Course Structure for M.Sc. (Zoology) under Semester System to come into force from Academic Session 2013-14.

M.Sc. (ZOOLOGY)

SEMESTER SYSTEM
MASTER OF SCIENCE (ZOOLOGY)

SEMESTER SYSTEM

Note: There will be three theory papers of 100 Marks each and Practical of 100 marks per semester. The question will be set from entire relevant syllabus. There shall be 10 questions. The candidate will be required to answer four questions.

**FIRST SEMESTER**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Course Title</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper I</td>
<td>Structure and functions in Invertebrates</td>
<td>100</td>
</tr>
<tr>
<td>Paper II</td>
<td>Structure and functions in Invertebrates</td>
<td>100</td>
</tr>
<tr>
<td>Paper III</td>
<td>Ethology, Microbiology</td>
<td>100</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical based on the above syllabus</td>
<td>100</td>
</tr>
</tbody>
</table>
**MASTER OF SCIENCE (ZOOLOGY)**

**SEMESTER SYSTEM**

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<table>
<thead>
<tr>
<th>SECOND SEMESTER</th>
<th>400 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper I : Cell Biology &amp; Genetics</td>
<td>-</td>
</tr>
<tr>
<td>Paper II : Environmental Biology, Toxicology</td>
<td>-</td>
</tr>
<tr>
<td>Paper III : Tools &amp; Techniques: Biostatistics</td>
<td>-</td>
</tr>
<tr>
<td>Practical : Practical based on the paper I – III</td>
<td>-</td>
</tr>
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MASTER OF SCIENCE (ZOOLOGY)

SEMESTER SYSTEM

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THIRD SEMESTER

<table>
<thead>
<tr>
<th>Paper</th>
<th>Title</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper I</td>
<td>Biotechnology, Molecular Biology</td>
<td>100</td>
</tr>
<tr>
<td>Paper II</td>
<td>Comparative anatomy of vertebrates and Development Biology</td>
<td>100</td>
</tr>
<tr>
<td>Paper III</td>
<td>Animal Physiology &amp; Biochemistry</td>
<td>100</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical based on the paper I – III</td>
<td>100</td>
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MASTER OF SCIENCE (ZOOLOGY)

SEMESTER SYSTEM

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FOURTH SEMESTER: (OPTIONAL)

GROUP-A  ENTOMOLOGY

<table>
<thead>
<tr>
<th>Paper I</th>
<th>Morphology &amp; Anatomy of Insects - 100 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper II</td>
<td>Physiology, Development &amp; Ecology - 100 Marks</td>
</tr>
<tr>
<td>Paper III</td>
<td>Systematic, Structure &amp; Applied Entomology - 100 Marks</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical based on the paper I – III - 100 Marks</td>
</tr>
</tbody>
</table>

OR

GROUP-B  ICHTHYOLOGY AND FISHERIES

<table>
<thead>
<tr>
<th>Paper I</th>
<th>Systematic and Morphology of Fish. - 100 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper II</td>
<td>Physiology and Embryology - 100 Marks</td>
</tr>
<tr>
<td>Paper III</td>
<td>Aquaculture and Fisheries Management - 100 Marks</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical based on the paper I-III - 100 Marks</td>
</tr>
</tbody>
</table>
OR

**GROUP-C  WILD LIFE AND ENVIRONMENTAL STUDIES**

<table>
<thead>
<tr>
<th>Paper I</th>
<th>Wild Life and Ecology</th>
<th>-</th>
<th>100 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper II</td>
<td>Environmental aspects of Wild Life and Biodiversity</td>
<td>-</td>
<td>100 Marks</td>
</tr>
<tr>
<td>Paper III</td>
<td>Wild Life Values &amp; Wild Life Management</td>
<td>-</td>
<td>100 Marks</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical based on the paper I-III</td>
<td>-</td>
<td>100 Marks</td>
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</tbody>
</table>
M.S.C. (ZOOLOGY)

RULES & REGULATION

- Each practical performance will be of 100 marks.

- Passing marks in individual theory as well as practicals be 40%, overall the Total aggregate of the candidate should be 45% in each semester.

- The entire course of M.Sc. (Zoology) will be of 1600 marks. So every semester will be of 400 marks.

- Each theory paper will be of 100 Marks.

- Practical Paper will be of 100 Marks.
M.Sc. Zoology

First Semester

Paper I: Structure and Functions in Invertebrates

1. Principles of Animal Taxonomy:
   (i) Species concept, International Code of Zoological nomenclature.
   (iii) Animal Collection, handling and Preservation.

2. Organization of Coelom:
   (i) Acoelomates.
   (ii) Pseccdocaelomates.
   (iii) Coelomates: Protostomia and Deuterostomia

3. Locomotion:
   (i) Flagellar and ciliary movements 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.
M.SC. ZOOLOGY

FIRST SEMESTER

PAPER II : STRUCTURE AND FUNCTION IN INVERTEBRATES

1. Excretion:
   (i) Organs of excretion: Coelom, Coelomoducts, Nephridia and Malphigian tubes.
   (ii) Mechanism of Excretion.
   (iii) Excretion and osmoregulation.

2. Nervous System:
   (i) Primitive nervous system: Coelenterata and Echinodermata.
   (ii) Advanced nervous system: Annelida, Arthropoda (crustacean and insecta) and Mollusca (cephalopoda).
   (iii) Trends in neural evolution.

3. Invertebrate Larvae:
   (i) Larval forms of free living invertebrates.
   (ii) Larval forms of parasites.
   (iii) Strategic and Evolutionary significance of Larval forms.

4. Minor Phyla:
   (i) Concept of significance.
   (ii) Organization and general characters.

5. Parasites of Protozoan and Helminthes.
M.SC. ZOOLOGY

FIRST SEMESTER

PAPER III : ETHOLOGY, MICROBIOLOGY:

1. Microbiology:
   (i) History and scope of microbiology:-
       (a) Recognition of microbial role in disease.
       (b) Microbial effects on organic and inorganic matter the composition of microbial world and scope and relevance of microbiology.
   (ii) Virus – Concept, general properties, cultivation, purification, assay, structure and structural properties.
   (iii) Microbial Taxonomy:-
       (a) Morphological, Physiological, Metabolic, Ecological and Molecular characteristics.
       (b) Aerobic, motile and non-motile gram negative bacteria, anaerobic gram negative and gram positive bacteria.
   (iv) Microbial disease:-
       (a) Viral air-borne, direct contact, food-borne and water-borne disease.
       (b) Bacterial air-borne, direct contact, food borne and water borne disease.
       (c) Fungal and protozoan disease.
   (v) Micro organism as components of environment and nature of symbiotic microbial association.
   (vi) Microbiology of food and industry:-
(a) Microbiology of fermented food.

(b) Microbial process and products.
M.S.C. ZOOLOGY

FIRST SEMESTER

Practical Based on Paper – I to III :-

I : Specimens and Slides (Economic Ecology)

(a) Protozoa:
Entamoeba histolytica, Entamoeba gingivalis, Trypanosoma, Trichomonas, Plasmodium.

(b) Poripera:
Euplectella, Spongilla, Cliona, Hippospongia

(c) Coelenterata:

(d) Ctenophora:
Ctenoplana; Coeloplana; Pleurobranchi; Cestum; Beroe.

(e) Platyhelminthes:
Planaria, convoluta, Gyrodactylus, Polystoma, Schistosoma, Echinorvius granulosa TS Planaria; Sporocyst larva of F. hepatica, Miracidium larva of F. hepatica, Radia larva of F. hepatica; Cercaria larva of F. hepatica; scolex of Taenia solium; Mature Proglottid T. solium; Cysticercus larva of T. Solum.

(f) Aschelmenthes:
Ancylosoma, Wuchereria bracorfti; Trichinellaspiralis Rhabdites, Enterobius vermicularis, T.S. through the body of Male Ascaris, T.S. through the body of Female Ascaris.
(g) *Annelida:*
Heteronereis, Eunice, Syllis, Glyceria, Chaetopterus, Arenicola, Amphitrite, Serpula, Lumbricus, Tubifex, Pontobdella, Hirudo, TS Pheretima through Pharynx, TS Pheretima through Gizzard, TS Pheretima through Typhlosolar region, Parapodium of nereis, Parapodium of Heteronereis, Trochopore Larva of Nereis, T.S. Hirudinaria through Crop with/without diverticula.

*Mollusca:*
Chiton, Dentalium, Haliotis, Patella, Murex, Doris, Planorbis, Mytilus, Pecten, Venus, Teredo, Loligo, Octopus, Nautilus.
LS Osphradium of Pila, Radula of Pula, TS Gill Lamina of Unio, Glochidium Larva of Unio.

*Arthropoda:*
Pranchiopus, Apus, Daphnia, Balanus, Sacculina, Cyclops, Mysis, Astacus, Eupagurus, Lucifer, Cancer, Scolopendra, Julus, Peripatus, Palamnaeus, Limulus, Lepisma, Melanopus, Gryllotalpa, Mantis, Pediculus, Termite, Dragon Fly, Belostoma, Cicada, Butter fly, Moth, Xenoylla, Zoea larva, Nauplius larva, Mysis larava, Megalopa larva, Larva of Culex, Pupa of Culex, Larva of Anopheles, Pupa of Anopheles, Head, Head and mouth parts of Female Anopheles, Head and Mouth part of Male Culex, Head and Mouth parts of female culex, Head, Head and mouth parts of Butter fly, Mouth parts of Apis, Sting apparatus of Apis.

*Echinodermata:*
Antedon, Cucumaria, Thyone, Synapta, Ophiothrix, Echinus, Clypeaster,
Bipinnaria larva, Branchiolaria larva, Ophioplutenes larva, Echinopluteus larva.

*Hemichordata:*
Saccoglossus, Cephalodiscus, Rhabodopleura,
T.S. of Balanoglossus through Proboscis, T.S. Balanoglossus through collar, Tornaria larva of Balanoglossus.
Minor Phyla:
Echiurus, Bonellia, Sipunculus, Lingula, Magellania, Echino rhynchus, Brachionus, Bugula, Sagitta,

Dissections (Major and Minor):

3. Sepia (Cuttle Fish):(i) Nervous System.
5. Palaemon: (i) External Features (ii) Appendages (iii) Nervous System.

SELECTED MOUNTING:

(i) Phylum Protozoa: Amoeba, Paramecium, Euglena, Balantidium
(ii) Phylum Porifera: Sponge Spicules, Sponge gemmules,
(iii) Phylum Coelenterata: Hydra, Obeliamedusa, other small coelenterates.
(iv) Phylum-Platyhelminthes: Planaria, Fasciola, & Nematodes
(v) Phylum-ANNELIDA (a) Earthworm: Ovary, Nephridia, b) Nereis: Parapodia
(vi) Phylum-Arthropoda:
   (a) Palaemon- Hastate Plate, Statocyst
   (b) Cyclops, Daphnia and Crustacean Larvae.
   (c) Cockroach – Salivary Glands, Trachea, Mouth parts.
   (d) Mouth parts of insects.

(vii) Phylum – Echinodermata : Tube Feet and pedicellariace of starfish

II. Microbiology:
(i) Isolate and cultivate bacteria from leaf sample.
(ii) Staining of bacterial smear.

III. Biostatistics:

(i) Presentation of data from frequency tables.

(ii) Discrete, variable, continuous variable.

(iii) Presentation of data in the form of graphs, pie chart, line charts, bar graphs, frequency, Polygons and ogives.

(iv) Measures of central tendencies, mean, median & mode.

(v) Measures of dispersion, range, mean deviation, variance, and standard deviation.

(vi) Standard errors, coefficient of variation.

(vii) Tests of significance, t-test, chi-square test.

**Scheme of Zoology Practical Examination:**

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<thead>
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<th>Duration: 5 Hours</th>
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<tr>
<td>1. Major Dissection</td>
<td>20</td>
</tr>
<tr>
<td>2. Minor Dissection</td>
<td>10</td>
</tr>
<tr>
<td>3. Permanent Preparation</td>
<td>20</td>
</tr>
<tr>
<td>4. Identification and Comment upon 8 Spots</td>
<td>20</td>
</tr>
<tr>
<td>5. Microbiology / Bio Statistics</td>
<td>10</td>
</tr>
<tr>
<td>6. Viva – Voce</td>
<td>10</td>
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<tr>
<td>7. Practical Records</td>
<td>10</td>
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</tbody>
</table>

Total 100
M.Sc. Zoology

Second Semester

Paper I: Cell Biology and Genetics

1. Cell Biology:

(i) Bio membranes: Composition and arrangement, functional consequences.
(ii) Transport across the Cell Membrane: Diffusion, Active Transports and Pumps.
(iii) Membrane Potential.
(iv) Cytoskeleton: Micro filaments & micro tubules, structure and dynamic.
(v) Cilia and flagella.
(vi) Cell organelles and their functions.
(vii) Molecular structure of chromosomes, heterochromatic and giant chromosomes.
(viii) Cell-cycle, mitosis and meiosis.

2. Genetics:

(i) Basic concept of genetics.
(ii) Linkage, crossing over, chromosomal aberration, mutations and chromosome mapping.
(iv) Sex – linked and sex limited traits.
(v) Inborn human diseases.
(vi) Varieties of expression: Multiple alleles, lethal genes, apheliotropic gene, gene interactions, epistaes.

(vii) Gene mapping and genome analysis.
M.SC. ZOOLOGY

SECOND SEMESTER

PAPER II : ENVIRONMENTAL BIOLOGY, TOXICOLOGY

1. Environmental Biology:

(i) Concepts of Ecosystem, laws of limiting factor, energy flow, tropic levels, food chain, ecological niches.
(ii) Biotic community – structure, stratification and growth.
(iv) Population – 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 of protected areas – biosphere reserve, sanctuaries and national parks.
(viii) Vanishing wild life – protection of endangered species of vertebrates.

2. Toxicology:

(i) Environmental Toxicology: food addition, air, water and soil pollutants.
(ii) Principle of systematic toxicology.
(iii) Application of toxicology.
(iv) Human toxicology and medical ethics.
(v) Development of toxicology and special branch of science. Different branches of toxicology, factors affective toxicology.
(vi) Types of toxicants and their respective modes of action.
(vii) Genotoxic agents and their toxicities.
(viii) Hepatotoxic agents and their toxicities.
(ix) Nephrotoxic agents and their toxicities.
M.Sc. Zoology

Second Semester

Paper III : Tools & Techniques: Biostatistics

Unit-I

Unit-II

Unit-III
Chromatography: Principles and applications of gel-filtration, Ion exchange and affinity chromatography, Thin-layer Chromatography, Gas Chromatography, High Pressure Liquid chromatography, Electrophoresis, Ultracentrifugation.

Unit-IV
Principles and techniques of nucleic acid hybridization. Sequencing of proteins and nucleic acids. Southern, Northern and South Western blotting techniques. Polymerase chainreaction technique.
M.SC. ZOOLOGY

SECOND SEMESTER

Practical:

I : Cytological Preparations:
(i) Squash preparation of onion root tips to observe stages of mitosis.
(ii) To prepare slide for study of meiosis from testes of grasshopper.
(iii) Preparation of slide of polytene chromosomes from the salivary glands of Drosophila larva and larva of chironomus.

II : Genetical Exercise: Based on basic principles of heredity:
(i) Dominance and recessive.
(ii) Incomplete dominance
(iii) Law of independent assortment
(iv) Multiple alleles.
(v) Sex – linked inheritance

III : Environmental Biology:
(i) BOD determination.
(ii) DO determination
(iii) Chloride determination
(iv) Sulphate determination

IV : Toxicology:
(i) Behavioural response of fish under different doses of DDT stress.
(ii) Determination of LC$_{50}$

(iii) Ocular effect of organophosphorus insecticides in rat.

**V : Molecular Biology:**

(i) Description of certain techniques in molecular biology on the basis of models.

(ii) Replication phenomenon: conservative and semi conservative.

(iii) DNA damage.

(iv) DNA repair Mechanism.

(v) Estimation of DNA content.

**VI : Biotechnology (on basis of availability):**

(i) Cell culture study.

(ii) Primary cell line and secondary cell line culture study.

(iii) Vermi culture.

(iv) Transgenic animals, their models.

**VII : Ethology:**

(i) Determination of taxes (phototaxes in Drosophila).

(ii) Determination of kinesis (chemotaxes in Paramecium)

(iii) Feeding behaviour

(iv) Grooming behaviour

(v) Maze test

**Scheme of Zoology Practical Examination:**

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<th>Duration: 5 Hours</th>
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<tbody>
<tr>
<td>1. Cytological Exercise</td>
<td>-</td>
</tr>
<tr>
<td>2. Genetics Exercise</td>
<td>-</td>
</tr>
</tbody>
</table>
3. Determination of pH, Colorimeter or - 10
   Spectro photometric estimation of carbohydrate and Protein.
4. Chromatographic Separation Paper/Thin Layer - 10
   Electrophoresis.
5. Spotting and identification and comment on - 15
   Cytology slides and Genetics Models (5 Nos.)
6. Toxicology/Ethology Exercise - 05
7. Viva – Voce - 05
8. Practical Records - 10

           =========
Total         100
           =========

**NOTE:-**

- **Tour of atleast one week is compulsory of costal or hilly areas for study of animals in natural habitat and collection and report of this work is too submitted.**

- **The time and programme of this tour will be decided by Department/college.**
M.S.C. ZOOLOGY

THIRD SEMESTER

PAPER I : BIOTECHNOLOGY & MOLECULAR BIOLOGY

1. Biotechnology:

(i) Basic concepts of genetic engineering.
(ii) Hybridization technology, cell & tissue culture.
(iii) DNA recombination expression in bacterial cell
(iv) Cloning
(v) DNA finger printing.
(vi) Application of Biotechnology in Industry.

2. Molecular Biology:

(i) History and scope of molecular biology.
(ii) DNA replication: Prokaryotic and Eukaryotic DNA replication, Mechanics of DNA replication, Enzymes and accessory proteins involved in DNA replication.
(iii) Transcription: Pro & Eukaryotic transcription, RNA polymerases, mechanisms of transcription, regulation, post transcriptional modifications in RNA.
(iv) Translation: Genetic code, prokaryotic and eukaryotic, mechanism of initiation, elongation and termination, regulation of translation.
(v) Recombination & repair: recombination RNA & other recombination DNA repair mechanism.
(vi) Molecular mapping of genome.
M.S.C. ZOLOGY

THIRD SEMESTER

PAPER II : COMPARATIVE ANATOMY OF VERTEBRATES AND DEVELOPMENT BIOLOGY

1. Comparative Anatomy of Vertebrates:
   (i) Origin and classification of vertebrates.
   (ii) Integument and its derivatives in vertebrates.
   (iii) Skeletal system.
   (iv) General plan of circulation in various groups.
   (v) Respiratory system.
   (vi) Evolution of uncongenial system in vertebrates.
   (vii) Sense organs.
   (viii) Nervous system.
   (ix) Reproductive system.

2. Developmental Biology:
   (i) Gametogenesis: Spermatogenesis & Oogenesis fertilization and biochemistry of fertilization.
   (ii) Different kinds of eggs in Chordales.
   (iii) Different types of Cleavages.
   (iv) Blastulation and fatemag construction in frog and chick.
   (v) Gastrulation and mode of three germ layers.
   (vi) Organogenesis: brain, aortic, arches, hearts, eyes in Mammals.
   (vii) Foetal membranes in chick
(viii) Placenta in Mammals.
(ix) Competence, determination, differentiation and regeneration.
M.SC. ZOOLOGY

THIRD SEMESTER

PAPER III : ANIMAL PHYSIOLOGY & BIOCHEMISTRY

1. Physiology:

(a) Digestion:

(i) Role of digestive glands 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 function
(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) Osmo regulation

(e) **Endocrine Glands:**

(i) Pituitary
(ii) Thyroid
(iii) Parathyroid and thymus
(iv) Adrenal and islets of Langerhans and their functions

(f) **Reproduction:**

(i) Hormonal control of gonadal maturation
(ii) Gonadal hormones
(iii) Ovulation

(g) **Muscles:**

(i) Types of muscles
(ii) Infrastructure and construction of skeletal muscles.
(iii) Tetanus, fatigue and summation

(h) **Nervous System:**

(i) Structure of nerves, nerve impulse, synaptic transmission, monosynaptic & polysynaptic reflex arc, function of basal ganglia.
(ii) Effects of sympathetic and para sympathetic 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, immunolized enzymes and their uses.
(viii) Metabolism – design and regulation metabolism of carbohydrates, lipids, nucleotides and amino acids.
M.SC. ZOOLOGY

THIRD SEMESTER

PRACTICAL : THIRD SEMESTER

I. Major Dissection :
   (i) Afferent Branchial Arteries of (Dogfish) Scoliodon.
   (ii) Efferent Branchial Arteries of Scoliodon
   (iii) Cranial nerves of Scoliodon.

II. Minor Dissection :
   (i) Exposure of internal ear of Scoliodon in situ.
   (ii) To takeout the Hyoid apparatus of Frog/Toad.
   (iii) To takeout the colemella auris of Frog.

III. Permanent Mounting : Protochordata
   (i) Mounting of Doliolum / Salpa / Cionia / Qikopleura.
   (ii) Preparation of slides of spicules pharyngeal wall of Herdmania
   (iii) Preparation of slides from Amphioxus – Oral – Hood / Wheel organ / Pharyngeal wall.
   (iv) Preparation of different types of feathers found in birds i.e. Filloplumes, Nestling, down etc./contour feather showing barbs.

IV. Vertebrate specimens from class Cyclostomata to class Mammalian.

V. Histological slides of various organ systems from class Cylostomata to class Mammalian.

VI. Osteology of vertebrates i.e. Amphibia, Reptilia, Aves and Mammalian:-
   (a) Axial skeleton: Skull and vertebral column.
   (b) Appendicular skeleton: girdles and limb bones.
   (c) Bird skull : study of skull to show palate types.
(d) Reptilian skulls: skulls of poisonous and non-poisonous snakes, turtle and crocodile, alligators and gavialis.
(e) Skull of dog and rabbit.
(f) Preparation of histological slides of various tissues of various classes by microtomy.

**Scheme of Zoology Practical Examination shall be as given below:-**

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<td>3. Permanent Preparation</td>
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</tr>
<tr>
<td>4. Identification &amp; Comments upon 10 spots</td>
<td>20</td>
</tr>
<tr>
<td>5. Microtomy (a) Sectioning &amp; Spreading</td>
<td>10</td>
</tr>
<tr>
<td>(b) Staining &amp; Mounting</td>
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</tr>
<tr>
<td>6. Physiology / Bio chemistry Experiment</td>
<td>10</td>
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<td>7. Viva – Voce</td>
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<td>8. Practical Records</td>
<td></td>
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</table>

Total 100

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M.Sc. Zoology

Fourth Semester (Special)

Group (A): Entomology

Paper I: Morphology & Anatomy of Insects:

1. Morphology:
   (i) Integument.
   (ii) Structure of insect head:
        (a) Orientation of insect head and siliculture.
        (b) Appendages – structure and types of antennae, types of mouth parts.
   (iii) Structure of insect thorax:
        (a) Sulci and areas of thorax.
        (b) Thorax as a locomotony organ, structure, articulation and coupling of wings.
        (c) Structure and functioning of insect legs.
   (iv) Structure of insect abdomen:
        (a) Male genitalia and their modifications.
        (b) Female ovipositor, genitalia and its modifications, substitute and oviposition.

2. Anatomy:
   (i) Digestive System:
        (a) Basic structure of digestive system including musculature.
        (b) Cardiac and Pyloric valves.
(c) Peritrophic 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 aortae.
(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) Somatogastric nervous system.

(vi) Reproductive system:
(a) Male internal reproductive organs.
(b) Female internal reproductive organs.
M.SC. ZOOLOGY

FOURTH SEMESTER (SPECIAL)

PAPER II : Physiology, Development & Ecology:

1. Insect Physiology:
   (i) Physiology of digestion.
   (ii) Physiology of excretion.
   (iii) Production and reception of sound.
   (iv) Physiology of photoreception and light production.
   (v) Insect eye & theory of mosaic vision.
   (vi) Hormones, their control and neurosecretions.

2. Development:
   (i) Structure of egg.
   (ii) Embryonic development, blast of kinesis and diagnose.
   (iii) Types of metamorphosis and significance of metamorphosis.
   (iv) Hormonal control of metamorphosis.
   (v) Ecdysis.

3. Ecology of Insects:
   (i) Abiotic factors influencing insect life, 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) Myrmecophily and Ternitophily.
M.SC. ZOOLOGY

FOURTH SEMESTER (SPECIAL)

PAPER III : Entomology: (Systematic, Structure and Applied Entomology):

1. Systematics:
   (a) Knowledge of international code of nomenclature with special references to law of priority concept of Holotype Allotype, Paratype and Lectotype.
   (b) Linean Hierarchy, Taxonomic characters, Constock needhem, nomenclature of insect wing venation.
   (c) Evolution of insects and fossil insects.
   (d) History of Entomology in India.

2. Detailed knowledge of the special structures, habit and importance of the following insect and families:
   (a) Ephemerida
   (b) Plectptera
   (c) Odonata
   (d) Embioptera
   (e) Orthoptera – Acrididae, Gryllidae, tettigoidae, locust and phase theory of locust.
   (f) Phasmida
   (g) Dermoptera
   (h) Mantoidea
   (i) Phithioptera – Anopleura and Mallophaga.
(j) Psocoptera
(k) Isoptera
(l) Thysanoptera
(m) Heteroptera – Pentatomidae, Coreidae, Pyrrhocoridae, Reduviidae, Belostomatidae, Nepidae.
(n) Homoptera: Jassidae, Aleurodidae, Aphididae and Coccidae.
(o) Coleoptera: Carabidae, Dytiscidae, Darmestidae, Hydrophilidae, Coccinellidae, Cyrambycidae, Scarabacidae, Curulionidae.
(p) Trichoptera
(q) Lepidoptera: Noctuidae, Sphingidae, Pyrrhulinae, Bombycidae, Papilionidae, Nymphalidae, piericidae.
(r) Hymenoptera: Ichneumonidae, Barconidae, Chalcidoidea, Apoidea, Formicoidea.
(s) Diptera: Psychodidae, Chuonomidae, Tabanidae, Asilidae, Syrphidae, Agronomyzaidae, Muscidae, Trypetidae, Hippoboscidae.
(t) Aphinaptera.
(u) Aptera
(v) Protura
(w) Collembola
(x) Thysaneura.

3. Applied Entomology:
   (a) Economic importance of insects.
(b) Concept of insect control by use of insecticide, concept of biological control &
   male sterility.
(c) Apiculture, sericulture and lac industry in India.
(d) Life history, damage and control of the main pests of:
   (i) Sugar Cane crop.
   (ii) Paddy Crop.
   (iii) Cotton Crop.
   (iv) Stored Grains.
(e) Insect vectors of various diseases like Malaria, Dengue, Fillariasis, Kala Azar,
   Yellow Fever, Sleeping sickness, Loa Loa, etc. transmitted to cattle and Man and
   their control measures.

**GROUP (A) ENTOMOLOGY - PRACTICAL:**

1. Anatomy of common grasshopper, cockroach, honey bee, wasp and dysdercus, mylabris,
   belestoma (Giant water Bugs).
2. dissection and mounting of:
   (i) Sting apparatus of honey bee and wasp.
   (ii) Tympanal organs of grasshoppers.
   (iii) Testes of cockroach
   (iv) Aristae of house fly.
   (v) Different types of mouthparts of insects.
   (vi) Different types of wings and antennae of insects.
   (vii) Tentorium of grasshoppers.
3. Identification and comment on insects of different orders and families.
4. Identification with the help of keys of common insects from different orders and families.
5. Study of prepared permanent slides of insects Morphology and Anatomy.

**GROUP (A) ENTOMOLOGY:**

**Scheme of Zoology Practical Examination shall be as given below:-**

<table>
<thead>
<tr>
<th>Duration: 5 Hours</th>
<th>Maximum Marks: 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Major Dissection</td>
<td>-</td>
</tr>
<tr>
<td>2. Minor dissection</td>
<td>-</td>
</tr>
<tr>
<td>3. Permanent Stained Preparation</td>
<td>-</td>
</tr>
<tr>
<td>4. Identification &amp; Comments upon 08 spots</td>
<td>-</td>
</tr>
<tr>
<td>5. Special Identification &amp; Comments with the help of key.</td>
<td>-</td>
</tr>
<tr>
<td>6. Viva – Voce</td>
<td>-</td>
</tr>
</tbody>
</table>

8. Sessional Records:

| I. Practical record book | - | 04 |
| II. Permanent Microscopic Preparation Exhibits | - | 04 |
| III. Collection as a result of field studies | - | 04 |
| 9. Field Work as mentioned in under Second Sem. | - | 25 |

| Total | 100 |
M.Sc. Zoology

Fourth Semester (Special)

Group (B) : Ichthyology & Fisheries

Paper I : Systematic and Morphology:

1. Systematic:
   (i) Classification
       (a) Evolutionary classification, merits and demerits of Berg’s classification.
       (b) Ostracoderms.
       (c) Placoderms
   (ii) Origin and Evolution of fishes:
       (a) Elasmobranches.
       (b) Bony Fishes.
   (iii) Adaptive radiation in fishes – elasmobranches and bony fishes.
   (iv) Hill Stream adaptations and Deep sea adoptions.

2. Morphology:
   (i) Integument – Scales and cotoveration.
   (ii) Fins and their origin, locomotion, electric and light producing organs.
   (iii) Nutrition – food, feeding habits, alimentary canal in relation to its physiology of digestion.
   (iv) Respiration-
(a) Structure of gills in elasmobranchs and bony fishes, gill ventilation.

(b) Fish blood as oxygen carrier.

(c) Air breathing fishes.

(d) Swim bladder & weberian ossicles.
M.SC. ZOOLOGY

FOURTH SEMESTER (SPECIAL)

PAPER II: Physiology and Embryology:

1. Physiology:
   (i) Stato – acoustic and Lateral line system, chemoreceptors, organ of sight and organ of smell.
   (ii) Osmo regulation and mechanism of water salt balance in fresh water and marine water fish.
   (iii) Circulation, Excretory and nervous system.
   (iv) Migration and Parental Care.

2. Embryology:
   (i) Reproductive system.
   (ii) Structure and kind of eggs, maturation cleavage and early embryonic development.
   (iii) Hatching and post embryonic development including fundamentals of morphogenesis.

PAPER III: Aquaculture & Fisheries Management:

1. Indian Agriculture:
   (i) Composite Prawn Culture.
   (ii) Oyster Culture :-
(a) Oyster Fishery.
(b) Sea Mussels.
(iii) Pearl Oyster Fishing
(iv) Fishery
(v) Spat Collection
(vi) Culture Methods:
  (a) raft methods
  (b) long line method
  (c) rack method
  (d) pole culture
  (e) bottom culture method
  (f) harvesting
  (g) cleaning and marketing
(vii) Net and craft of inland and marine water, electric fishing and eco sounders.
(viii) Effect of lights, temperature, turbidity, dissolved gases and solids in water.
(ix) Types of planktons & their role.
(x) Maintenance of fresh water aquarium.

2. Fisheries Management:
(i) Pond culture and its management.
(ii) Principle cultivable fishes:-
    Brief account of indigenous and exotic species.
    Procurement of seed collection, identification and transport of seed.
(iii) Induced breeding:-
    (a) Stripping.
(b) Hypophysation techniques.
(iv) Special Culture:-
   (a) Composite fish culture
   (b) Fish culture in paddy fields, sewage fish culture and integrated fish culture.
(v) Fish diseases and their control – fungal diseases, bacterial diseases, arotzoan disease induced by pollutants, prophylactic measures.
(vi) Fish preservation and processing – causes of spoilage, methods of preservation & their merits and demerits.
(vii) Fish bye products.
(viii) Fish pollution and toxicity.
(ix) Age and growth, length and weight relationship.
(x) Tagging of fish.

**GROUP (B) ICHTHYOLOGY & FISHERIES - PRACTICAL:**

1. (a) Anatomy of Scoliodon, sting ray, electric ray, Wallago and Macronis.
   (b) Accessory respiratory organs of Saccobranchus, Claries and Anabas.

2. Osteology of a fresh water teleost.

3. (a) Mounting: permanent preparation of different kinds of scales, Ampulla of Lorenzini and fish tissue (skin, muscles, TS 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 and comment on museum specimens 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 corpuscles.
   (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.

**GROUP (B) ICHTHYOLOGY & FISHERIES:**

**Scheme of Zoology Practical Examination shall be as given below:-**

<table>
<thead>
<tr>
<th>Duration: 5 Hours</th>
<th>Maximum Marks: 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Major Dissection</td>
<td>- 15</td>
</tr>
<tr>
<td>2. Minor dissection</td>
<td>- 10</td>
</tr>
<tr>
<td>3. Permanent Stained Preparation</td>
<td>- 05</td>
</tr>
<tr>
<td>4. Identification &amp; Comments upon 08 spots</td>
<td>- 16</td>
</tr>
<tr>
<td>5. Special Identification &amp; Comments with the help of Fauna and Atlas (2 Nos.)</td>
<td>- 10</td>
</tr>
<tr>
<td>6. Viva – Voce</td>
<td>- 05</td>
</tr>
<tr>
<td>8. Sessional Records:</td>
<td></td>
</tr>
<tr>
<td>I. Practical record book</td>
<td>- 04</td>
</tr>
<tr>
<td>II. Permanent Microscopic Preparation Exhibits</td>
<td>- 05</td>
</tr>
<tr>
<td>III. Collection as a result of field studies</td>
<td>- 05</td>
</tr>
<tr>
<td>9. Field Work as mentioned in Second Semester</td>
<td>- 25</td>
</tr>
</tbody>
</table>

 Total 100
M.Sc. Zoology

Fourth Semester (Special)

Group (C): Wild Life & Environmental Study

Paper I: (1) Wild Life & Ecology:

(i) Demography, Life table and generation time.
(iii) Inter and intra specific relationship – prediction models of prey, predatory dynamics, optional forging theory, patch choice, diet choice, prey selection, forging time.
(iv) Competition and niche theory – inter specific and intra specific competition, history of niche concept, theory of limiting similarities.
(vi) Population regulation – extrinsic and intrinsic mechanism.
(vii) Case studies of population dynamics.

Paper I: (2) Ecology:

(i) Ecological modelling – fundamental of constructive and testing them.
(ii) Types of eco system – nutrient cycle, food chain & food web.
(iii) Terrestrials ecology – forest and grassland ecology, desert life, Himalayan ecology, floristic regions and islands of India.
(iv) Habitat ecology – Aquatic – fresh water ecology, estuarine ecology & Oceanography.
(v) Zoogeographical regions and world biota.
M.SC. ZOOLOGY

FOURTH SEMESTER (SPECIAL)

PAPER II: Environmental Aspects of Wild Life & Biodiversity:

1. Environmental aspects of wild life:
   (i) Morphological variations and adaptations in species of Reptiles, Birds and Mammals in different ecosystems – forest, desert, hills, rivers, estuaries and oceans.
   (ii) Behaviour and breeding patterns of wild species.
   (iii) General anatomical organization and sense organs in wild species.
   (iv) Oil field pollution, drilling operation monitoring, environmental impact assessment.
   (v) Origin and evolution of reptiles, birds and mammals.
   (vi) Special features in the developmental biology of reptiles, birds and mammals.

2. Environment and Biodiversity:
   (i) Environmental hazards, destruction of habitat and extrication of species causes and preventive measures.
   (ii) Environmental planning of rural and urban development.
   (iii) Management of soil resources.
   (iv) UNESCO’s role in ecology, earth summit, SARC, ED trust fund.
   (v) Biodiversity, its significance and conservation measures.
   (vi) Role of biodiversity in species development.

PAPER III: Wild Life values and Wild Life Management:
1. Wild Life Values:

(i) Wild Life, values as tourism, aesthetical, game, ethical, commercial and scientific.

(ii) Conservation movements in India, Historical perspective, Himalayan Foot Hills and tribal Belts.

(iii) Groups of allied importance – fishes and insects.

(iv) Forestry – forest resource, erosion, deforestation and a forestation.

(v) National Parks and sanctuary in India – Concept and histories in regards to ecology.

(vi) Important Nature reserves in the world.

2. Wild Life Management:

(i) Interaction of man and nature.

(ii) Legislation, wild life protection – Act and regulation.

(iii) National Bank, Sanctuaries – Planning Management, administration and economics.

(iv) National Parks and Sanctuaries – Case Studies.

(v) Maintenance and rearing of wild species.

(vi) Environmental education, public awareness and future programmes.

(vii) Conservation movement in India.

GROUP (C) WILD LIFE & ENVIRONMENTAL STUDY - PRACTICAL:

1. Anatomy of:

(a) Toad / Frog.

(b) Lizard / Snake / Turtle.

(c) Pigeon / Parrot.
(d) Rat / Squirrel.

2. Ecological survey of National Parks and Sanctuaries.


4. Study of slides of different microscopic structure.

5. Identification of wild animal species as objects of museum and zoo and specimens of photographs.

6. Osteology of wild animals.

7. Ecological comments on wild species of different niche and habits. Candidates would be required to keep records of exercise in laboratory, field types, sanctuaries and parks of importance and collections.

**GROUP (C) WILD LIFE & ENVIRONMENTAL STUDY:**

Scheme of Zoology Practical Examination shall be as given below:-

<table>
<thead>
<tr>
<th>Duration: 5 Hours</th>
<th>Maximum Marks: 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Major Dissection</td>
<td></td>
</tr>
<tr>
<td>(i) Neck Nerves of squirrel or Rat</td>
<td>15</td>
</tr>
<tr>
<td>(ii) Cranial Nerves of frog</td>
<td></td>
</tr>
<tr>
<td>2. Minor dissection</td>
<td>10</td>
</tr>
<tr>
<td>(i) Hyoid plate or columella of frog</td>
<td></td>
</tr>
<tr>
<td>3. Permanent Stained Preparation</td>
<td>05</td>
</tr>
<tr>
<td>(i) Different kinds of feathers found in birds or foot pads of lizards or scales of snake</td>
<td></td>
</tr>
</tbody>
</table>
4. Identification & Comments upon 08 spots - 16
   based on Wild Life and Environment
5. Special Comments - 10
   (i) Wild Life
   (ii) Environment
6. Viva – Voce - 05
8. Sessional Records:
   I. Practical record book - 04
   II. Permanent Microscopic Preparation Exhibits - 05
   III. Collection as a result of field studies - 05
9. Field Work as mentioned in Second Semester - 25

Total 100
BOOKS RECOMMENDED

4. Ekman S. Zoo-geography of the Sea, Sedgwick and Jackson Ltd., London.
5. Du Beaufort – Zoogeography of the land and inland water.
28. Peter F. Hall. – Functions of Endocrine Glands.
29. E.V. Cowdry – Laboratory Techniques on Biology and Medicine.
30. H. Giese – Cell Physiology.
31. Hawk, Dser and Simon – Practical Physiology Chemistry.
32. Cele – Practical Physiology Chemistry.
33. C.L. Prosser and F. A. Brown – Comparative Animal Physiology, W.B. Sanders Co.
37. Laskin – Advance in Applied Microbiology.
38. Banwart – Basic Food Microbiology.
40. Campbell- Microbial Ecology
42. Wistreich- Microbiology.
43. Silverman- Animal Behaviour in the laboratory.
44. B.H.M.S.- Wild Animals of India.
48. E. Mayer- Elements of Taxonomy.
49. E. Mayer & Peter D. Ash lock- Principles of Systematic Zoology.
54. Gerald Karp- Cell and Molecular Biology.
55. C.L. Prosser- Comparative Animal Physiology W.B. Saunders & Co.
57. W.S. Hear- General and Comparative Animal Physiology.
58. C.L. Prosser- Environmental and Metabolic Physiology Wilax- Liss, New York.
61. B.K. Tikadar- Threatened Animals of India.
63. Lehninger’s Biochemistry- Nelson and Cox.
71. Sustad and Simmons- Principles of Genetics.
74. Kuby- Immunology, W.H. Freemauc, USA.
75. W. Paul – Fundamentals of Immunology.
85. Smith, K.G.V. – Insects and other asthropods of medical importance.