

J. S. University

Shikohabad



MASTER OF SCIENCE (M.Sc.)

(TWO YEAR DEGREE COURSE)

SESSION-2018

SUBJECT- ZOOLOGY

M.Sc. in Zoology

M. Sc. (Zoology) Programme

Programme Outcomes:

After successfully completing M. Sc. (Zoology) Programme students will be able to:

PO1. Zoology knowledge: Apply the knowledge of Zoology, Life Sciences and allied subjects to the understanding of complex life Processes and phenomena.

PO2. Problem analysis: Identify, review research literature, and analyse complex situations of living forms.

PO3. Design/development of solutions: Design processes/strategies that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and ICT tools for understanding of the subject.

PO6. The Postgraduate and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the natural and anthropogenic activities in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. Identify a range of invertebrates and vertebrates and justify their conservation.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the work/research practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Programme Specific Outcomes

After successfully completing M. Sc. (Zoology) Programme students will be able to:

- PSO1.** Explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system and develop theoretical and practical knowledge in handling the animals and using them as model organism
- PSO2.** Illustrate physiological adaptations, development, reproduction and behaviour of different forms of life.
- PSO3.** Illustrate zoological science for its application in branches like medical entomology, apiculture, aquaculture and agriculture etc.
- PSO4.** Develop proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization and relate concepts of comparative biology to explain evolution and success to live in varied environment

SYLLABUS OF ZOOLOGY

M.Sc. (Previous)

Note – There will be four theory papers of 100 marks each and a practical of 200 marks. The question will be set from the entire syllabus.

Paper I – Structure and function in invertebrates

Paper II – Tools and Technique for Biology, Cell Biology and Biostatistics.

Paper III – Genetics, Molecular Biology and Biotechnology.

Paper IV – Environmental Biology, Toxicology and Ethnology.

SUBJECT NAME: Structure and function in invertebrates

PAPER CODE: MSZL- 101

COUSE OUTCOME(CO)- Describe general taxonomic rules, concept, organization, general characters and significances of minor phyla, different functions of body such as nutrition, digestion, respiration, excretion, nervous system and invertebrate larvae, forms of parasites.

Paper I

Structure and function in invertebrates

(1) Biosystematics and Applications

- I. Basic principles of classification.
- II. Species concept mechanism of speciation: Allopatric and Sympatric speciation
- III. Apomictic species and Panmictic species.
- IV. Typification and different types of zoological types, taxonomic keys

(2) Organization of coelom

- I. Acoelomates
- II. Pseudocoelomates
- III. Coelomates : Protostomia and Deuterostomia

(3) Locomotion

- I. Flagella and Ciliary movement in Protozoa
- II. Hydrostatic movement in coelenterate, Annelida and Echinodermata

(4) Nutrition and Digestion

- I. Patterns of feeding and digestion in lower metazoa
- II. Filter feeding in Polychaeta, Mollusca and Echinodermata

(5) Respiration

- I. Organs of respiration : Gills, Lungs and trachea
- II. Respiratory pigments
- III. Mechanism of respiration

(6)Excretion Organs of excretion: Coelom, coelomoducts, nephridia and malphigian tubules.

(7)Mechanisms of excretion.

(8) Excretion and osmoregulation

(9) Nervous System

- I. Primitive nervous system: Coelenterata and echinodermata.
- II. Advanced nervous system : Annelida, arthropoda (Crustacea and Insecta) and mollusca (Cephalopoda)

III. Trends in neural evolution.

(10) Invertebrate larvae

I. Larval forms of free living invertebrates.

II. Larval forms of parasites.

III. Strategies and Evolutionary significance of larval forms.

(11) Minor Phyla

I. Concept and significance

II. Organization and general characters.

(12) Parasites of Protozoans and Helminthes

SUBJECT NAME- Tools and Techniques for Biology Cell Biology and Biostatistics,

Subject code- MSZL 102

Course outcome (co)- Explain/Describe the use and importance of tools and techniques which used for biology and biostatistics.

Paper II

Tools and Techniques for Biology Cell Biology and Biostatistics

(1) Tools and Techniques for Biology:

- I.** Principles and use of analytical Instruments, Balance pH Meter, Colorimeter, Spectrophotometer, Ultra centrifuge, Densitometric scanner Radioactivity counters.
- II.** Microscopy: Principles of light transmission, electron, Phase-contrast, fluorescence, scanning electron microscopes, Microphotography.
- III.** Cell culture Techniques: Design & functioning of tissue culture laboratory, culture media preparation and cell harvesting methods.
- IV.** Cryopreservation for cells, tissues, organisms. Freeze drying for physiologically active substance.
- V.** Separation techniques, molecular separation by chromatography electrophoresis, centrifugation.

(2) Cell Biology:

- I.** Bio membranes, composition & arrangements functional consequences.
- II.** Transport across cell membrane – Diffusion, active transport & pumps.
- III.** Membrane potential.
- IV.** Cytoskeleton: Microfilaments & Microtubules structure & dynamics, Microtubules & Mitosis, Intracellular transport. Cilia & Flagella, cell cycle.
- V.** Cell organelles & their functions.
- VI.** Molecular of chromosomes, heterochromatin, Euchromatin and giant Chromosomes.

(3) Biostatistics:

- I.** Definition development & scope of Biostatistics, Central tendency: Mean, Mode & Median.
- II.** Variation: Mean Deviation, Standard Deviation, Coefficient of variation.
- III.** Sampling : Types of sampling, Random & Non Random
- IV.** Presentation of Data in the form of Graphs, Pie-charts, Line, bar diagrams, histograms, Frequency Polygons.
- V.** Test of significance t-test, chi square test.

- VI.** Analysis of variance –F- test.
- VII.** Probability distribution- binomical, Poisson and normal.
- VIII.** Correlation & regression.

(4) Radiation techniques in Biology:

- I.** GM (Gieger-Muller) Counter- Description and Applications
- II.** Scintillation Counter- Description and Applications
- III.** Autoradiography- Methods and Applications
- IV.** Principle and application of Biosenseros

Subject name- Genetics, Molecular biology & Biotechnology.

Subject code- MSZL 103

Course Outcome (CO) –

1. The course offers a detailed and conceptual understanding of molecular processes *viz.* Replication, transcription, translation *etc.* underlying survival and propagation of life at molecular level. It will help students to understand how genes are ultimately expressed as proteins which are responsible for the structure and function of all organisms. To learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms.
2. The student will have awareness about genetic diseases, their types and causes. Also the understanding of molecular techniques will provide improved diagnosis and management of these diseases.
3. The principles of inheritance, linkage and crossing over which lead to variations will be made clear as well as the application thereof in gene mapping.
4. Perform procedures as per laboratory standards in the areas of biotechnology.

Paper III

Genetics, Molecular biology & Biotechnology

(1) Genetics :

- I. Basic concept of genetics.
- II. Linkage, crossing over, chromosomal aberrations, mutations and chromosome mapping.
- III. Biology of sex determination: chromosomal sex determination (mammals & *Drosophila*), testis determining gene, ovarian development, secondary sex determination in mammals.
- IV. Sex linked and sex limited traits
- V. Inborn human diseases.
- VI. Varieties of expression: Multiple alleles lethal genes, pleiotropic gene, gene interactions epistasis.
- VII. Gene mapping & genome analysis.

(2) Molecular Biology:

- I. History & scope of Molecular Biology.

- II. DNA replication : Prokaryotic & Eukaryotic DNA replication, Mechanics of DNA replication, enzymes & accessory proteins involved in DNA replication
- III. Transcription: Pro & Eukaryotic transcription RNA polymerases, mechanisms of transcriptions regulation Post transcriptional modification in RNA.
- IV. Transcription: Genetic code, prokaryotic & eukaryotic, Mechanism of Initiation, elongation & termination Regulation of transcription.
- V. Recombination & Repair: Rec A & Other recombination DNA repairs mechanisms.
- VI. Molecular mapping of genome.

(3) Biotechnology :

1. Basic Concept of genetic engineering.
2. DNA recombination & expression in bacterial cell.
3. Cloning.
4. DNA finger printing.
5. Application of Biotechnology in Industry.

Subject Name- Environmental Biology, Toxicology & Ethology.

Subject Code- MSZL 104

Course outcome (CO)-

1. Apply the scientific method and quantitative techniques to describe, monitor and understand environmental system. Identify relationship between chemical exposure and effects on physiological systems and design strategies for study of dose-response relationships.
2. Understanding how genes and the environment come together to shape animal behavior is also an important underpinning of the field and it sheds light on human benefits.
3. Effectively understand and convey scientific material from peer-reviewed sources.

Paper IV

Environmental Biology, Toxicology & Ethology

(1) Environmental Biology:

- I. Concept of Ecosystem, laws of limiting factors, Energy flow, trophic levels, food chain, ecological niches.
- II. Biotic community- Structure, stratification & Growth.
- III. Population Ecology-Structure and growth and population.
- IV. Pollution- Air, water, land, noise, Radiation sources effects and control.
- V. Conservation of Natural resources.
- VI. Wild life Conservation in India, National action plan.
- VII. Conservation in protected areas – biosphere reserve Sanctuaries and national parks.
- VIII. Vanishing wild life-protection of endangered species of vertebrates.

(2) Toxicology:

- I. Environmental Toxicology: Food additives, air, water and soil pollutants.
- II. Principle of systematic toxicology.
- III. Application of toxicology.
- IV. Human Toxicology and medical ethics.
- V. Development of toxicology as special branch of science. Different branches of toxicology, Factors affective toxicology.
- VI. Type of Toxicant then respective modes of actions.

- VII.** Genotoxic agents & their toxicities.
- VIII.** Nephrotoxic agents & Their toxicities.
- IX.** Hepatotoxic agents & their toxicities.

(4) Ethology :

- I.** Elementary movements of animals (Tropisms) & Migration (Sun Compass).
- II.** Breeding behavior & Parental care.
- III.** Pheromones, Attractants. marker, alarm, metamorphosis and maturation pheromones.
- IV.** Learning & motivations.
- V.** Means of communication, acoustic signal, ultrasonic communication, & visual perceptions.
- VI.** Hormonal control of behavior.
- VII.** Basic concepts of behavior genetics.

M.Sc. (Previous) Zoology

PRACTICAL

Details list of Zoology Practical for M.Sc. (P) Zoology:

- 1. Environmental Biology :**
 - I. BOD determination**
 - II. DO determination**
 - III. Chloride determination**
 - IV. Sulphate determination**
 - V. Alkalinity determination (using Methyl Oranges/Pheno-pthaline as indicators)**
 - VI. Acidity determination**
 - VII. Hardness determination**
 - VIII. pH determination by pH meter.**
- 2. Toxicology :**
 - I. Determination of LC₅₀(Fish, Aquative Insects) (96 hrs.)**
 - II. Determination of LC₅₀(Terrestrial of organisms)(96 hrs.)**
- 3. Biostatistics :**
 - I. Determination of Means in the given grouped data.**
 - II. Determination of Mode in the given grouped data.**
 - III. Determination of Median in the given grouped data.**
 - IV. Determination of Standard Deviation in the grouped data.**
 - V. Determination of 't' Test and significance level.**
 - VI. Estimation of correlation.**
- 4. Molecular Biology:**
 - I. Depiction of certain techniques in molecular biology on the basic of Models.**
 - II. Replication phenomenon: Conservation and Semi conservative.**
 - III. DNA Damage.**
 - IV. DNA Repair Mechanism**
- 5. Estimation of DNA content.**
- 6. Biotechnology (On the basic of availability)**
 - I. Cell culture study.**
 - II. Primary Cell line and Secondary cell line culture study.**
 - III. Vermiculture.**

IV. Transgenic Animals. Their Models.

7. Ethology:

I. Determination of Taxes (Phototaxes of *Drosophila*)

II. Determination of Kinesis (Chemotaxes of *Paramecium*. by putting a drop of saline solution)

III. Feeding Behavior

IV. Grooming Behavior

V. Death Feigning Behavior among the *Coccinellida* Beetles.

VI. Maza test. Such kinds of behavioral exercises may be designed by the teacher concerned on the basis of example given in the theory.

M.Sc. (P) Zoology

Practical

It will be of 200 Max. Marks and in two sitting of 5 hours each.

The distribution shall be as follows:-

First sitting

Items	M.M. : 200
1. Dissection	
(i) Major Dissection	15
(ii) Minor Dissection	10
2. Permanent Preparation (One)	10
3. Identification and comments on sports (8)	24
4. Genetics Exercise (1)	08
5. Bio Statistics	08
6. Molecular Biology (2) Exercise	10
7. Cell Biology (1)	15

Total 100 Marks

Second Sitting

1. Environmental Biology Exercise (1)	15
2. Toxicology Exercise (2)	15
3. Ethology Exercise (1)	15
4. Viva Voce	25
5. Sessional Record	
(i) Practical Record Book	10
(ii) Field Report	10
(iii) Permanent Microscopic Preparation	10

Total 100 Marks

Note: A field trip of minimum two weeks is compulsory to the coastal or hilly areas for the study of the fauna in natural habitat and collection for Practical Examination. The time and area or the field work shall be decided by the concerned college/Department.

SYLLABUS OF ZOOLOGY

M.Sc. (Final)

Note- There will be four theory papers of 100 marks each and a practical of 200 marks. The questions will be set from the entire syllabus.

Paper I- Comparative Anatomy of Vertebrates and Development Biology

Paper II- Physiology & Biochemistry

Paper III- Special (Entomology/Ichthyology and Fisheries/Wild life)

Paper IV- Special (Entomology/Ichthyology and Fisheries/Wild life)

Subject Name- Comparative Anatomy of Vertebrates and Development Biology

Subject Code- MSZL 201

Course outcome (CO) –

1. The student at the completion of the course will be able to: demonstrate comprehensive identification abilities of chordate diversity explain structural and functional diversity of chordate explain evolutionary relationship amongst chordate

Paper I

Comparative Anatomy of Vertebrates and Development Biology

(A) Comparative Anatomy of Vertebrates:

1. Origin of Chordate
 - I. Concept of Protochordata
2. The nature of vertebrate morphology
 - I. Definition, scope and relation to other disciplines.
 - II. Importance of the study of vertebrates morphology.
3. Origin and classification to vertebrates
4. Vertebrate integument and its derivatives
 - I. Development, general structure and functions of skin and its derivatives.
 - II. Glands, scales, horns, claws, nails, hoofs, feathers and hairs.
5. General plan of circulation in various groups.
 - I. Blood
 - II. Evolution of heart
 - III. Evolution of aortic arches, and portal system
6. Respiratory system

Subject Name- Physiology & Biochemistry

Subject Code- MSZL 202

Course outcome (CO)-

1. Student able to design and conduct scientific experiments
2. An integrated understanding of comparative physiological mechanisms
3. Described the physiology of digestive and respiratory system.
4. Understood the blood composition, types, groups and circulatory system.
5. Understand the blood, excretory system, nervous digestion system carbohydrate, protein.

Paper II

Physiology & Biochemistry

1. Physiology :

(a) **Digestion:**

- (i) Role of digestive gland and regulation of their activities.
- (ii) Digestion and absorption of carbohydrates, lipids and proteins, water and electrolyte absorption.
- (iii) Symbiotic digestion
- (iv) Vitamins

(b) **Blood Physiology and Circulation:**

- (i) Body fluids
- (ii) Physiology of RBC and leucocytes.
- (iii) Antibody production & phagocytes.
- (iv) Blood groups
- (v) Blood coagulation
- (vi) Conductile and contractile mechanism of heart.
- (vii) Cardiac cycle and its regulation

(c) **Respiration:**

- (i) Chemistry of respiration
- (ii) Transport of gases by blood
- (iii) Buffer system of blood, acid base balance
- (iv) Respiratory pigments with special emphasis on hemoglobin

(d) **Excretion:**

- (i) Urine formation (Mammal)
- (ii) Acid base balance and regulation of kidney function
- (iii) Osmoregulation
- (e) **Mammalian Endocrine Glands:**
- (f) **General characters of hormones.**
- (g) **Insect Endocrine glands**
- (h) **Reproduction:**
 - (i) Hormonal control of gonadal maturation
 - (ii) Gonadal hormones
 - (iv) Ovulation
- (i) **Muscles:**
 - (i) Types of muscles
 - (ii) Infrastructure and construction of skeletal muscles.
 - (iii) Tetanus, fatigue and summation
- (j) **Nervous System:**
 - (i) Structure of nerves, nerve impulse, synaptic transmission, monosynaptic & polysynaptic reflex arc, function of basal ganglia.
 - (ii) Effects of sympathetic and parasympathetic activities
 - (iii) Spinal reflex arc
 - (iv) Integrated functions of hypothalamus.

2. **Biochemistry:**

- (i) Amino acids and peptides – properties and structure.
- (ii) Carbohydrates and lipids – classification, structure and clinical significance.
- (iii) Proteins - classification & structural properties
- (iv) Vitamins – discovery, structure and functions.
- (v) Nucleic acids and nucleotides – structural properties and functions.
- (vi) Analytical and separation techniques.
- (vii) Enzymes – nature and classification, purification and kinetic assay, immunized enzymes and their uses.
- (viii) Metabolism – design and regulation metabolism of carbohydrates, lipids, nucleotides and acids.

Subject Name- Entomology: Morphology Anatomy, Physiology & Development

Subject Code- MSZL 203

Course outcome (co)- Imparts knowledge of beneficial and non-beneficial insects.

Understood the morphology, physiology and development of insect.

Paper III

Entomology: Morphology Anatomy, Physiology & Development

1. Morphology:

(i) Integument (ii) Structure of insect head: (a) Orientation of insect head and silviculture of insect head. (b) Appendages, structure and types of antennae type of insect mouth-parts. (iii) Structure of insect thorax: (a) Sulci and areas of thorax. (b) Thorax as a locomotors organ, structure, articulation and coupling of wings. (c) Structure and functioning of insect leg. (iv) Structure of insect abdomen: (a) Male genitalia of insects and their modifications. (b) Female ovipositor, genitalia, its modification in insects, substitution ovipositor.

2. Anatomy:

(i) Digestive system: (a) Basic structure of digestive system including musculature. (b) Cardiac and pyloric calves. (c) peri-trophic membrane. (d) Filter chamber. (e) Rectal pads. (ii) Excretory system: (a) Malpighian tubules (b) Other excretory glands (iii) Respiratory system: (a) Basic structure of trachea, spiracles and air sacs. (b) Respiration: In Terrestrial, Aquatic and Parasitic insects. (iv) Circulatory system: (a) Structure of heart and aorta. (b) Blood or Haemolymph along with other cells. (v) Nervous system: (a) Central nervous system. (b) Peripheral nervous system. (c) Sensory cells and sense organs. (d) Stomatogastric nervous system. (vi) Reproductive system: (a) Male internal reproductive organs. (b) Female internal reproductive organs.

3. Insect Physiology:

(a) Physiology of digestion (b) physiology of excretion (c) Production and reception of sound (d) Physiology of photoreception and light production (e) Insect eye, theory of mosaic vision (f) Hormones, Hormonal control, neurosecretions.

4. Development

Structure of egg. (b) Embryonic development of blastokinesis, diapauses. (c) Types of metamorphosis, significance of metamorphosis. (d) Hormonal control of metamorphosis. (e) Ecdysiast.

Subject Name- Entomology: Systematics, Ecology and Applied Entomology

Subject Code- MSZL 204

Course Outcome (CO)-

1. Demonstrate an understanding of insect identification, structure and function.
2. Understand the evolutionary and ecological relationships of insects with other life forms and the impact of insect relative human health and wellbeing and animal and plant health.
3. Understand the principles and methods of meaning beneficial and pest insect populations.
4. Be able to apply the scientific in problems solving and the principles of experimental design and analysis.

Paper IV

Entomology: (Systematics, Ecology and Applied Entomology)

1. Systematic :

- I.** Knowledge of International Code of Nomenclature with special reference to Law of Priority, Concept of Holotype, Allotype, Paratype and Lectotype .
- II.** Linnean Hierarchy, Taxonomic characters, Comstock-Needhem nomenclature of insect wing venation.
- III.** Evolution of insects and Fossils insects.
- IV.** History of Entomology in India.

2. Detailed knowledge of the special structure, habits and importance of the following

insect orders and Families: Ephemera, Plecoptera, Odonata, Embioptera, Orthoptera-Acrididae, Gryllidae, Tettigoniidae; Locust and Phase theory of Locust, Phasmoda, Dermaptera, Blattaria, Mantodea, Phthiroptera-Anoplura and Mallophaga, Psocoptera. Isoptera, Thysanoptera, Heteroptera-Pentatomidae, Coreidae, Pyrrhocoridae, Reduviidae, Lygaeidae, Tingidae, Belostomatidae, Nepidae, Gerridae., Homoptera-Membracidae, Jassidae, Aleocharidae, Psyllidae, Aphididae and Coccidae. , Coleoptera-Carabidae, Dyscolidae, Dermestidae, Hydrophilidae, Chrysomelidae, Meloidae, Coccinellidae, Curculionidae, Tenebrionidae, Cerambycidae, Scarabaeidae, Curculionidae, Trichoptera., Lepidoptera-Noctuidae Sphingidae, Pyralidae, Bombycidae, Papilionidae, Nymphalidae, Pieridae, Hymenoptera-Ichneumonidae, Braconidae, Chalcidoidea, Vespoidea, Apoidea, Formicoidea; Diptera-Tipulidae, Psychodidae, Chironomidae, Simuliidae, Culicidae,

Itonididae, Tabanidae, Asilidae, Syrphidae, Agromyzaidea, Muscidae, Trypetidae, Hippoboscidae.; Aphinaptera, Apterata, Protura, Collecmbula, Thysaneura.

3. Ecology :

- I.** Abiotic factors influencing insect life, the effect of temperature on insect development.
- II.** Biotic factors : (a) Insect parasitism. (b) Entomophagus insects. (c) Social life in Termites, Bees, Ants. (d) Parental care. (e) Mymecophily and Termitophily.

4. Applied Entomology

- I.** Economic importance of insects.
- II.** Concept of insect control by use of insecticides, concepts of biological control, male sterility.
- III.** Apiculture, sericulture and Lac Industry in India.
- IV.** Life history, damage and control of the main pests of :
a.Sugarcane crop. b Paddy crop. c Cotton crop. d Stored grains.
- V.** Insect vectors of various deseases like Malaria, Dengue, Fillarissis, Kala-szar, yellow fever, sleeping sickness Loa-los, etc. transmitted to cattle and man and their control measures.

Group B
Ichthyology & Fisheries
Paper – IV

Section A : Systematics :

1. Classification-Evolutionary classification, merits & demerits of Berg's classification, Ostracoderms, Placoderms.
2. Origin & evolution of Fishes (Elasmobranches and Bony Fishes).
3. Adaptive radiation in fishes Elasmobranches and bony fishes.
4. Hill stream adaptations & Deep sea adaptations.

Section B : Morphology :

1. Integument-Scale & Coloration.
2. Fins-their origin, locomotion, Electric & Light producing organs.
3. Fish nutrition, Food, Feeding habit Alimentary canal in relation to its physiology of Digestion.
4. Fish respiration structure of gills in bony & elasmobranches fishes, gill ventilation, fish blood as oxygen carrier; Air breathing fishes; Swim Bladder webstrion ossicles.

Section C : Physiology :

1. Stator-acoustic Lateral line system; chemoreceptor's; organ of sight & organ of smell.
2. Osmoregulation & mechanism of water salt balance in fresh water & marine fishes.
3. Circulatory, Excretory system & Nervous system.
4. Migration & Parental care.

Section D : Embryology :

1. Reproductive system.
2. Structure & kind of eggs, maturation cleavage & early embryonic development.
3. Hatching & post embryonic development including fundamentals of morphogenesis.
4. Endocrine glands : Neuro-endocrina; co-ordination.

Aquaculture & Fisheries
Paper IV

Section A :

1. Types of fisheries-Marine fisheries (deep water, off shore) Riverine fisheries (Major river system of North India), Reservoir fisheries, lacustrine fisheries (Fresh water & brackish water), Estuaries fisheries.
2. Prawns Fisheries-Fishing method, Culture methods, future of prawn fisheries in India & processing of prawns.
3. Molluscan fisheries & Pearl industry.
4. Net & crafts of inland & marine water; Electric fishing, light fishing & eco sounders.
5. Effect of light temperature, turbidity, dissolved gases & solids in water.
6. Types of planktons & their role in fish life.
7. Maintenance of fresh water aquarium.

Section B :

1. Pond culture & its management.
2. Principle cultivable fishes-Brief account of indigenous & exotic species. Procurement of seed, collection, identification & transport of seed.
3. Induced breeding-stripping, hypophysation techniques.
4. Special culture-Composite fish culture; fish culture in paddy fields sewage fish culture and integrated fish culture.
5. Fish diseases & their control-Fungal diseases, bacterial diseases, protozoan diseases, helminthes diseases & diseases induced by pollutants; prophylactic measures.
6. Fish Preservation & processing-Cause of spoilage, methods of preservation, their merits & demerits.
7. Fish by-products.
8. Fish pollution & toxicity.
9. Age & growth, length & weight relationship.
10. Tagging of fish.

Group C : Wild Life

Paper III Wild life and Ecology

Unit I

1. Demography, life table and generation time.
2. Population growth of wild life, growth of organism with non-overlapping generation, exponential growth, population growth projection using beely matrice.
3. Inter and Intra specific relationship : Predation models of prey-predatory dynamics optional forging theory-Patch choice, diet choice, prey, selection, forging time.
4. Competition and niche theory-Interspecific and interspecific competition, History of niche concept, theory of limiting similarities.
5. Mutalism animal-animal relationship.
6. Population regulation-extrinsic and intrinsic mechanism.
7. Case studies of Population dynamics.

Unit II

1. Ecological modeling-fundamental of constructive and testing them.
2. Types of Ecosystem-nutrient cycle, food chain, food web.
3. Habitat Ecology-Aquatic fresh water ecology, esturine ecology and oceanography.
4. Terrestrial Ecology-Forest and Grassland ecology, desert life, Himalayan ecology, Floristic regions and Islands of India.
5. Zoogeographical regions and world Biota.
6. Environmental hazards, destruction of habitat and extrication of species causes and preventive measures.
7. Environmental Planning of Rural and Urban development.
8. Management of soil resources.
9. UNESCO's role in Ecology, Earth summit, SARCED Trust fund.

Unit III

1. Morphological variations and adaptations in species of Reptiles, birds and mammals different Ecosystem, Forest, deserts hills reivers, sanctuaries and oceans.

2. Behaviour and breeding patterns of Wild species.
3. General anatomical organization and sense organs in wild species.
4. Oil field pollution, drilling operations, monitoring, Environmental impact assessment.
5. Origin and evolution of Reptiles, birds and mammals.
6. Special features in the development Biology of Reptiles, birds and mammals.

Note-

Attempt one question from each unit, total four questions are to be answered.

**Wild life; Wild life valued, Wild life Management & Biodiversity
Paper IV**

Unit I -

- I. Habit and habitat and zoogeographical distributions of Reptiles, bird and mammalia.
- II. Groups of allied importance –A fishes, amphibia and Insect.
- III. Forestry-forest resource, erosion, deforestation and aforestation.
- IV. Conservation movements in Himalayan Foot hills and Tribal belts of India
- V. National Parks and sanctuaries in India, concept and histories in regards to Ecology
- VI. Importance Nature reserves in the world.

Unit II

1. Interaction of man and Nature.
2. Legislation, wild life protection Act and Regulations.
3. National Parks, Sancturies, planning management, administration and economics.
4. National Parks and Sancturies-Case studies.
5. Maintenance and rearing of wild species.

Unit III

1. Wild life value as tourism, acethetical game, ethical, commercial and scientific.
2. Environmental education, Public awareness and future programmes.
3. Conservation movement in India-historical perspectives.
4. Biodiversity, its significance and conservation measures.
5. Role of Biotechnology in species development.

Note- Attempt one question from each Unit. Total four question are to be answered.

M.Sc. (Final) Zoology

Entomology Practicals

(A) Entomology

1. Anatomy of common grasshopper, Cockroach, Honey bee, Wasp and Dysdercus, Mylabris, Belestoma (Giant water bug.)
2. Dissection of mounting of :
 - (i) Sting apparatus of honey bee and wasp,
 - (ii) Tympanal organs of grasshopper.
 - (iii) Tests of Cockroach.
 - (iv) Arista of house fly.
 - (v) Different types of mouth parts of insects.
 - (vi) Different types of Wings and antennae of insects.
 - (vii) Tentorium of grasshopper.
3. Identification and comment on insect of different orders and families.
4. Identification with help of keys of common insects from different orders and families.
5. Study of prepared permanent slides of insects of Morphology and Anatomy.

(B) Fishes :

1. (a) Anatomy of scoliodon, sting ray, electric ray. Wallago and Macrones.
(b) Accessory respiratory organs of Sacco-branchus, Clarias and Anabas.
2. Study of osteology of a fresh water teleost.
3. (a) Mounting : Permanent preparation of different types of scales, Ampulla of Lorenzini and fish tissue (skin, muscles, T.S. of Vertebra).
(b) Preparation of
 - (i) Girdles (Pectoral and Pelvic).
 - (ii) Vertebra and tail fin.
4. Examination of prepared slides and whole mounts of fishes.
5. Identification of comment on museum specimen of various groups, both marine and fresh-water fishes.
6. Identification of fresh-water fishes.
7. Various structure used in age determination of fishes.
8. Fish physiology :

- (i) Preparation of the stained blood film of fish.
 - (ii) Differential count of corpuscle.
 - (iii) Identification of plankton in given samples of water.
 - (iv) Examination of gut contents.
 - (v) Adaptations in fishes.
9. Survey of fish resources. Candidates would be required to have excursions to the coastal regions and fresh water system.

(C) Wildlife and Ecology

1. Anatomy of :
 - (i) Toad, Frog.
 - (ii) Lizard. Snake, Turtle.
 - (iii) Pigeon, Parrot.
 - (iv) Rabbit, Rat, Guinea a pig.
 2. Ecological survey of national parks and sanctuaries.
 3. Mounting; Permanent preparation of parts of internal organization
 4. Study of slides of different microscopic structures.
 5. Identification of wild animal species as objects of museum and zoo and specimens of photograph.
 6. Osteology of wild animals.
 7. Ecological comments on wild species in different niche and habits.
- Candidates would be required to keep a record of exercise in lab, field trips, sanctuaries and parks of importance and collections.

M.Sc. (Final) Zoology
Practical Examination

I. Major Dissection :

1. Cranial Nerves of Macrones.
2. Weberian ossicles of Macrones.
3. Neck nerves of Squirrel or Rat.
4. Cranial Nerves of Fowl.
5. Air Sacs of Bird.
6. Afferent Branchial Arteries of Dogfish.
7. Efferent Branchial Arteries of Dogfish.
8. Cranial Nerves of Dogfish.

II. Minor Dissection :

1. Expose Internal ear of Dogfish in Situ.
2. Air sacs of Saccobranchus.
3. Labyrinthine Plates of Anabus.
4. Accessory organs of Cleans.
5. Electric organs of Electric Ray.

III. Permanent Mounting :

Protochordata : Mounting of Doliolum, Salpa, Oikopleura, Ciona. Preparation of slides of spicules of Herdmania. Pharyngeal wall. Preparation of slides from Amphioxus-Oral hood, whell organ and pharnygeal wall. Preparation of different types of scales founds in fishes, Placoid, Cycloid. Ctenoid and Rhomboyd. Preparation of different types of feathers found in birds, i.e. Filopumes, Nestling down, etc. A part of contour feathers to show Barbs. Mounting of Pecten. Practical

Examination shall include the study of :

- I. Vertebrate Specimens from the Class Cyclostomata to Class Mammalia.
- II. Histology Slides of various organ systems from the Class Cyclostomata to Class Mammalia.

III. Osteology of vertebrates i.e. Amphibia, Reptilia, Aves and Mammalia :

- (a) Axial Skeleton : Skull and Vertebral column.
- (b) Appendicular Skeleton : Girdles, Forelimb and Hind limb bones.
- (c) Bird Skull : Study of skulls to show Palate types.
- (d) Reptilian Skull : Skull of Poisonous and Non-poisonous Snake, skulls of Turtles and girdles of turtles Skull of Crocodile, Alligator and Gravidalis.
- (e) Skull of Pteropus. Dog. Cat and monkey and rabbit.

Scheme of Zoology Practical Examination shall be as given below:

It will be of 200 marks and shall be performed in two sittings of 5 hours each.

The distribution shall be as follows :

First Sitting

Items	M.M.
1. Major Dissection	20 Marks
2. Minor Dissection	10 Marks
3. Permanent Preparation	07 Marks
4. Identification & Comment upon Sports (10)	30 Marks
5. Physiology Experiment/Embryology Experiment	08 Marks

Total : 75 Marks

Second Sitting

1. Dissection-Major (Related to special Paper viz.
Ichthyology/Entomology and Wild Life) 15 Marks
 2. Dissection-Minor 10 Marks
 3. Permanent Stained Preparation 10 Marks
 4. Identification and Comments of spot (10) 30 Marks
- Note:- 2 spots for special comments with the help of Keys may be added. In such case marks for the general spots shall be of 20 marks and for special spots as 10 marks.
5. Viva-Voce 20 Marks
 6. Sessional Record
 - I. Practical Record Book 10 Marks
 - II. Permanent microscopic preparations and exhibits 15 Marks
 - III. Collection as a result of field studies 15 Marks

Total : 125 Marks