

# Patna University

Department of Zoology



COURSES OF STUDIES

**B.Sc. ZOOLOGY**

(Three Years Degree Course)

2015



OFFICE OF THE  
DEAN OF THE FACULTY OF SCIENCE  
PATNA UNIVERSITY,  
PATNA - 800 005 (INDIA)

Ref. : D.F.Sc-290

Date : 04.08.2015

NOTIFICATION

The Board of Courses and Studies for the subject of Zoology is constituted with the following members as per decision of the meeting of the Faculty of Science held on 03.8.2015 in the Department of Chemistry:

Chairman

1. Prof. R. K. Sinha. Head of the University Department of Zoology - *ex-officio*

External Experts

1. Prof. Shashi Dhar Singh. Former Professor of Zoology, Patna University, Patna.
2. Prof. Suresh Prasad Sinha. Former Professor and Head of University Department, T. M. Bhagalpur University, Bhagalpur.

Teachers of the subject in the university

1. Sri Pashupati Nath. Associate Professor and Head of Zoology Department , B. N. College, Patna.
2. Dr. Vivekanand Mishra. Associate Professor and Head of Zoology Department, Patna Science College.
3. Dr. (Mrs.) Shahala Yasmin. Associate Professor and Head of Zoology Department, Patna Women's College.
4. Dr. Masoodul Haque. Associate Professor, Department of Zoology, Patna University.
5. Dr. Parimal Kumar Khan. Associate Professor, Department of Zoology, Patna University.
6. Dr. (Mrs.) Anupma Kumari. Sr. Assistant Professor, Department of Zoology, Patna University.
7. Dr. Gyanendra Bahadur Chand. Sr. Assistant Professor, Department of Zoology, Patna University.

Copy to

Chairman: Prof R.K. Sinha

HOD, Zoology, P.U.

  
(Dean, Faculty of science)

# PATNA UNIVERSITY, PATNA

## DEPARTMENT OF ZOOLOGY

A meeting of the Board of Courses and Studies of Zoology was held in the Department of Zoology, Patna University on ~~September~~<sup>October</sup> 9, 2015 to recommend to the Faculty of Science, the syllabi of studies for the B.Sc. courses of Patna University examination in the subject of Zoology with which the Board is concerned.

The following members were present:

- |  |                   |                                |
|--|-------------------|--------------------------------|
| 1. Prof. Ravindra Kumar Sinha  | Head and Chairman | <i>R. Sinha</i><br>9.10.15     |
| 2. Prof. Shashi Dhar Singh.<br>Former Professor of Zoology, Patna University                                 | External Expert   | <i>S. D. Singh</i>             |
| 3. Prof. Suresh Prasad Sinha<br>Former Professor and Head of Zoology<br>T.M. Bhagalpur University, Bhagalpur | External Expert   | <i>S. P. Sinha</i><br>09/10/15 |
| 4. Sri Pashupati Nath. Assoc. Professor and Head<br>Department of Zoology, B.N. College, Patna               | Member            | <i>P. Nath</i><br>9.10.15      |
| 5. Dr. Vivekanand Mishra. Assoc. Professor and Head<br>Department of Zoology, Patna Science College          | Member            | <i>V. Mishra</i><br>9.10.15    |
| 6. Dr. (Mrs.) Shahala Yasmin, Assoc. Professor and Head<br>Department of Zoology, Patna Women's College      | Member            | <i>S. H. Yasmin</i><br>9.10.15 |
| 7. Dr. Masoodul Haque. Assoc. Professor<br>Department of Zoology, Patna University                           | Member            | <i>M. Haque</i><br>9.10.15     |
| 8. Dr. Parimal Kumar Khan. Assoc. Professor<br>Department of Zoology, Patna University                       | Member            | <i>P. K. Khan</i><br>9.10.15   |
| 9. Dr. (Mrs.) Anupma Kumari. Asstt. Professor<br>Department of Zoology, Patna University                     | Member            | Anupma Kumari<br>9.10.15       |
| 10. Dr. Gyanendra Bahadur Chand. Asstt. Professor<br>Department of Zoology, Patna University                 | Member            | <i>G. B. Chand</i><br>9.10.15  |

### Three Years Honours Degree Courses

#### Theory Papers

1<sup>st</sup> Year (B.Sc.I) Paper I & II [75 Marks each]

2<sup>nd</sup> Year (B.Sc.II) Paper III & IV [75 Marks each]

3<sup>rd</sup> Year (B.Sc.III) Paper V,VI & VII [100 Marks each]

#### Two Years Subsidiary Courses

1<sup>st</sup> Year (B.Sc.I) Paper I [75 Marks each]

2<sup>nd</sup> Year (B.Sc.II) Paper II [75 Marks each]

#### Practical

1<sup>st</sup> Year (B.Sc.I) One Paper [50 Marks each]

2<sup>nd</sup> Year (B.Sc.II) One Paper [50 Marks each]

3<sup>rd</sup> Year (B.Sc.III) One Paper [100 Marks each]

#### Two Years Subsidiary Courses

1<sup>st</sup> Year (B.Sc.I) One Paper [25 Marks each]

2<sup>nd</sup> Year (B.Sc.II) One Paper [25 Marks each]

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**PAPER – I [honours]**

Time (3) three Hours: Full Marks 75

In all ten questions are to be set, out of which number 1 and 2 shall consist of objective (1 x 15 marks) and Short answer (3 x 5 marks), requiring questions respectively and both shall span over the whole syllabus. Four questions are to be set from each group. The students would be required to answer five questions of which questions numbered 1 and 2 shall be compulsory. The students shall answer not more than two questions from any group.

**Group – A**

**DIVERSITY AND EVOLUTION OF NON-CHORDATA  
PROTISTA TO PSEUDOCOELOMATES**

**Kingdom Protista**

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Plasmodium vivax*, *Trypanosoma gambiense* and *Entamoeba histolytica*; Locomotion and Reproduction in Protista

**Phylum Porifera**

General characteristics and classification up to classes; Canal system in sponges

**Phylum Cnidaria**

General characteristics and classification up to classes; Metagenesis in *Obelia*; Polymorphism in Cnidaria; Corals and coral reefs

**Phylum Ctenophora**

General characteristics and evolutionary significance

**Phylum Platyhelminthes**

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Schistosoma haematobium* and *Taenia solium* Parasitic adaptations

**Phylum Nemathelminthes**

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Ascaris lumbricoides* and *Wuchereria bancrofti* Parasitic adaptations

**Group – B**

**COELOMATE NON-CHORDATA**

**Phylum Annelida**

General characteristics and classification up to classes; Evolution of Coelom, Metamerism; Excretion in Annelida

**Phylum Arthropoda**

General characteristics and classification up to classes; Vision in Arthropoda; Respiration in Arthropoda; Moulting in insects, Metamorphosis in Insects; Social life in insects (bees and termites)

**Phylum Onychophora**

General characteristics and evolutionary significance

**Phylum Mollusca**

General characteristics and classification up to classes; Respiration in Mollusca; Torsion and detorsion in Gastropoda; Pearl formation in bivalves; Evolutionary significance of trochophore larva

**Phylum Echinodermata**

General characteristics and classification up to classes; Water-vascular system in Asterozoa; Larval forms in Echinodermata; Evolutionary significance (Affinities with Chordates)

Note: Classification to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition" Holt Saunders International Edition"

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## PAPER II [honours]

Time (3) three Hours: Full Marks 75

In all ten questions are to be set, out of which number 1 and 2 shall consist of objective (1 x 15 marks) and Short answer (3 x 5 marks), requiring questions respectively and both shall span over the whole syllabus. Four questions are to be set from each group. The students would be required to answer five questions of which questions numbered 1 and 2 shall be compulsory. The students shall answer not more than two questions from any group.

### Group – A

#### PERSPECTIVES IN ECOLOGY

##### Introduction to Ecology

Relevance of studying ecology, History of ecology, Autecology and synecology, levels of organization, Laws of limiting factors, detailed study of temperature and light as physical factors.

##### Population

Unitary and Modular populations, Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion; Exponential and logistic growth, equation and patterns, r and K strategies, Population regulation - density-dependent and independent factors; Population interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses

##### Community

Community characteristics: Dominance, diversity, species richness, abundance, stratification; Ecotone and edge effect; Ecosystem development (succession) with example; Theories pertaining to climax community

##### Ecosystem

Types of ecosystem with one example in detail, Food chain, Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies. Nutrient and biogeochemical cycle with one example of Nitrogen cycle

##### Biodiversity Conservation

Types of biodiversity, its significance, loss of biodiversity, Conservation strategies, Application of ecology in wild life conservation

### Group – B

#### PHYSIOLOGY :LIFE SUSTAINING SYSTEMS

##### Digestive System

Structural organization, histology and functions of gastrointestinal tract and its associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Role of gastrointestinal hormones on the secretion and control of enzymes of Gastrointestinal tract

##### Respiratory System

Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen in the blood oxygen- hemoglobin and myoglobin, dissociation curve and the factors influencing it Carbon monoxide poisoning; Carbon dioxide transport in the blood; buffering action of blood and haemoglobin Control of respiration

##### Excretory System

Structure of kidney and its histological details, Renal blood supply; Mechanism formation and its regulation, Regulation of acid-base balance

##### Blood

Components of blood and their functions; Structure and functions of haemoglobin; Haemopoiesis; Haemostasis and Coagulation of blood; Disorders of blood

##### Heart

An outline structure of heart; Coronary circulation; structure of conducting and working myocardial fibers. Origin and conduction of cardiac impulses functions of AV node; Cardiac cycle; Cardiac output and its regulation-Frank-Starling Law of the heart, nervous and chemical regulation of heart rate; Blood pressure and its regulation; Electrocardiogram

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**PAPER – III [honours]**

Time (3) three Hours: Full Marks 75

In all ten questions are to be set, out of which number 1 and 2 shall consist of objective (1 x 15 marks) and Short answer (3 x 5 marks) requiring questions respectively and both shall span over the whole syllabus. Four questions are to be set from each group. The students would be required to answer five questions of which questions numbered 1 and 2 shall be compulsory. The students shall answer not more than two questions from any group.

**Group – A**

**DIVERSITY AND DISTRIBUTION OF CHORDATA**

**Protochordata**

General characters of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata

**Origin of Chordates**

Dipleurula concept and the Echinoderm theory of origin of chordates

**Introduction to Vertebrata**

Advanced features of vertebrates over Protochordata

**Agnatha**

General characters and classification of cyclostomes up to class

**Pisces**

General characters of Chondrichthyes and Osteichthyes and classification up to order; Migration, Osmoregulation and Parental care in fishes

**Amphibia**

Origin of *Tetrapoda* (Evolution of terrestrial ectotherms); General characters and classification up to order; Parental care in Amphibians

**Reptilia**

General characters and classification up to order; Affinities of *Sphenodon*; Poison apparatus and Biting mechanism in snakes

**Aves**

General characters and classification up to order; Principles and aerodynamics of flight, Flight adaptations; *Archaeopteryx*-- a connecting link; Migration in birds

**Mammals**

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

**Zoogeography**

Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, Distribution of vertebrates in different realms

**Group – B**

**EVOLUTIONARY BIOLOGY**

**History of Life**

Historical Overview, Chemogeny, Biogeny, RNA World, Major Events in History of Life

**Introduction to Evolutionary Theories**

Lamarckism, Darwinism, Neo-Darwinism

**Evidences of Evolution**

Fossils as direct evidences, Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse as an example, Molecular evidences (Globin gene families as an example), Molecular clock concept

**Processes of Evolutionary Change**

Organic variations; Isolating Mechanisms; Natural selection (Examples; Industrial melanism, Pesticide/Antibiotic resistance); Types of natural selection (Directional, Stabilizing, Disruptive), Sexual Selection, Artificial selection

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**PAPER IV [honours]**

Time (3) three Hours: Full Marks 75

In all ten questions are to be set, out of which number 1 and 2 shall consist of objective (1 x 15 marks) and Short answer (3 x 5 marks) requiring questions respectively and both shall span over the whole syllabus. Four questions are to be set from each group. The students would be required to answer five questions of which questions numbered 1 and 2 shall be compulsory. The students shall answer not more than two questions from any group.

**Group – A**

**PHYSIOLOGY – CONTROLLING AND COORDINATING SYSTEM**

**Tissues and Glands**

Structure, location, function and classification of Epithelial tissue, Connective tissue Muscular tissue, Nervous tissue and glands

**Bone and cartilage**

Structure and types of bones and cartilages, Ossification, bone growth, resorption

**Nervous System**

Structure of neuron, resting membrane potential , Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; types of synapsis, Synaptic transmission and, Neuromuscular junction; Reflex action and its types -reflex arc; Physiology of hearing and vision

**Muscle**

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor Unit, summation and tetanus

**Reproductive System**

Histology of male and female reproductive systems, Puberty, Physiology of male and female reproduction; Methods of contraception (depicted through flow chart)

**Endocrine System**

Functional Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas,adrenals; hormones secreted by them and their mechanism of action, Classification of hormones; Regulation of their secretion; Mode of hormone action; Signal transduction pathways utilized by steroidal and non-steroidal hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system, Placental hormones.

**Group – B**

**COMPARATIVE ANATOMY OF VERTEBRATES**

**Integumentary System**

Structure, functions and derivatives of integument

**Skeletal System**

Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches

**Digestive System**

Alimentary canal and associated glands

**Respiratory System**

Skin, gills, lungs and air sacs; Accessory respiratory organs

**Circulatory System**

General plan of circulation, evolution of heart and aortic arches

**Urinogenital System**

Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

**Nervous System**

Comparative account of brain; Autonomic nervous system, Spinal cord, Cranial nerves in mammals

**Sense Organs**

Classification of receptors: Brief account of visual receptors, chemo-receptors and mechanoreceptors

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## Paper -V [honours]

Time (3) three Hours: Full Marks 100

In all ten questions are to be set, out of which number 1 and 2 shall consist of objective (1 x 15 marks) and Short answer (3 x 5 marks) requiring questions respectively and both shall span over the whole syllabus. Four questions are to be set from each group. The students would be required to answer five questions of which questions numbered 1 and 2 shall be compulsory. The students shall answer not more than two questions from any group.

### Group - A

#### BIOCHEMISTRY OF METABOLIC PROCESSES

##### Biomolecules

Structures and properties of important mono-, di- and polysaccharides; fatty acids, triglycerides and steroids; and amino acids

##### Carbohydrate Metabolism

Glycolysis, Citric acid cycle, pentose phosphate pathway, Gluconeogenesis, Shuttle systems (Malate-aspartate shuttle, Glycerol 3-phosphate shuttle), Glycogenolysis, Glycogenesis

##### Lipid Metabolism

$\beta$ -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis and its regulation

##### Protein Metabolism

Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids

##### Intermediary metabolism

Inter-relationship of carbohydrates, lipid and protein metabolism

##### Enzymes

Introduction, kinetics, mechanism of action, inhibition, allosteric enzymes

##### Oxidative Phosphorylation

Oxidative phosphorylation in mitochondria, Respiratory chain, ATP synthase, Inhibitors and Uncouplers

### Group - B

#### CELL BIOLOGY

##### Overview of Cells

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions

##### Plasma Membrane

various models of plasma membrane structure. Transport across membranes, Cell junctions: Occluding junctions (Tight junctions), Anchoring junctions (desmosomes), Communicating junctions (gap junctions) and Plasmodesmata

##### Endomembrane System

The Endoplasmic Reticulum, Golgi Apparatus, Mechanism of vesicular transport, Lysosomes, Polymorphism of lysosomes

##### Mitochondria and Peroxisomes

Structure of mitochondria, Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis, Semi- autonomous nature of mitochondria, endosymbiotic hypothesis, Peroxisomes

##### Cytoskeleton

Structure and functions of intermediate filament, microtubules and microfilaments

##### Nucleus

Ultra structure of nucleus, Nuclear Envelope - Structure of nuclear pore complex, Chromosomal DNA and its packaging, Structure and function of Nucleolus

##### Cell Cycle

Cell cycle, Regulation of cell cycle

##### Cell Signaling

Signaling molecules and their receptors

##### Apoptosis

Extrinsic (Death Receptor) Pathway and Intrinsic (Mitochondrial) Pathway

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**PAPER -VI [honours]**

Time (3) three Hours: Full Marks 100

In all ten questions are to be set, out of which number 1 and 2 shall consist of objective (1 x 15 marks) and Short answer (3 x 5 marks) requiring questions respectively and both shall span over the whole syllabus. Four questions are to be set from each group. The students would be required to answer five questions of which questions numbered 1 and 2 shall be compulsory. The students shall answer not more than two questions from any group.

**PRINCIPLES OF GENETICS**

**Group - A**

**Mendelian Genetics and its Extension**

Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked inheritance

**Linkage, Crossing Over and Chromosomal Mapping**

Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization

**Mutation**

Gene mutations, Chromosomal mutations: Deletion, duplication, inversion, translocation, aneuploidy and polyploidy; Induced versus spontaneous mutations; Backward and forward mutations; Suppressor mutations; Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method, DNA repair mechanisms

**Sex Determination**

Chromosomal mechanisms of sex determination; Sex-linked, sex-influenced and sex-limited characters

**Extra-chromosomal Inheritance**

Criteria for extra-chromosomal inheritance, Antibiotic resistance in *Chlamydomonas* Mitochondrial mutations and Maternal effects

**Quantitative Genetics**

Polygenic inheritance and Transgressive variation

**Group - B**

**DEVELOPMENTAL BIOLOGY**

**Introduction**

History and basic concepts: Epigenesis, preformation, Mosaic and regulative development; Discovery of induction, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division, Reliability of development: Redundancy and negative feed-back

**Early Embryonic Development**

Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization: Changes in gametes, monospermy and polyspermy; Planes and patterns of cleavage; Early development of frog and chick up to gastrulation; Fate maps; Embryonic induction and organizers

**Late Embryonic Development**

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)

**Post Embryonic Development**

Metamorphosis: Changes, hormonal regulations in amphibians; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and models

**Implications of Developmental Biology**

Teratogenesis: Teratogenic agents and their effects on embryonic development; *In vitro* fertilization, Stem cell culture, Amniocentesis

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## PAPER VII [honours]

Time (3) three Hours: Full Marks 100

In all ten questions are to be set, out of which number 1 and 2 shall consist of objective (1 x 15 marks) and Short answer (3 x 5 marks) requiring questions respectively and both shall span over the whole syllabus. Four questions are to be set from each group. The students would be required to answer five questions of which questions numbered 1 and 2 shall be compulsory. The students shall answer not more than two questions from any group.

GROUP- A

### MOLECULAR BIOLOGY

#### Nucleic Acids

Salient features of DNA double helix: Watson and Crick model of DNA, DNA denaturation and renaturation; DNA topology - linking number and DNA topo-isomerases, Cot curves, Structure of RNA, tRNA and DNA and RNA associated proteins

#### DNA Replication

DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Role of proteins and enzymes in replication, Licensing factors, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear *ds-DNA*, replication of telomeres

#### Transcription

RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors, regulation of transcription

#### Translation

Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNAsynthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

#### Post Transcriptional Modifications and Processing of Eukaryotic RNA

Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing

#### Gene Regulation

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencers elements; Gene silencing, Genetic imprinting

#### Regulatory RNAs

Ribo-switches, RNA interference, miRNA, siRNA

GROUP- B

### IMMUNOLOGY

#### Overview of Immune System

Historical perspective of Immunology, Early theories of Immunology, Haematopoiesis, Cells and organs of the Immune system

#### Innate and Adaptive ImmUnity

Anatomical barriers, Inflammation, Cell and molecules involved in innate immUnity, Adaptive immUnity (Cell mediated and humoral), Passive: Artificial and natural ImmUnity Active: Artificial and natural ImmUnity, Immune dysfunctions

#### Antigens

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes

#### Immunoglobulins

Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays, Polyclonal sera, Monoclonal antibodies, Hybridoma technology

#### Major Histocompatibility Complex

Structure and functions of endogenous and exogenous pathway of antigen presentation

#### Cytokines

Properties and functions, Cytokine-based therapies

#### Complement System

Components and pathways of complement activation

#### Hypersensitivity

Gell and Coombs' classification and Brief description of various types of hypersensitivities

#### Vaccines

Types of vaccines: Recombinant vaccines and DNA vaccines

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**PRACTICAL [B.Sc. I] [Honours]**

**Time- 3 (Three) Hours: Full Marks – 50**

Practical will include: - 1. Spotting - 10, 2. Mounting -5, 3. Practical record - 5, 4. field works -5  
5. Two Experiments - 20, and 7. viva-voce - 5.

**DIVERSITY AND EVOLUTION**

**Kingdom Protista**

1. Study of *Paramecium* W.M., Binary fission and Conjugation in *Paramecium*
2. Life stages of *Plasmodium vivax*, *Trypanosma gambiense* and *Entamoeba histolytica* (Slides/Micro-photographs)
3. Examination of pond water for protists

**Phylum Porifera**

4. Study of *Sycon* (including T.S. and L.S.), *Hyalonema*, and *Euplectella*
5. Temporary mounts of spicules, gemmules and spongin fibres

**Phylum Cnidaria**

6. Study of *Obelia*, *Physalia*, *Millepora*, *Aurelia*, Ephyra larva, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium* (including T.S. and L.S.)

**Phylum Ctenophora**

7. Any one specimen/slide

**Phylum Platyhelminthes**

8. Study of adult *Schistosoma haematobium*, *Taenia solium* and their life stages (Slides/micro-photographs)

**Phylum Nematelminthes**

9. Study of adult *Ascaris lumbricoides*, *Wuchereria bancrofti* and their life stages (Slides/micro-photographs)

**Phylum Annelida**

1. Study of *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Serpula*, *Chaetopterus*, *Pheretima*, *Hirudinaria*
2. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
3. T.S. through crop of leech

**Phylum Arthropoda**

4. Study of *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*,

**Phylum Onychophora**

5. Any one specimen/slide

**Phylum Mollusca**

6. Study of *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Ostrea*, *Mytilus*, *Loligo*, *Sepia*, *Octopus* and *Nautilus*

**Phylum Echinodermata**

7. Study of Echinoderm larvae
8. Study of *Pentaceros/Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Echinocardium*, *Cucumaria* and *Antedon*

**ECOLOGY**

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community.
3. Study of an aquatic ecosystem: fauna and flora Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO<sub>2</sub>.
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

**HISTOLOGY & PHYSIOLOGY**

1. Enumeration of red blood cells using haemocytometer
2. Estimation of haemoglobin using Sahli's haemoglobinometer
3. Preparation of haemin and haemochromogen crystals
4. Recording of blood pressure using a sphygmomanometer
5. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney

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**PRACTICAL [B.Sc.II] [Honours]**

**Time- 3 (Three) Hours: Full Marks – 50**

Practical will include: - 1. Spotting – 10, 2. Mounting -5, 3. Practical record – 5, 4. field works - 5  
5. Two Experiments – 20, and 7. viva-voce – 5.

**DIVERSITY AND DISTRIBUTION OF CHORDATA**

**Protochordata**

*Balanoglossus*, *Herdmania*, *Branchiostoma*, Colonial Urochordata Sections of *Balanoglossus* through proboscis and branchiogenital regions Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions  
Permanent slide of *Herdmania* spicules

**Agnatha**

*Petromyzon*

**Fishes**

*Sphyrna*, *Pristis*, *Torpedo*, *Chimaera*, *Notopterus*, *Mystus*, *Heteropneustes*, *Labeo*, *Exocoetus*, *Echeneis*, *Anguilla*, *Tetrodon/ Diodon*, *Anabas*, Flat fish

**Amphibia**

*Ichthyophis/Ureotyphlus*, *Necturus*, *Bufo*, *Hyla*, *Alytes*, *Salamandra*

**Reptiles**

*Chelone*, *Trionyx*, *Hemidactylus*, *Varanus*, *Uromastix*, *Chamaeleon*, *Draco*, *Ophiosaurus*, *Bungarus*, *Vipera*, *Naja*, *Hydrophis*, *Zamenis*, *Crocodylus*

Key for Identification of poisonous and non-poisonous snakes

**Aves**

Study of six common birds from different orders Types of beaks and claws

**Mammalia**

*Sorex*, Bat (Insectivorous and Frugivorous), *Funambulus*, *Loris*, *Herpestes*, *Hemiechenis*

**EVOLUTION**

1. Study of fossil evidences from plaster cast models and pictures
2. Study of homology and analogy from suitable specimens/ pictures
3. Demonstration of changing allele frequencies with and without selection
4. Construction of cladogram based on morphological characteristics
5. Construction of phylogenetic tree with bioinformatics tools (Clustal X and Phylip)
6. Interpretation of phylogenetic trees

**CONTROLLING AND COORDINATING SYSTEM**

1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
3. Examination of sections of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell,
4. Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid

**COMPARATIVE ANATOMY OF VERTEBRATES**

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, *Varanus*, Fowl, Rabbit
3. Carapace and plastron of turtle /tortoise
4. Mammalian skulls: One herbivorous and one carnivorous animal

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**SUGGESTED BOOKS**

**DIVERSITY AND DISTRIBUTION OF CHORDATA**

- 1. Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- 2. Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- 3. Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger Pub. Co.
- 4. Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc

**EVOLUTION**

- 1. Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
- 2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press
- 3. Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
- 4. Pevsner, J. (2009). *Bioinformatics and Functional Genomics*. II Edition. Wiley- Blackwell. Cummings
- 5. Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
- 6. Minkoff, E. (1983). *Evolutionary Biology*. Addison-Wesley.
- 7. Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- 8. Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- 9. Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger Pub. Co.
- 10. Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc

**CONTROLLING AND COORDINATING**

- 1. Guyton, A.C. & Hall, J.E. (2006). *Textbook of Medical Physiology*. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
- 2. Tortora, G.J. & Grabowski, S. (2006). *Principles of Anatomy & Physiology*. XI Edition John Wiley & sons
- 3. Victor P. Eroschenko. (2008). *diFiore's Atlas of Histology with Functional correlations*. XII Edition. Lippincott W. & Wilkins.
- 4. Arey, L.B. (1974). *Human Histology*. IV Edition. W.B. Saunders.
- 5. DeFiore Atlas of Human histology
- 6. Physiology Vantor

**COMPARATIVE ANATOMY OF VERTEBRATES**

- 7. Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
- 8. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
- 9. Weichert C.K and William Presch (1970). *Elements of Chordate Anatomy*, Tata McGraw Hills
- 10. Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
- 11. Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House

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## PRACTICALS [B.Sc. III] [Honours]

Time – 6 (Six) Hours: Full Marks – 100

Practical will include: - 1. Spotting – 20, 2. Mounting -5, 3. Practical record – 5, 4. field works - 5  
5. Four Experiments – 60, and 7. viva-voce – 5.

### BIOCHEMISTRY

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose)
2. Colour tests of functional groups in protein solutions.
3. Action of salivary amylase under optimum conditions
4. Effect of pH on the action of salivary amylase
5. Effect of temperature on the action of salivary amylase
6. Estimation of total protein in given solutions by Lowry's method

### CELL BIOLOGY

1. Gram's staining technique for visualization of prokaryotic cells
2. Study various stages of mitosis from permanent slides
3. Study various stages of meiosis from permanent slides.
4. Study the presence of Barr body in human female blood cells/cheek cells. (Preparation of permanent slides)

### PRINCIPLES OF GENETICS

1. To study the Mendelian laws and gene interactions and their verification by Chi-square analyses using seeds/beads/*Drosophila*.
2. Identification of various mutants of *Drosophila*
3. To calculate allelic frequencies by Hardy-Weinberg Law
4. Linkage maps based on data from *Drosophila* crosses
5. Study of human karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited traits.
7. Preparation of polytene chromosomes from *Chironomous/Drosophila* larva.
8. To study mutagenicity in *Salmonella/E. coli* by Ames test

### DEVELOPMENTAL BIOLOGY

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of developmental stages (above mentioned) by raising chick embryo in the laboratory.
4. Study of the developmental stages and life cycle of *Drosophila* from stock culture
5. Study of different types of placenta
6. Project report on *Drosophila* culture/chick embryo development

### MOLECULAR BIOLOGY

1. Study of DNA replication using Photographs or slides and special cases e.g. Polyteny using permanent slides of polytene chromosomes
2. Preparation of liquid culture medium (LB) and raise culture of *E. coli*.
3. Estimation of the growth kinetics of *E. coli* by turbidity method.
4. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking.
5. Demonstration of antibiotic sensitivity/resistance of *E. coli* to antibiotic pressure and interpretation of results.
6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement).
7. Quantitative estimation of RNA using Orcinol reaction.

### IMMUNOLOGY

1. Demonstration of lymphoid organs
2. Ouchterlony's double immuno-diffusion method
3. ABO blood group determination
4. Preparation of single cell suspension of splenocytes from chick spleen, cell counting and viability test
5. ELISA/ dot Elisa (using kit)
6. Principles, experimental set up and applications of immuno-electrophoresis, RIA, F

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## SUGGESTED READINGS

### BIOCHEMISTRY

1. Cox, M.M and Nelson, D.L. (2008). *Lehninger Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
3. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). *Harper's Illustrated Biochemistry*, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.
4. Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.

### CELL BIOLOGY

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.

### GENETICS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *Genetics- A Molecular Approach*. III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.

### DEVELOPMENTAL BIOLOGY

1. Gilbert, S. F. (2010). *Developmental Biology*, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky B. I. and Fabian B. C. (1981). *An Introduction to Embryology*, V Edition, International Thompson Computer Press.
3. Kalthoff (2008). *Analysis of Biological Development*, II Edition, McGraw-Hill Publishers.
4. Lewis Wolpert (2002). *Principles of Development*. II Edition, Oxford University Press

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## PAPER – I [Subsidiary]

Time (3) three Hours: Full Marks 75

In all ten questions are to be set, out of which number 1 and 2 shall consist of objective (1 x 15 marks) and Short answer (3 x 5 marks), requiring questions respectively and both shall span over the whole syllabus. Four questions are to be set from each group. The students would be required to answer five questions of which questions numbered 1 and 2 shall be compulsory. The students shall answer not more than two questions from any group.

### Group – A

#### Kingdom Protista

General characteristics and classification up to classes; Life cycle *Entamoeba histolytica*;

#### Phylum Porifera

General characteristics and classification up to classes; Canal system in sponges

#### Phylum Cnidaria

General characteristics and classification up to classes; Metagenesis in *Obelia*; Polymorphism in

#### Phylum Platyhelminthes

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Taenia solium*

#### Phylum Nematelminthes

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Ascaris lumbricoides*

#### Phylum Annelida

General characteristics and classification up to classes; Evolution of Coelom, Excretion in Annelida

#### Phylum Arthropoda

General characteristics and classification up to classes; Vision in Arthropoda; Respiration in Arthropoda;

#### Phylum Mollusca

General characteristics and classification up to classes; Respiration in Mollusca; Torsion and detorsion in Gastropoda; Pearl formation in bivalves

#### Phylum Echinodermata

General characteristics and classification up to classes; Water-vascular system in Asteroidea;

### Group – B

## PHYSIOLOGY :LIFE SUSTAINING SYSTEMS

### Digestive System

Structural organization, histology and functions of gastrointestinal tract and its associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins

### Respiratory System

Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen in the blood oxygen- haemoglobin and myoglobin , dissociation curve and the factors influencing it Carbon monoxide poisoning; Carbon dioxide transport in the blood

### Excretory System

Structure of kidney and its histological details, Renal blood supply; Mechanism formation and its regulation ,

### Blood

Components of blood and their functions; Structure and functions of haemoglobin

### Heart

An outline structure of heart; Coronary circulation; structure of conducting and working myocardial fibres. Origin and conduction of cardiac impulses functions of AV node; Cardiac cycle; Blood pressure and its regulation

Note: Classification to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition"  
Holt Saunders International Edition"

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**PAPER – II [Subsidiary]**

Time (3) three Hours: Full Marks 75

In all ten questions are to be set, out of which number 1 and 2 shall consist of objective (1 x 15 marks) and Short answer (3 x 5 marks) requiring questions respectively and both shall span over the whole syllabus. Four questions are to be set from each group. The students would be required to answer five questions of which questions numbered 1 and 2 shall be compulsory. The students shall answer not more than two questions from any group.

**Group – A**

**DIVERSITY AND DISTRIBUTION OF CHORDATA**

**Protochordata**

General characters of Hemichordata, Urochordata and Cephalochordata

Retrospective metamorphosis in Urochordata

**Introduction to Vertebrata**

Advanced features of vertebrates over Protochordata

**Agnatha**

General characters and classification of cyclostomes up to class

**Pisces**

General characters of Chondrichthyes and Osteichthyes and classification up to order; Migration, Osmoregulation and Parental care in fishes

**Amphibia**

Origin and Evolution; General characters and classification up to order and Parental care in Amphibians

**Reptilia**

General characters and classification up to order; Poison apparatus and Biting mechanism in snakes

**Aves**

General characters and classification up to order; Flight adaptations

**Mammals**

General characters and classification up to order; Affinities of Prototheria

**Group – B**

**PHYSIOLOGY – CONTROLLING AND COORDINATING SYSTEM**

**Tissues and Glands**

Structure, location, function and classification of Epithelial tissue, Connective tissue Muscular tissue, Nervous tissue and glands

**Bone and cartilage**

Structure and types of bones and cartilages, Ossification, bone growth, resorption

**Nervous System**

Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibres

**Muscle**

Histology of different types of muscle; Ultra structure of skeletal muscle

**Reproductive System**

Histology of male and female reproductive systems, Puberty, Physiology of male and female reproduction; Methods of contraception (depicted through flow chart)

**Endocrine System**

Functional Histology of endocrine glands - pituitary, thyroid, pancreas, adrenals; hormones secreted by them and their mechanism of action

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**PRACTICAL [B.Sc. I] [Subsidiary]**

**Time- 3 (Three) Hours: Full Marks – 50**

Practical will include: - 1. Spotting – 10, 2. Mounting -5, 3. Practical record – 5, 4. field works -5  
5. Two Experiments – 20, and 7. viva-voce – 5.

**DIVERSITY AND EVOLUTION**

**Kingdom Protista**

1. Study of *Paramecium* W.M., Binary fission and Conjugation in *Paramecium*
2. Life stages of *Plasmodium vivax*, *Trypanosma gambiense* and *Entamoeba histolytica* (Slides/Micro-photographs)
3. Examination of pond water for protists

**Phylum Porifera**

4. Study of *Sycon* (including T.S. and L.S.), *Hyalonema*, and *Euplectella*
5. Temporary mounts of spicules, gemmules and spongin fibres

**Phylum Cnidaria**

6. Study of *Obelia*, *Physalia*, *Millepora*, *Aurelia*, Ephyra larva, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium* (including T.S. and L.S.)

**Phylum Ctenophora**

7. Any one specimen/slide

**Phylum Platyhelminthes**

8. Study of adult *Schistosoma haematobium*, *Taenia solium* and their life stages (Slides/micro-photographs)

**Phylum Nemathelminthes**

9. Study of adult *Ascaris lumbricoides*, *Wuchereria bancrofti* and their life stages (Slides/micro-photographs)

**Phylum Annelida**

1. Study of *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Serpula*, *Chaetopterus*, *Pheretima*, *Hirudinaria*
2. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
3. T.S. through crop of leech

**Phylum Arthropoda**

4. Study of *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*,

**Phylum Onychophora**

5. Any one specimen/slide

**Phylum Mollusca**

6. Study of *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Ostrea*, *Mytilus*, *Loligo*, *Sepia*, *Octopus* and *Nautilus*

**Phylum Echinodermata**

7. Study of Echinoderm larvae
8. Study of *Pentaceros/Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Echinocardium*, *Cucumaria* and *Antedon*

**HISTOLOGY & PHYSIOLOGY**

1. Enumeration of red blood cells using haemocytometer
2. Estimation of haemoglobin using Sahli's haemoglobinometer
3. Preparation of haemin and haemochromogen crystals
4. Recording of blood pressure using a sphygmomanometer
5. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney

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**PRACTICAL [B.Sc.II] [Subsidiary]**

**Time- 3 (Three) Hours: Full Marks – 50**

Practical will include: - 1.Spotting – 10, 2. Mounting -5, 3.Practical record – 5, 4.field works - 5  
5. Two Eperiments – 20, and 7.viva-voce – 5.

**DIVERSITY AND DISTRIBUTION OF CHORDATA**

**Protochordata**

*Balanoglossus, Herdmania, Branchiostoma*, Colonial Urochordata Sections of *Balanoglossus* through proboscis and branchiogenital regions Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions  
Permanent slide of *Herdmania* spicules

**Agnatha**

*Petromyzon*

**Fishes**

*Sphyrna, Pristis, Torpedo, Chimaera, Notopterus, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Tetraodon/ Diodon, Anabas, Flat fish*

**Amphibia**

*Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra*

**Reptiles**

*Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Draco, Ophiosaurus, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus*

Key for Identification of poisonous and non-poisonous snakes

**Aves**

Study of six common birds from different orders Types of beaks and claws

**Mammalia**

*Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Hemiechenis*

**CONTROLLING AND COORDINATING SYSTEM**

- 1.Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
- 2.Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres
- 3.Examination of sections of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell,
- 4.Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
- 1.Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
- 2.Disarticulated skeleton of Frog, Rabbit
- 3.Carapace and plastron of turtle /tortoise
- 4.Mammalian skulls: One herbivorous and one carnivorous animal

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