MSc ZOOLOGY
Semester II
(2020-21)
MSc Second Semester - Zoology (2020-21)

PAPER-I

GENERAL AND COMPARATIVE ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY OF VERTEBRATES

Max marks: 35

Unit I

- Respiratory pigments through different phylogenetic groups.
- Transport of oxygen and carbon dioxide in blood and other body fluids
- Regulation of respiration
- Physiology of impulse transmission through nerves and synapses
- Autonomic nervous system, Neurotransmitters and their physiological Functions

Unit II

- Excretion: Patterns of Nitrogen excretion, Urine formation and Urea Cycle.
- Comparative physiology of digestion
- Osmoregulation in different animal groups (Terrestrial & Aquatic animals)
- Thermoregulation:
  - Hypothalamic mechanism of thermoregulation.
  - Hibernation and Aestivation.
- Physiology of circulation:
  - Composition and functions of blood

Unit III

- Comparative study of Mechanoreception.
- Comparative study of Photoreception
- Comparative study of Phonoreception
- Comparative study of Chemoreception
- Comparative study of Equilibrium reception
Unit IV

- Bioluminescence as means of communication among animals
- Pheromones and other similar chemicals as means of communication among animals
- Chromatophores and regulation of their function among animals
- Hormones, their classification and chemical nature
- Mechanisms of hormone action

Unit V

- Phylogeny of endocrine glands (pituitary, thyroid, pancreas, adrenal.)
- Ontogeny of endocrine glands (Pituitary & Thyroid)
- Neuroendocrine system: Neurohypophysial axis in Insects.
- Hormone receptor, Signal transduction mechanisms
- Hormones and reproduction
  a. Seasonal breeders
  b. Continuous breeders

Suggested Reading Materials:

- R.H. Williams-Text Book of Endocrinology-W.B. Saunders
- C.R. Martin- Endocrine Physiology-Oxford University Press.
- J. Darnell, H. Lodish and D. Baltimore. Molecular Cell Biology, Scientific American Book USA
Unit I

- Populations and their characters.
- Demography: Life tables, generation time, reproductive value.
- Population growth:
  - Growth of organisms with non-overlapping generations.
  - Stochastic and time lag models of population growth.
  - Stable age distribution.
- Population interaction & Regulation.

Unit II

- Adaptations:
  - Levels of adaptations (Simple and Complex)
  - Significance of body size, Metabolism and body size, Mass specific metabolic rate, Surface hypothesis.
- Aquatic environments: Fresh water, marine, shores and estuarine environments.
- Eco-physiological adaptations to fresh water environments (Invertebrates in general and Fishes.)
- Eco-physiological adaptations to marine environments.(Marine Fishes)
- Eco-physiological adaptations to terrestrial environments.(Insect, Reptile & Birds)

Unit III

- Environmental limiting factors.
- Inter and intra-specific relationship.
- Predator- prey relationship, Predator dynamics.
- Optimal foraging theory
  (Patch choice, diet choice. Prey selectivity, and foraging time).
- Mutualism and Evolution of plant pollinator interaction.
Unit IV

- Environmental pollution and human health: Air Pollution & Solid waste pollution
- Conservation management of Natural resources: Renewable (Energy resource & Forest resource) and Non-renewable (Mineral & Soil)
- Environmental monitoring & impact assessment:
  - Biological monitoring programme
  - Biological Indicators
  - Bioremediation-Brief introduction
- Concept of Sustainable development.

Unit V

- Concept of Homeostasis; wsr to electrolyte balance
- Physiological response to oxygen deficient stress.
- Physiological response to body exercise wsr to Cardiovascular
- Meditation: Effect on Stress and body relaxation
- Yoga: Effect of Asana (Posture) on Musculoskeletal and Effect of Pranayam (Deep breathing) on ventilation.

Suggested Reading Materials:

8. Gyton, Medical Physiology
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PAPER- III
TOOLS AND TECHNIQUES IN BIOLOGY
Max marks: 35

Unit I

1. Microscopy: Principle and Applications
   - Light microscope and Phase contrast microscope
   - Fluorescence microscope
   - Electron microscope (TEM & SEM)
   - Confocal microscope
2. Colorimeter y: Principle and Applications
   - Beer and Lambert’s law.
   - Spectrophotometer
   - Flame photometer
3. Microbiological techniques
   - Media Preparation and sterilization
   - Inoculation and growth monitoring.
   - Microbial assays (Vitamins and Amino acids)
   - Microbial identification (cytological staining methods for bacterial and fungal strains)
   - Structure and Use of Fermentors.

Unit II

1. Computer aided techniques for data presentation, data analysis, and statistical techniques: (Power point Presentation and Word excel.)
2. Cryotechniques:
   - Cryopreservation of cells, tissues, organs and organisms.
   - Cryosurgery
   - Cryotomy
   - Freeze fracture and freeze drying.
   - Chromatography: Principle, Types and Application.
   - Electrophoresis: Principle, Types and Application.
     (PAGE and Agarose gel electrophoresis)
   - Ultra centrifuge: Principle & Organelle separation by centrifugation.
Unit III

1. Radioisotope and Isotope techniques in biology:
   - Sample preparation for radioactive counting and elementary idea of apparatus used.
   - Autoradiography.

2. Immunological techniques:
   - Immunodiffusion (Single & Double)
   - Immuno electrophoresis

3. Immunodetection techniques:
   - Immunocyto / histochemistry
   - Immunoblotting, immunodetection, immunofluorescence.

4. Surgical techniques.
   - Organ ablation (eg. Ovariactomy, adrenalectomy)
   - Perfusion techniques
   - Stereotaxy
   - Indwelling catheters

5. Biosensors.

Unit IV

1. Histological techniques
   - Principles of tissue fixation
   - Microtomy
   - Staining & Mounting
   - Histochemistry (proteins, carbohydrates and nucleic acids)

2. Cell culture techniques.
   - Design and functioning of tissue culture laboratory
   - Culture media, essential components and Preparation
   - Cell toxicity and Cell viability testing.
Unit V

1. Cytological techniques:
   - Mitotic and meiotic chromosome preparations from insects & vertebrates.
   - Chromosome banding techniques (G.C.Q. R. banding)
   - Flowcytometry.

2. Molecular cytological techniques:
   - In situ hybridization (radio labelled and non-radio labelled methods)
   - FISH
   - Restriction banding

3. Molecular biology techniques:
   - Southern hybridization
   - Northern hybridization
   - DNA Sequencing
   - Polymerase chain reaction (PCR)

Suggested Reading Materials:

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PAPER- IV
MOLECULAR CELL BIOLOGY AND GENETICS

Max marks: 35

Unit I
Bio membranes
- Molecular composition, arrangement and functional consequences.
- Transport across cell membrane: Diffusion, Active transport, Pumps, Uniports, Symports and Antiports
- Micro filaments and microtubules structure and dynamics
- Cell movements intracellular transport, role of kinesis and dynein

Unit II
Cell-Cell signalling
- Cell surface receptors: G-Protein, coupled receptor and their signal transduction.
- Second messenger system (cAMP, Phosphatidylinositol)
- Regulation of Blood glucose level
- Signalling from plasma membrane to nucleus
- Signal transduction – Protein Tyrosine kinase, & Insulin

Unit III
1. Cell-Cell adhesion and communication
   - Ca++ dependant homophilic cell-cell adhesion (Selectins, Integrins and cadherins)
   - Ca++ independant homophilic cell-cell adhesion (Immunoglobins)
   - Gap junctions and connexins
- Genome organization, hierarchy in organization
- Chromosomal organization of genes and non-coding DNA
3. Cot-values in relation to non-repetitive, moderately and highly repetitive DNA

Unit IV
Sex determination
- Sex determination in Drosophila
- Sex determination in mammals with special reference to TdF
- Basic concept of dosage compensation
- Cytogenetic of human chromosomes: Structure & Karyotype
- Human genome project (HGP): purpose and implications
- Transgenic and Knock out animals and their applications
Unit V

Genetic Diseases and Genomics

- Human gene therapy & General idea of genetic diseases wrt Cystic fibrosis, Thalasimia, Sickle cell anemia.
- Prenatal diagnosis & Genetic counseling
- Genetic screening (Screening of recombinants)
- Structural Genomics (Study of structure of Genome: cytological and genetic mapping of chromosomes, RFLP, Contig and STS mapping.)
- Functional Genomics. (Study of function of Genome: RNA and protein assays of genome function by a study of expressed sequence through assay hybridization and gene chips.)
- Gene libraries

Suggested Reading Materials:

- J. Darnell, H. Lodish and D. Baltimore - Molecular cell biology - Scientific American book. Inc. USA
- J.M. Barry - Molecular biology
- Philip E. Hartman- Gene Action
- L.C. Dunn- Principals of Genetics
- A.M. Winchester - Genetics
- Edgar Alterbrg - Genetics
- L.C. Dunn - Genetics and the origin of species
- Gardener- Principles of Genetics
- Karp G - Cell and Molecular Biology
- Deroberties- Cell and Molecular Biology
- Schaum,s Series- Molecular Biology
- Snustad- Principles of Genetics. 
Semester II (2020-21)

PRACTICAL I
(Based on Paper I & II)

Practical Course

- Spots related with Endocrine glands and related disorders (Slides, Models, Display Cards)
- Microtomy slide preparation and staining of various organs of any Vertebrate.
- Study of Adaptations, Inter and Intra specific relationships.
- Demonstration of Consumption of Oxygen (Respiratory rate) in any Vertebrate.
- Detection of Protein, Carbohydrate and Fat and Nitrogenous waste products (NH₃, Uric acid and Urea)

Practical Scheme

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Marks Allocated</th>
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<tbody>
<tr>
<td>Spotting</td>
<td>10</td>
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<tr>
<td>Microtomy: Preparation and Staining of slide</td>
<td>10</td>
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<tr>
<td>Exercise related to Adaptations &amp; species relationships</td>
<td>10</td>
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<tr>
<td>Demonstration of O₂ consumption</td>
<td>04</td>
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<tr>
<td>Biochemical detection in a given sample</td>
<td>06</td>
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<tr>
<td>Viva voce</td>
<td>05</td>
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<tr>
<td>Record</td>
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Total Marks : 50

Max.marks :-50     Min:-20     Time :- 4 hrs


Semester II (2020-21)

PRACTICAL II
(Based on Paper III & IV)

Practical Course

- Study of Structure, Principle and Application of analytical Instruments:
  - pH meter
  - Colorimeter
  - Spectrophotometer
  - ESR & NMR Spectrophotometer
  - Ultracentrifuge

- Separation techniques:
  Separation of Amino Acids by Chromatography technique.

- Immunological technique:
  - Study of antigen (Ag) and antibody (Ab) diffusion pattern by Ouchterlony double diffusion test.

- Cytological techniques:
  - Demonstration of Gram’s staining in Bacteria and Lactophenol staining in Fungi.
  - Study and Preparation of Mitotic (onion root tips), Meiotic (grasshopper testis) and Polytene chromosomes (in chironomous or drosophila larva).
  - Demonstration of Barr Body as sex determination.

5. Estimation technique:
   - DNA Estimation based on Colorimeter.
   - RNA Estimation based on Colorimeter.


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**Practical Scheme**

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<tr>
<td>Comments (Structure, Principle, Application) on given Analytical Instrument</td>
<td>05</td>
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<tr>
<td>Separation Immunological technique</td>
<td>10</td>
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<tr>
<td>Cytological techniques</td>
<td>10</td>
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<tr>
<td>Estimation technique</td>
<td>10</td>
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<tr>
<td>Exercise based on Pedigree Analysis</td>
<td>05</td>
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