *Anabas*, *Clarias*, *Channa* and *Heteropneustis* showing the blood supply wherever possible.
4. Permanent preparations and study of pharyngeal denticles, cycloid scales.
5. Micro-technical procedures: Preparation and study of serial sections of a larval fish and representative tissues and organs of fish.
6. Collection of local fishes and their identification upto the species level, study of the available museum specimens.
7. Hydro-biological exercise:
 - (a) Analysis of water: Determination of pH, free carbon dioxide, dissolved oxygen, chlorides, calcium, total alkalinity, total salinity, BOD, COD.
 - (b) Collection: Qualitative and quantitative analysis of planktons.
8. 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):

- eggs, cleavage, blastula, gastrula, external gill, mature larva, fry and fingerlings.
9. (a) Periodical visits to a local fishing farm to gain a first hand 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.
 10. 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 7 and 10 has to be submitted compulsorily by each candidate.

Scheme of M.Sc. (Final) Zoology : Practical (Fish Biology) Examination Distribution of Marks

1.	Major Dissection	16 marks
2.	Minor Dissection / Permanent preparation	04 marks
3.	Species identification using taxonomic key	06 marks
4.	Microtomy	10 marks
5.	Hydrobiological exercise	06 marks
6.	Biochemical / Physiological exercise	06 marks
7.	Identification and comments on 8 spots	16 marks
8.	Viva-voce	08 marks
9.	Class Record	10 marks
10.	Field Trip and Project Report	08 marks
11.	Seminar (internal)	10 marks

	Total	100 marks