

AC/4.8.18/RS 2



College of Arts,
Science &
Commerce

RISE WITH EDUCATION
Sion (West), Mumbai – 400022
(Autonomous)

Faculty: Science

Program: M.Sc.-I

Subject: ZOOLOGY

Academic Year: 2018 – 2019

**Credit Based Semester and Grading System approved
by Board of Studies in Zoology to be brought into effect
from June 2018**

M.Sc. Zoology Syllabus (Autonomous)
Semester I and Semester II
(Credit Based Semester and Grading System, with effect from academic year 2018-19)

Preamble

“Excellence is not an act, it’s a habit.”

Academic freedom is a privilege entitled with Academic Autonomy. This paradigm shift urged us for restructuring and refining the curriculum for the postgraduate section in the subject of Zoology. A clarity of the basic concepts of science is a requisite to build a strong foundation in scientific knowledge. This syllabus will offer students to acquire an in depth knowledge of the subject and also help them equip with the skills and attitudes necessary to enhance their competencies in this technological revolution.

Some topics included in this syllabus like Phylogeny and Systematics, Genetics and Evolution will help students recognize that there are common threads that connect all living organisms. The tools and techniques in Biology included in the syllabus will expose students to the vast arena of technological improvements applied to better understand the world around. The topics on Biochemistry and Metabolism, the intricate chemical reactions which sustain life, will help students appreciate the fact that the same principles/ laws govern the physical and the living worlds.

This syllabus is a collective and constructive effort of the professors of Zoology at SIES College, Sion (West) and other board members from outside the institution whose suggestions and expertise were so valuable in materializing this syllabus. The syllabus was approved by the Board of Studies (Ad hoc) in the meeting held on 16th June 2018 at the institution’s department of Zoology.

As we hope, this syllabus will inculcate an interdisciplinary approach in students and develop a mind for scientific inquiry aspiring to explore new dimensions of the subject.

*Dr. Satish Sarfare
Chairman,
Board of Studies in the subject of Zoology*

M.Sc. Zoology Syllabus (Autonomous) – Semester I
Credit Based Semester and Grading System (With effect from academic year 2018-19)

| Paper Code | Unit No. | Unit Name | Credits | Lectures/week |
|------------------|---|--|-----------|---------------|
| SIPSZO11 | 1 | Phylogeny, Systematics of Nonchordates and assorted topics - I | 4 | 1 |
| | 2 | Phylogeny, Systematics of Nonchordates, Hemichordata and assorted topics | | 1 |
| | 3 | Phylogeny, Systematics of Chordates and assorted topics - I | | 1 |
| | 4 | Comparative Vertebrate Osteology - I | | 1 |
| SIPSZO12 | 1 | Biomolecules - A structural and functional Approach - I | 4 | 1 |
| | 2 | Biochemical Thermodynamics | | 1 |
| | 3 | Metabolic Pathways and Integration of Metabolism - I | | 1 |
| | 4 | Regulation of Metabolism | | 1 |
| SIPSZO13 | 1 | Genetics - Chromosome theory of Inheritance and Mendelism - I | 4 | 1 |
| | 2 | Genetics - Extension of Mendelian Genetics and Non-Mendelian Inheritance - I | | 1 |
| | 3 | Evolution - I | | 1 |
| | 4 | Developmental Biology - I | | 1 |
| SIPSZO14 | 1 | Principles and applications of Microtomy, Microscopy and Centrifugation | 4 | 1 |
| | 2 | Principles and applications of Radioisotopes and Extraction techniques | | 1 |
| | 3 | Principles and applications of Spectroscopy | | 1 |
| | 4 | Good laboratory practices and Research Methodology - I | | 1 |
| SIPSZOP11 | Nonchordates, Chordates and their Phylogeny - I | | 2 | 4 |
| SIPSZOP12 | Biochemistry and Metabolism - I | | 2 | 4 |
| SIPSZOP13 | Genetics, Evolution and Developmental Biology - I | | 2 | 4 |
| SIPSZOP14 | Tools and Techniques in Biology - I | | 2 | 4 |
| | Total | | 24 | 32 |

M.Sc. Zoology Syllabus (Autonomous) – Semester II
Credit Based Semester and Grading System (With effect from academic year 2018-19)

| Paper Code | Unit No. | Unit Name | Credits | Lectures/week |
|-------------------|--|---|----------------|----------------------|
| SIPSO21 | 1 | Phylogeny, Systematics of Nonchordates and assorted topics - II | 4 | 1 |
| | 2 | Phylogeny of Protochordates, Agnatha and assorted topics | | 1 |
| | 3 | Phylogeny, Systematics of Chordates and assorted topics - II | | 1 |
| | 4 | Comparative Vertebrate Osteology - II | | 1 |
| SIPSO22 | 1 | Biomolecules - A structural and functional approach - II | 4 | 1 |
| | 2 | Enzymes and Enzyme kinetics | | 1 |
| | 3 | Metabolic Pathways and Integration of Metabolism - II | | 1 |
| | 4 | Inborn Errors of Metabolism | | 1 |
| SIPSO23 | 1 | Genetics - Chromosome theory of Inheritance and Mendelism - II | 4 | 1 |
| | 2 | Genetics - Extension of Mendelian Genetics and Non-Mendelian Inheritance - II | | 1 |
| | 3 | Evolution - II | | 1 |
| | 4 | Developmental Biology - II | | 1 |
| SIPSO24 | 1 | Principles and applications of Chromatography - I | 4 | 1 |
| | 2 | Principles and applications of Chromatography - II (Gel Chromatography and Affinity Chromatography) | | 1 |
| | 3 | Principles and applications of Chromatography (GC, HPTLC) and Electrophoresis | | 1 |
| | 4 | Good laboratory practices and Research Methodology - II | | 1 |
| SIPSO21 | Nonchordates, Chordates and their Phylogeny - II | | 2 | 4 |
| SIPSO22 | Biochemistry and Metabolism - II | | 2 | 4 |
| SIPSO23 | Genetics, Evolution and Developmental Biology - II | | 2 | 4 |
| SIPSO24 | Tools and Techniques in Biology - II | | 2 | 4 |
| | 3 Total | | 24 | 32 |

**M.Sc. Zoology Syllabus (Autonomous)
Credit Based Semester and Grading System
(With effect from academic year 2018-19)
Semester I – Theory**

**Paper Code: SIPSZO11
Nonchordates, Chordates and their Phylogeny - I**

Learning Objectives

- *To attempt to gain an insight of the hierarchy of life forms from the simplest to the most complex ones by a study of the levels of organization in animal kingdom. Also, to know the different modifications the animal life has made for its survival, through phylogenic and taxonomic studies.*
- *To study comparative vertebrate osteology to know about the skeletal framework found in the vertebrates; a study which can be helpful in forensic context to differentiate human bones from other vertebrates and also in archaeology.*

Unit 1: Phylogeny, Systematics of Nonchordates and assorted topics - I **15 Lectures**

1.1: Principles of Systematics, importance of taxonomic studies in Biology, use of morphometric studies, osteological studies, use of homologous organs

1.2: Taxonomic keys: Different kinds of taxonomic keys, their merits and demerits

1.3: Phylogeny, salient features, classification up to classes (wherever applicable) of the following phyla:

*1.3.1: Protista (Protozoa)

*1.3.2: Porifera

1.3.3: Coelenterata

1.3.4: Ctenophora

Unit 2: Phylogeny, Systematics of Nonchordates, Hemichordata and assorted topics **15 Lectures**

2.1: Phylogeny, salient features, classification (wherever applicable) up to classes of the following phyla:

2.1.1: Mollusca

2.1.2: Bryozoa

2.1.3: Brachiopoda

2.1.4: Echinodermata

2.1.5: Chaetognatha

2.2: Systematic position and affinities of Hemichordata

2.3: Assorted Topics

*2.3.1: Economic importance of Protozoa

*2.3.2: Mesenteries in Coelenterata

*2.3.3 Economic importance of Arthropoda

2.3.4: Sense organs in Arthropoda

2.3.5: Spines and pedicellariae in Echinodermata

*2.3.6: Invertebrate larvae: larval forms of free living invertebrates, larval forms of parasites; Strategies and evolutionary significance of larval forms

Unit 3: Phylogeny, Systematics of Chordates and assorted topics - I

15 Lectures

- 3.1:** Discovery of Coelacanth
- 3.2:** Overview of fish phylogeny
- 3.3:** Primitive tetrapods: Labyrinthodonts
- 3.4:** Crossopterigians: A blue print
- 3.5:** Dipnoi: A group that has failed to evolve as Amphibia
- 3.6:** Lissamphibia
- *3.7:** Sphenodon: a living fossil
- *3.8:** Extinct reptiles
- *3.9:** Adaptive radiation in Reptilia

Unit 4: Comparative Vertebrate Osteology - I

15 Lectures

- 4.1:** Embryonic development of:
Neurocranium, Splanchnocranium and Dermatocranium
- *4.2:** Comparative account of jaw suspension
- *4.3:** Embryonic development of vertebra
- 4.4:** Vertebral column of tetrapods: Atlas, Axis, Typical Vertebra, Thoracic vertebra, Trunk vertebra, Caudal vertebra of Dog fish and Bony fish, Frog, Varanus, Pigeon and Rabbit
- * Topics for Seminars**

Semester I – Theory
Paper Code: SIPSZO12
Biochemistry and Metabolism - I

Learning Objectives

- *To go into the details of biomolecules which form the chemical basis of life.*
- *To know about the energy transductions that occur in or between organisms through thermodynamic study.*
- *To study in detail the chemical processes that occur in living organisms that maintain life and the modes to regulate them.*

Unit 1: Biomolecules - A structural and functional approach - I

15 Lectures

1.1: Concepts

- *1.1.1: Biological macromolecules
- *1.1.2: Polymerization and macromolecules
- *1.1.3: Central role of Carbon
- *1.1.4: Common functional groups
- *1.1.5: Common ring structure and isomerization in biological molecules

1.2: Carbohydrates

- 1.2.1: Classification: Monosaccharides, oligosaccharides and polysaccharides
 - a) Monosaccharides: Structure, classification, D- and L-isomers, anomers and mutarotation, open chain and ring forms, pyranose and furanose forms, reactions of monosaccharides, glycosidic bond and nomenclature
 - b) Oligosaccharides
 - c) Polysaccharides: Homopolysaccharides and heteropolysaccharides
- *1.2.2: Biological functions of carbohydrates

1.3: Lipids

- 1.3.1: Classification: Simple and complex lipids
- *1.3.2: Fatty acids: Even and odd carbon fatty acids, numbering the carbon atoms, saturated and unsaturated fatty acids, cis- and trans-configuration, nomenclature and short hand representation of fatty acids
- 1.3.3: Acylglycerols: Monoglycerides, diglycerides and triglycerides; stereospecific numbering of glycerols in glycerides; properties of triacylglycerols
- 1.3.4: Complex lipids: Phospholipids, sphingolipids, sterols and waxes, amphipathic lipids – Membrane lipid bilayers
- 1.3.5: Biological functions of lipids

1.4: Nucleic acids (RNA and DNA)

- 1.4.1: Components: Pentose, nitrogenous bases, nucleosides, tautomeric forms of purines and pyrimidines
- 1.4.2: Structure of DNA: *Watson and Crick model; different forms of DNA double helix
- *1.4.3: Structure, types and functions of RNA

1.5: Complex biomolecules

- *1.5.1: Glycoproteins: Blood group substances

1.5.2. Glycolipids: Gangliosides

1.5.3: Lipoproteins: Classification and functions – Chylomicrons, VLDL, LDL, HDL and free fatty acid-albumin complex

Unit 2: Biochemical Thermodynamics

15 Lectures

2.1: Laws of thermodynamics, free energy, entropy, enthalpy, exergonic and endergonic reactions

***2.2:** High energy compounds: ATP, ADP, ATP-ADP cycle, ATP-AMP ratio

2.3: Biological oxidation: Electron transport chain and mitochondria; Oxidative phosphorylation – mechanism, uncoupling of oxidative phosphorylation and its significance

2.4: Free radicals, antioxidants and antioxidant system

Unit 3: Metabolic Pathways and Integration of metabolism - I

15 Lectures

3.1: Metabolism

Concept, definitions, catabolism, anabolism

3.2: Carbohydrate metabolism

*3.2.1: Glycolysis: Reaction sequence, flow of carbon, conversion of pyruvate to lactate and Acetyl coenzyme-A; significance of pyruvate-lactate interconversion; aerobic and anaerobic glycolysis; energetics of glycolysis; regulation of glycolysis

3.2.2: Gluconeogenesis: Reaction sequence from pyruvate, gluconeogenesis from amino acids, glycerol, propionate, lactate; regulation of gluconeogenesis

*3.2.3: Glycogen metabolism: Glycogenesis, Glycogenolysis; regulation of the two pathways

3.2.4: Significance of the following pathways: Hexose monophosphate shunt as a multifunctional pathway; * Uronic Acid Pathway; Glyoxalate cycle

3.3: Lipid Metabolism

3.3.1: Dynamics of body lipids, mobilization of fats, regulation of hormone sensitive TG-lipase, fate of glycerol and free fatty acids

3.3.2: Fatty acid metabolism: Oxidation of even-carbon and odd-carbon atom fatty acids, oxidation of unsaturated fatty acids, biosynthesis of fatty acids including desaturation; metabolism of phospholipids, cholesterol and *alcohol

Unit 4: Regulation of Metabolism

15 Lectures

***4.1:** Concept of homeostasis

4.2: Regulation of metabolic flux by genetic mechanisms: Control of enzyme synthesis, constitutive and inducible enzymes; *induction and repression of enzymes (lac operon and trp operon); regulatory proteins – Helix turn Helix, Zinc Fingers, Leucine Zippers

4.3: Regulation of metabolism by extracellular signals: nutrient supply, nutrient transport, endocrine control and neural control

*** Topics for Seminars**

Semester I – Theory

Paper Code: SIPSZO13 Genetics, Evolution and Developmental Biology - I

Learning Objectives

- *To uncover the rules governing the transmission of genetic traits and the relation between genes and chromosomes, through the study of classical genetics and its extension.*
- *To understand the evolutionary processes that have helped shape life on earth through a study of organic evolution; also to understand the evolutionary path our ancestors walked to attain to this present day *Homo sapiens* species.*
- *To study Developmental Biology to appreciate how embryonic cells interact ultimately to form the entire organism.*

Unit 1: Genetics - Chromosome theory of Inheritance and Mendelism - I **15 Lectures**

1.1: Mitosis and Meiosis

1.1.1: Mitosis: *Interphase and cell cycle, genetic control of cell cycle, *stages of mitosis

1.1.2: Meiosis: An overview of meiosis, first meiotic division, second meiotic division, comparison of spermatogenesis and oogenesis in animal cells

*1.1.3: Non-disjunction and its implications

1.2: Organization of Genetic material

*1.2.1: Structure of chromosomes

*1.2.2: Chromosome number, shape and types

1.2.3: Structural features of eukaryotic chromosomes: Chromatids, centromeres and telomeres; significance of telomeres; telomeres and cancer

1.2.4: Heterochromatin and euchromatin

1.2.5: *In situ* hybridization

*1.2.6: Giant chromosomes: Lampbrush and polytene chromosomes

1.2.7: Human chromosomes

1.2.8: Chromosome banding

*1.2.9: Variations in chromosome structure and chromosome number

1.3: Principles of Mendelian Genetics

*1.3.1: Mendel's first law – Segregation of alleles

*1.3.2: Mendel's second law – Independent assortment

1.3.3: Monohybrid and dihybrid crosses

1.3.4: Molecular basis of dominance (genotype, phenotype, dominance, alleles)

1.3.5: The cellular basis of segregation and independent assortment

Unit 2: Genetics - Extension of Mendelian Genetics and Non-Mendelian Inheritance - I **15 Lectures**

2.1: Alleles and Phenotypes

*2.1.1: Incomplete or partial dominance and co-dominance

*2.1.2: Epistasis

2.1.3: Complementation analysis

*2.1.4: Multiple alleles

*2.1.5: Lethal alleles (recessive and dominant)

2.1.6: Penetrance and expressivity

2.2: Quantitative Inheritance

2.2.1: Traits controlled by many loci

2.2.2: Location of polygenes

2.2.3: Heritability: Measurement of heritability

2.3: Linkage, Crossing over and Gene mapping

2.3.1: Chromosomal theory of linkage

*2.3.2: Mechanism and types of crossing over

2.3.3: Mapping in prokaryotes and bacterial viruses

2.3.4: Gene mapping in eukaryotes (Three point cross)

2.3.5: Genetic mapping in humans:

a) Physical chromosome mapping: Deletion mapping, somatic cell hybridization mapping, mapping by *in situ* hybridization; correspondence of genetic and physical maps

b) Practical application of chromosome mapping: Tracking the inheritance of an allele with coupled DNA markers

Unit 3: Evolution - I

15 Lectures

3.1: *3.1.1: Concept of evolution and theories of organic evolution: Lamarckism, Darwinism, De Vries Mutation theory, Neo-Darwinism

*3.1.2: Evolution of horse

3.1.3: Human evolution

3.2: Population and Evolutionary genetics

*3.2.1: Gene pool

3.2.2: Calculating allelic frequencies

3.2.3: The Hardy-Weinberg equilibrium and mating systems (non-random mating, assortative mating, inbreeding, dis-assortative mating)

Unit 4: Developmental Biology - I

15 Lectures

4.1: Basic concepts in Developmental Biology

4.1.1: Cell fate and commitment

4.1.2: Mechanism of developmental commitment

*4.1.3: Mosaic and regulative development

4.1.4: Pattern formation and compartments

4.1.5: Morphogenesis and cell adhesion:

a) Differential cell affinity

*b) Cadherins and catenins

*c) Sorting out of embryonic tissues and cell recognition

4.2: Cell differentiation and Totipotency

4.2.1: Nucleocytoplasmic interaction

*4.2.2: Mechanism of gene action during cell differentiation

*4.2.3: Factors affecting cellular differentiation

4.2.4: Maintenance of differentiation

*** Topics for Seminars**

Semester I – Theory

Paper Code: SIPSZO14 Tools and Techniques in Biology - I

Learning Objectives

- To deal with the tools and techniques in Biology that have helped enhance our understanding of the various aspects of Biology.
- To develop a research attitude among the students by introducing Research methodology.

Unit 1: Microtomy, Microscopy and Centrifugation

15 Lectures

1.1: Microtomy

Tissue fixation, dehydration, clearing, infiltration, embedding for paraffin method, sectioning, mounting, staining: differential and specific

1.2: Principles and applications of Microscopy

*Light microscopy, phase contrast microscopy, fluorescence microscopy, polarization microscopy, confocal scanning microscopy, transmission electron microscopy, specimen preparation for electron microscopy, scanning electron microscopy

***1.3: Principles and applications of Centrifugation**

Basic principles of centrifugation; Low speed and high speed centrifuges, ultracentrifuge; applications of centrifugation: Preparative techniques, analytical measurements; care of centrifuges and rotors

Unit 2: Radioisotopes and Extraction techniques

15 Lectures

2.1: Principles and applications of Radioisotopes

*Use of isotopes in biological sciences; units of radioactivity; detection and measurement of radioactivity by scintillation counting, autoradiography, preparation for the experiment, performing the experiment

2.2: Principles and application of Filtration, Distillation and Extraction

Ordinary filtration under suction pressure, fractional distillation, steam distillation, technique of extraction with solvents

Unit 3: Principles and applications of Spectroscopy

15 Lectures

***3.1: Ultraviolet and visible absorption spectroscopy**

3.2: Fluorescence spectroscopy

3.3: Nuclear magnetic resonance spectroscopy

3.4: Mass spectroscopy

3.5: Atomic absorption spectrophotometer

Unit 4: Good Laboratory Practices and Research Methodology - I

15 Lectures

***4.1: Safety in laboratories; use, care and maintenance of common laboratory equipments: Microscope, pH meter, colorimeter/ spectrophotometer, analytical balance, centrifuge,**

electrophoresis apparatus, glassware; general safety measures, personal protection, chemical hazards, spillage and waste disposal, first aid

4.2: Research methodology

Meaning of research; objective of research; motivation in research; types of research; research approaches; significance of research; research methods versus methodology; Research and scientific methods; Importance of knowing how research is done; Research process; Criteria for good research

4.3: Research problem and research design

Selecting a research problem, necessity of defining a problem, techniques involved in defining the problem; meaning of research design, need for research design, important concepts related to research design, different research designs, basic principles of experimental design, important experimental designs

*** Topics for Seminars**

**M.Sc. Zoology Syllabus (Autonomous)
Credit Based Semester and Grading System
(With effect from academic year 2018-19)
Semester I – Practical I (SIPSZOP11)**

Based on SIPSZO11

1. *Study of Animal type:

Sepia: Morphology, digestive system, nervous system, reproductive system; mounting of jaws, radula, statocyst and spermatophore

2. Study of Systematics and major features of:

- a) Protozoa: *Amoeba*, *Volvox*, *Noctiluca*, *Paramecium*, *Plasmodium*
- b) Porifera: *Leucosolenia*, *Grantia*, *Euplectella*, *Euspongia*
- c) Coelenterata: *Obelia* colony, *Physalia*, *Porpita*, Sea anemone, *Madrepora*, *Aurelia*
- d) Mollusca: Chiton, Dentalium, Patella, Aplysia, *Limnaea*/ *Achatina*, *Mytilus*, *Loligo*/ Octopus, *Nautilus*
- e) Echinodermata: Starfish, Brittle star, Sea urchin, Sea cucumber, Feather star
- f) Minor Phyla: Comb jelly, *Lingula*, *Sagitta*
- g) Hemichordata: *Balanoglossus*

3. Study of accessory respiratory organs in *Anabas*, *Clarias*, *Saccobranchus* and *Boleophthalmus*.

4. Study of larval forms: Echinoderm larvae and Tornaria larva

5. Study of Systematics and major features of:

- a) Cephalochordata: *Amphioxus*
- b) Agnatha: *Petromyzon*, *Myxine*
- c) Pisces: Shark, Sting ray, Electric ray, Hippocampus, Eel and any lung fish
- d) Amphibia: *Caecilian*, Salamander, Frog, Toad
- e) Reptilia: Turtle/ Terrapin, Tortoise, *Calotes*/ Chameleon, *Draco*, Phrynosoma, Viper, Rattle snake, *Hydrophis*, Crocodile/Alligator/ Gharial

*6. Mounting of spicules of Holothurian.

7. Comparative Osteology:

Types of vertebrae: Procoelous, Opisthocoelous, Amphicoelous and Heterocoelous

Note: *Demonstration practical/ Dissection/ Virtual dissection/ Model (2D or 3D)/ Chart of the animal system as per UGC guidelines.

Semester I – Practical II (SIPSZOP12)

Based on SIPSZO12

1. Qualitative tests for carbohydrates and identification of the nature of carbohydrates in the given sample:

Molisch's test, Anthrone test, Iodine test, Barfoed's test, Seliwanoff's test, Fehling's test, Benedict's test, Picric acid test, Mucic acid test, and Bial's test.

2. Determination of glucose by Benedict's (volumetric) method.

3. Determination of reducing sugars by 3,5-dinitrosalicylic acid (colorimetric) method.

4. Estimation of glycogen in the given tissue (liver/ skeletal muscle/ kidney/ brain).

5. Acid and enzyme hydrolysis of glycogen and colorimetric estimation of the products by 3,5-DNSA method.

6. Isolation of starch from potato.

7. Determination of acid value of fats/ oils.

8. Determination of saponification value of fats/ oils.

9. Reichert-Meissl (RM) number of fat.

Semester I –Practical III (SIPSZOP13)

Based on SIPSZO13

1. Temporary squash preparation of onion/ garlic root tip cells to study stages of mitosis.
2. Temporary squash preparation of testis of cockroach/ grasshopper/ *Tradescantia* pollen to study stages of meiosis.
3. Demonstration of inter-chromosomal connections in the cells of *Tradescantia* buds.
4. Temporary preparation of polytene chromosomes from salivary gland cells of *Drosophila*/ Chironomus larva.
5. Study of chromosome structures in human karyotype.
6. Study of different types of chromosome banding techniques.
7. Temporary preparation of buccal smear to study sex chromatin in human.

Semester I – Practical IV (SIPSZOP14)

Based on SIPSZO14

1. Identification of pictograms, symbols and signs of safety in laboratory.
2. Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation, sectioning, staining.
3. Solutions and Buffers:
 - a) Mode of expressing concentration of solutions: Molarity (M), molality (M), normality (N), Mass concentration, mass fraction, mass percentage or % (w/w), % by volume (v/v), parts per million (ppm) (explain with practical exercises).
 - b) Types of solutions: Stock solutions (explain with practical exercises).
4. Preparation of buffers of different pH using Henderson-Hasselbalch equation and its verification using pH meter.
5. Determination of pKa of a weak acid.
6. Colorimeter: Selection of filter and determination of unknown concentration of solute.

**M.Sc. Zoology Syllabus (Autonomous)
Credit Based Semester and Grading System
(With effect from academic year 2018-19)
Semester II – Theory**

**Paper Code: SIPSZO21
Nonchordates, Chordates and their Phylogeny - II**

Learning Objectives

- *To attempt to gain an insight of the hierarchy of life forms from the simplest to the most complex ones by a study of the levels of organization in animal kingdom. Also, to know the different modifications the animal life has made for its survival, through phylogenic and taxonomic study.*
- *To study comparative vertebrate osteology to know about the skeletal framework found in the vertebrates; a study which can be helpful in forensic context to differentiate human bones from other vertebrates and also in archaeology.*

Unit 1: Phylogeny, Systematics of Nonchordates and assorted topic - II 15 Lectures

1.1: Platyhelminthes and Nematelminthes

1.2: Acanthocephala

***1.3:** Annelida

***1.4:** Sipunculoidea

1.5: Arthropoda

1.6: Onychophora: Peripatus, a connecting link between Annelida and Arthropoda

Unit 2: Phylogeny of Protochordates, Agnatha and assorted topics - II 15 Lectures

***2.1:** Urochordata and its affinities

***2.2:** Cephalochordata and its affinities

2.3: Vertebrate ancestry and origin of vertebrates

2.4: Changes leading to first vertebrates

2.5: Salient features and phylogeny of Ostracoderms

***2.6:** Affinities of Cyclostomes:

a) Resemblance with Cephalochordates

b) Differences from fishes

c) Vertebrate characters

d) Specialized characters

Unit 3: Phylogeny, Systematics of Chordates and assorted topics - II 15 Lectures

3.1: Warm blooded reptiles; Archaeopteryx: A connecting link between Reptiles and Aves

3.2: Affinities of Aves and classification up to subclass

3.3: Origin of flight: Theory of cursorial and arboreal origin

***3.4:** Birds as glorified reptiles

***3.5:** Egg laying mammals: A connecting link between reptiles and mammals

***3.6:** Classification of mammals up to orders

***3.7:** Dentition in mammals

3.8: Walking gait: Plantigrade, Digitigrade and Unguligrade

Unit 4: Comparative Vertebrate Osteology - II

15 Lectures

4.1: Pectoral and pelvic girdles of Dog fish, Bony fish, Frog, Varanus, Pigeon and Rabbit

4.2: Comparative anatomy of limbs of tetrapods

***4.3:** Mechanism of support and movements: Running, jumping and digging

*** Topics for Seminars**

Semester II – Theory

Paper Code: SIPSZO22 Biochemistry and Metabolism - II

Learning Objectives

- *To go into the details of biomolecules which form the chemical basis of life.*
- *To study enzymes, the catalysts found in living organisms.*
- *To study in detail the chemical processes that occur in living organisms that maintain life and the modes to regulate them.*
- *To learn about the inadequacies of the metabolic machinery due to defects at the genetic level.*

Unit 1: Biomolecules - A structural and functional approach - II

15 Lectures

1.1: Proteins as polymers of amino acids

*1.1.1: Amino acids: Structure, classification based on structure, polarity, nutritional requirement and metabolic fate, properties of amino acids, derivatives of amino acids, non-transcribed amino acids as protein constituents, D-amino acids

1.1.2: Organization of protein structure: Primary structure and peptide bond, secondary, tertiary and quaternary structure; conjugate proteins: Haemoglobin, cytochromes, myoglobin; bonds involved in protein organization

1.1.3: Properties of proteins: Classification, denaturation and protein folding

1.1.4: Biological functions of proteins: Biologically important peptides: Glutathione, octa-, nona-, and deca-peptides

Unit 2: Enzymes and Enzyme kinetics

15 Lectures

*2.1: Enzymes: Nomenclature and classification with numerical code; chemical nature of enzymes

*2.2: Mechanism of enzyme action: Fischer's Lock and Key Theory, Koshland's Induced fit model; Mechanism of enzyme catalysis

2.3: Enzyme kinetics: Michaelis-Menten equation; Lineweaver-Burk plot; significance of V_{max} and K_m ; factors affecting enzyme activity; enzyme activation and inhibition

2.4: Regulatory enzymes: Covalently modulated; allosteric regulation; Isoenzymes (LDH, CK, ALP, ADH)

2.5: Non-protein enzymes: Ribozymes

2.6: Advanced enzymes in human healthcare, e.g. fungal lactase, hemicellulase, trypsin chymotrypsin mix

Unit 3: Metabolic Pathways and Integration of metabolism - II

15 Lectures

3.1: Protein Metabolism

3.1.1: Metabolism of amino acids: Amino acid pool, transamination, oxidative and non-oxidative

deamination; metabolism of branched chain amino acids; fate of carbon skeleton of amino acids

*3.1.2: Metabolism of ammonia: Urea cycle

3.2: Metabolism of Nucleic acids

3.2.1: Synthesis of ribonucleotides: A brief idea of *de novo* pathway and salvation pathway

*3.2.2. Conversion of ribonucleotides to deoxyribonucleotides

3.2.3: Degradation of nucleotides

3.3: Integration of Metabolism

3.3.1: Energy demand and supply; integration of major metabolic pathways of energy metabolism

3.3.2: Intermediary metabolism; organ specialization and metabolic integration

3.3.3: Metabolism in starvation

Unit 4: Regulation of Metabolism and Inborn Errors of Metabolism

15 Lectures

4.1: Inborn errors of metabolism

4.1.1: Carbohydrate metabolism: Glycogen storage disease,* G-6-PD deficiency

4.1.2: Lipid metabolism: Metabolic disorders of cerebrosides

4.1.3: Protein metabolism: PKU, Albinism, Cystinuria

4.1.4: Purine metabolism: Primary Gout

4.2: Mineral metabolism and diseases: Hypocalcemia, Hypercalcemia and osteoporosis

*** Topics for Seminars**

Semester II – Theory

Paper Code: SIPSZO23 Genetics, Evolution and Developmental Biology - II

Learning Objectives

- To uncover the rules governing the transmission of genetic traits through the study of classical genetics applying statistics.
- To study the concept of sex determination in different animals.
- To understand the evolutionary processes that change the structure of natural populations over time.
- To study Developmental Biology and its aspects: Metamorphosis, Regeneration and Aging.

Unit 1: Genetics - Chromosome theory of Inheritance and Mendelism - II

15 Lectures

1.1: Mendelian genetics, Probability and Statistics

1.1.1: Combining probabilities (sum rule and product rule)

1.1.2: Chi square test

1.2: Modern Concept of Gene

*1.2.1: Difference between prokaryotic and eukaryotic gene structure

1.2.2: Properties of genes, gene-enzyme relationship

1.2.3: One gene-one enzyme hypothesis, one gene-one polypeptide concept

1.2.4: Fine structure of gene; cistron, recon and muton

1.2.5: Split gene: exon and intron

1.2.6: Mobile genes and transposons

1.2.7: Pseudoalleles

Unit 2: Genetics - Extension of Mendelian Genetics and Non-Mendelian Inheritance - II

15 Lectures

2.1: Determination of sex

*2.1.1: Environmental control of sex (*Bonellia*, *Crepidula*); temperature dependent sex determination (TSD) in reptiles

2.1.2: Genic control of sex determination in Maize, *Caenorhabditis elegans*

*2.1.3: XX-XO, XX-XY and ZZ-ZW method of sex determination

2.1.4: Genic balance theory of sex determination in *Drosophila*

2.1.5: Gynandromorphs in *Drosophila*

2.1.6: Haplodiploidy in honey bees

2.1.7: Sex chromatin, Lyon hypothesis, X inactivation

2.1.8: SRY and Dax genes

*2.1.9: XX males and XY females in human

2.2: Non-Mendelian Inheritance

*2.2.1: Maternal effects; Shell coiling in snails, pigmentation in moths

2.2.2: Cytoplasmic inheritance: Mitochondria, chloroplasts, plasmids, infective particles

Unit 3: Evolution - II

15 Lectures

*3.1: Additive gene action and continuous variation

3.2: Heterosis and inbreeding depression: Measuring inbreeding; effects of inbreeding

3.3: Processes that change allelic frequencies: Mutation, migration, natural selection, directional selection, stabilizing and disruptive selection, heterozygote advantage; balance between selection and mutation; genetic drift – random genetic drift

3.4: Environmental variation: Causes of environmental variation; genotype by environmental interaction

3.5: Broad sense heritability:

- a) Effect of dominance, epistasis and environmental variations on selection
- b) Quantitative trait loci and DNA markers
- c) Realized heritability

3.6: Limits on selection

Unit 4: Developmental Biology - II

15 Lectures

4.1: Cell specialization: RBC, secretory cell, retinal rod cell

4.2: Organizer and its role in embryonic development

4.3: Primary embryonic induction

4.4: Metamorphosis, Regeneration and Aging:

4.4.1: Metamorphosis:

- *a) Amphibian metamorphosis
- b) Metamorphosis in insects – Types of insect metamorphosis; eversion and differentiation of imaginal discs; hormonal control of insect metamorphosis
- c) Programmed cell death

*4.4.2: Regeneration: Regeneration in Hydra; regeneration of salamander limbs

*4.4.3: Aging: Senescence, life span and causes of aging

*** Topics for Seminars**

Semester II – Theory

Paper Code: SIPSZO24 Tools and Techniques in Biology - II

Learning Objectives

- To deal with the tools and techniques in Biology that have helped enhance our understanding of the various aspects of Biology.
- To develop a research attitude among the students by introducing Research methodology and to learn about how to write and present a research proposal in a scientific way.

Unit 1: Principles and applications of Chromatography - I

15 Lectures

***1.1:** Planar chromatography (Paper and Thin layer):

Preparation of stationary support, solvent, detection and measurement of components, applications

1.2: Column chromatography:

Packing and operation of column, loading the column, eluting the column, collection of eluent, detection of eluent, applications

1.3: Ion exchange chromatography:

Ion exchange resins, selection of ion exchanger, choice of buffers, preparation and use of ion exchangers, storage of resins

Unit 2: Principles and applications of Chromatography - II

15 Lectures

2.1: Gel chromatography:

*Theory of gel filtration, physical characteristics of gel chromatography, chemical properties of gel, selection of gel, gel preparation and storage, operation of gel column, applications

2.2: Affinity chromatography:

Chromatography media, immobilized ligands, attachment of ligands to the matrix, experimental procedures and applications

Unit 3: Principles and applications of Chromatography and Electrophoresis

15 Lectures

3.1: Gas chromatography:

3.1.1: Gas chromatography (GC): Instrumentation, selection of operating conditions, analysis of data and applications

3.1.2: HPLC

3.2: Electrophoresis:

*3.2.1: Theory of electrophoresis

*3.2.2: Horizontal agarose gel electrophoresis

*3.2.3: Vertical polyacrylamide gel electrophoresis

3.2.4: Pulse field electrophoresis

3.2.5: Capillary electrophoresis

3.2.6: Isoelectric focusing of proteins

3.2.7: Two-dimensional electrophoresis

Unit 4: Good Laboratory Practices and Research Methodology - II

15 Lectures

4.1: Interpretation and report writing

4.1.1: Meaning of interpretation, technique of interpretation, precautions in interpretation

4.1.2: Significance of report writing, layout of research report, types of reports, precautions for writing a research report

*4.1.3: Presentation of research work: Oral, poster and writing a research paper

4.2: Review of related literature:

Understanding the role of review; how to begin a search for related literature: Library reference, recording and indexing, classification of references, internet sites for biological references; downloading the information through internet; requests for reprints through e-mail and post; classification and filing of reprints

4.3: Writing a research proposal:

Characteristics of a proposal, content and organization of a proposal, weakness in proposal seeking funding

*** Topics for Seminars**

M.Sc. Zoology Syllabus (Autonomous)
Credit Based Semester and Grading System
(With effect from academic year 2018-19)
Semester II – Practical I (SIPSZOP21)

Based on SIPSZO21

1. *Study of Animal type:

Periplaneta americana: Morphology, digestive system, nervous system, reproductive system and life history; mountings of cornea, salivary glands, gonapophyses and spermatheca.

2. Study of Systematics and major features of:

a) Helminthes: *Planaria*, Liverfluke, Tapeworm, *Ascaris*, *Trichinella*

b) Annelida: *Nereis*, Earthworm, Leech

c) Sipunculoidea: *Sipunculus*

d) Arthropoda: Lobster, *Balanus*, Crab, *Lepas*, Scorpion, Spider, *Limulus*, Centipede, Millipede, Beetle

e) Urochordata: Simple Ascidian, *Salpa/ Doliolum*

f) Cephalochordata: *Amphioxus*

3. Study of larval forms: Larvae of Helminthes (Miracidium, Redia, Cercaria, Metacercaria); Trochophore; Crustacean larvae; Ascidian tadpole

4. Study of Systematics and major features of:

a) Aves: Ostrich, Kiwi, Kite, Owl, Duck

b) Mammals: Duck-billed platypus, Echidna, Kangaroo, Shrew, Bat, Loris, Seal/ Walrus, Dolphin, Sea Cow, Tiger, Giant panda, Tapir, Camel, Striped squirrel, Guinea pig, Porcupine, Rabbit

5. Comparative Osteology:

a) Study of pectoral and pelvic girdles of Shark, Bony fish, Frog, Varanus, Pigeon, Rabbit

b) Study of comparative anatomy of tetrapod limbs (Frog, Varanus, Pigeon, Rabbit)

Note: *Demonstration practical/ Dissection/ Virtual dissection/ Model (2D or 3D)/ Chart of animal system as per UGC guidelines.

Semester II – Practical II (SIPSZOP22)

Based on SIPSZO22

1. Determination of total cholesterol and HDL cholesterol from serum.
2. Qualitative tests for amino acids and proteins:
Ninhydrin test, Xanthoproteic test, Millon's test, Biuret test
3. Colorimetric estimation of proteins by Peterson-Lowry method.
4. Quantitative estimation of amino acids using Ninhydrin reagent.
5. Isolation of casein from milk.
6. Detection of conformation of BSA by viscosity measurement and effect of varying concentration of urea on viscosity of BSA.
7. Determination of creatinine in serum and urea.
8. Determination of SDH specific activity.

Semester II –Practical III (SIPSZOP23)

Based on SIPSZO23

1. Problems in genetics.
2. Pedigree analysis.
3. Quantitative estimation of DNA from a suitable tissue by Diphenylamine method.
4. Quantitative estimation of RNA from a suitable tissue by Orcinol method.
5. Observation of morphogenetic movements in chick embryo.
6. Isolation of limb bud and its chorio-allantoic grafting.

Semester II – Practical IV (SIPSZOP24)

Based on SIPSZO24

1. Identification of lipids in a given sample by TLC.
2. Separation of pigments from leaves or flowers by adsorption column chromatography.
3. Separation of amino acids by ion exchange chromatography using cation exchanger.
4. Separation and identification of amino acids by two dimensional paper chromatography.
5. SDS-polyacrylamide slab gel electrophoresis of proteins.

**M.Sc. Zoology Syllabus (Autonomous)
Credit Based Semester and Grading System
(With effect from academic year 2018-19)
Semester I and Semester II**

REFERENCES

SIPSO11 and SIPSO21

- Vertebrate comparative anatomy, Function, Evolution, K.V. Kardong, 3rd Ed. Tata McGraw Hill Publication
- Vertebrate Life: F.H.Pough, C.M.Janis, J.B.Heiser, 6th Ed. Pearson Education
- Functional Anatomy of Vertebrates. An evolutionary perspective. K.F.Liem, W.E.Bemis, W, F.Walker, L.Grande, 3rd Ed. Harcourt College Publishers
- The Life of Vertebrates: J.Z.Young, ELBS-Oxford Univ. Press
- A Text Book of Zoology; T.J.Parkar and W.A.Haswell, McMillan
- Chordate Zoology; E.L.Jordan and P.S.Verma, S. Chand & Company
- Biology of Invertebrates; J.A.Pechenik, 4th Ed, Tata McGraw Hill Publication
- Invertebrate Zoology; E.L.Jordan and P.S.Verma, S. Chand & Company
- Analysis of Vertebrate Structure: Milton Hildebrand, Wiley International
- Life of Invertebrates; Russell, W.D. Hunter, McMillan
- Invertebrate Zoology: Bares, R.D., Saunders Publication

SIPSO12 and SIPSO22

- Biochemistry- 2nd Ed. 2002 by U. Satyanarayan, Books and Allied Publ.
- Biochemistry- 2nd Ed. S.C. Rastogi, Tata McGraw Hill
- Fundamentals of Biochemistry- 3rd Ed. 1988; J.I.Jain, S. Chand and Co. Publ.
- Biochemistry- a Functional Approach; MacGuilver
- www.enzymesIndia.com

SIPSO13 and SIPSO23

- Genetics; Daniel J. Fairbanks and W.R. Anderson. Wadsworth Publ.
- Prin. Of Genetics; Robert H. Tamarin; 7th Ed. Tata McGraw Hill
- Basic Human Genetics; Elaine Johansen Mange and Arthur Mange; Indian Reprint; 1997; Rastogi Publ.
- Genes and Evolution: A.P. Jha; MacMillon India
- Concepts of Genetics; William S. Kluge;, M.R.Cummings, Pearson Edu.
- Developmental Biology; Scott F. Gilbert, Sinauer Associates Inc.
- Developmental Biology; T. Subramanian, Narosa Publ.
- Biology of Developing System; Philip Grant; Holt Saunders International Ed.
- Evolution; M. W. Strikberger, CBS Publ.
- Cytology and Genetics; Sumitra Sen and Dipak Kumar Kar, Narosa Publ.
- Instant Notes- Developmental Biology; R.M. Twyman, Bios. Scientific Pub. Ltd.

SIPSO14 and SIPSO24

- Modern Experimental Biochemistry; 3rd Ed. Rodney Boyer, Pearson Education
- Principles and Techniques of Practical Biochemistry. Wilson and Walker, Cambridge Univ. Press
- Biological Science; 3rd Ed. D.J. Taylor, N.P.O. Green, G.W. Stou, Cambridge Univ. Press
- Cell and Molecular Biology- Concepts and Experiments, Gerald Karp. John Wiley & Co.
- Introductory Practical Biochemistry; S.K. Swahney, Randhir Sing. Narosa Publ.
- An Introduction to Practical Biochemistry; 3rd Ed. David Plummer. Tata McGraw Hill
- Practical Research Planning and Design; 2nd Ed. Paul D. Leedy. Macmillan Publ.
- Elementary Practical Organic Chemistry Part I: Small Scale Preparations. 2nd Ed. Arthur I. Vogel. CBS Publ. and Distributors
- Research Methodology: Methods and Techniques; C.R. Kothari; Wiley Eastern Ltd. Mumbai

Practical Examination Question Paper Pattern

Semester I – Practical I (SIPSZOP11)

Based on SIPSZO11

Time: 5 hours

Marks: 50

Q.1 *Dissect Sepia so as to expose its digestive system/ reproductive system/ nervous system. **14**

Q.2 *Make temporary preparation/ mounting (stain if necessary) of:
Sepia: Jaws/ Radula/ Spermatophore/ Statocyst. **08**

OR

Q.2* Spicules of Holothurian.

Q.3 Identify specimen/ slide **a, b, c, d** as per instructions. **16**

Q.4 Identify specimen/ slide **e, f** as per instructions. **08**

Q.5 Identify specimen/ slide **g** as per instructions. **04**

(* Demonstration/ Dissection/ Virtual dissection/ Model (2D or 3D)/ Chart of animal system as per UGC guidelines.)

Semester I – Practical II (SIPSZOP12)
Based on SIPSZO12

Time: 5 hours

Marks: 50

Q.1 Estimate the yield of glycogen from skeletal muscles/ liver. Submit a report. **25**

OR

Q.1 Demonstrate the enzymatic/ acid hydrolysis of glycogen from the given sample. Submit a report of the results obtained. **25**

OR

Q.1 Identify the nature of carbohydrates in the given sample using qualitative tests (6 tests). **25**

Q.2 From the given material isolate starch and estimate the yield. Submit a report of the results obtained. **25**

OR

Q.2 Estimate the amount of glucose by Benedict's volumetric method. Submit a report of the results obtained. **25**

OR

Q.2 Determine the amount of reducing sugars from the given sample by DNSA method. Submit a report of the results obtained. **25**

OR

Q.2 Determine the Saponification Value/ Acid Value/ Reichert-Meissl (RM) number of the given sample of lipid. Submit a report of the results obtained. **25**

Semester I – Practical III (SIPSZOP13)
Based on SIPSZO13

Time: 5 hours

Marks: 50

Q.1 Make a temporary squash preparation of testis of cockroach/ grasshopper/ *Tradescantia* young anther to study stages of meiosis. **20**

OR

Q.1 Make a temporary preparation of polytene chromosomes from salivary gland cells of *Drosophila*/ Chironomus larva. **20**

Q.2 Make a temporary squash preparation of onion/ garlic root tip cells to study stages of mitosis. **18**

OR

Q.2 Make a temporary preparation of buccal smear to study sex chromatin in human. **18**

Q.3 Make a Karyotype analysis from the given printed material and comment on the numerical and/ or structural variations in chromosomes. **12**

OR

Q.3 Identify and describe different types of chromosome banding techniques. **12**

Semester I – Practical IV (SIPSZOP14)
Based on SIPSZO14

Time: 5 hours

Marks: 50

Q.1 Demonstrate the relationship between absorbance of light and concentration of the dye in the given solution using different wavelengths for five dilutions. Tabulate the readings. Plot the absorbance curves on the same graph paper and explain the choice of ideal filter from your results. **20**

OR

Q.1 Determine the pKa of the given weak acid. **20**

Q.2 Using Henderson-Hasselbalch equation calculate the pH of buffer prepared by mixing known volume of either acid and/ or salt solutions. Check pH using pH meter. **16**

OR

Q.2 (A) Identify the pictograms/ signs/ symbols **a** and **b** and comment on their significance in a laboratory. **08**

(B) Prepare a solution of given molarity/ normality. **08**

Q.3 From the infiltrated tissue prepare a block, trim and mount it on the holder for section cutting. **14**

Q.3 Trim the given block, mount it on the block holder, cut the sections and from ribbons prepare slides. **14**

OR

Q.3 Dewax the mounted ribbons and stain the sections with haematoxylin/ eosin. **14**

Practical Examination Question Paper Pattern

**Semester II – Practical I (SIPSZOP21)
Based on SIPSZO21**

Time: 5 hours

Marks: 50

- Q.1** *Dissect Cockroach so as to expose its digestive system/ reproductive system/
nervous system. **14**
- Q.2** *Make temporary preparation/ mounting (stain if necessary) of:
Cockroach: Cornea/ Salivary glands/ Gonapophyses/ Spermatheca. **08**
- Q.3** Identify specimen/ slide **a, b, c, d** as per instructions. **16**
- Q.4** Identify specimen/ slide **e** and **f** as per instructions. **08**
- Q.5** Identify specimen **g** as per instructions. **04**

(*Demonstration/ Dissection/ Virtual dissection/ Model (2D or 3D)/ Chart of animal system as per UGC guidelines.)

Semester II – Practical II (SIPSZOP22)
Based on SIPSZO22

Time: 5 hours

Marks: 50

Q.1 Estimate the protein content of the given tissue homogenate by Peterson-Lowry method. Submit a report of the results obtained. **28**

OR

Q.1 Estimate the amino acid content of the given sample by Ninhydrin reagent. Prepare a standard graph. Submit a report of the results obtained. **28**

OR

Q.1 Demonstrate the effect of inhibitor on Succinic Dehydrogenase activity. Submit a report of the results obtained. **28**

OR

Q.1 Demonstrate the effect of variation in Urea concentration on the conformation of Protein by viscosity measurements. Submit a report of the results obtained. **28**

OR

Q.1 Estimate the concentration of Creatinine in the given serum/ urine sample. Submit a report of the results obtained. **28**

Q.2 Isolate Casein from the given sample of milk and determine its yield. Submit a report of the results obtained. **22**

OR

Q.2 Determine Total /HDL Cholesterol from the given serum sample. Submit a report of the results obtained. **22**

OR

Q.2 Detect proteins /amino acids in the given sample by qualitative tests (4 tests). Submit a report of the results obtained. **22**

Semester II – Practical III (SIPSZOP23)
Based on SIPSZO23

Time: 5 hours

Marks: 50

Q.1 Extract and quantitatively estimate the amount of DNA/ RNA from the given tissue homogenate. **20**

Q.2 Demonstrate the morphogenetic movements in chick embryo and isolate limb bud from the given chick embryo. **14**

OR

Q.2 Isolate limb bud from the given chick embryo and demonstrate the chorio-allantoic grafting from the given chick embryo. **14**

Q.3 (A) Solve the given problem on Genetics. **08**

(B) Solve the given problem on Pedigree analysis. **08**

Semester II – Practical IV (SIPSZOP24)
Based on SIPSZO24

Time: 5 hours

Marks: 50

Q.1 Demonstrate the technique of two-dimensional paper chromatography to separate the amino acids. Calculate R_f value. **30**

OR

Q.1 Demonstrate the use of adsorption column chromatography to separate the pigments from leaves or flowers. **30**

OR

Q.1 Demonstrate the technique of ion exchange column chromatography in the separation of amino acids using two buffers. **30**

Q.2 Identification of lipids in a given sample by TLC. **20**

OR

Q.2 Demonstrate SDS-PAGE under reducing conditions for separation of Plasma proteins. **20**

**M.Sc. Zoology Syllabus (Autonomous)
Credit Based Semester and Grading System
(With effect from academic year 2018-19)
Semester I and Semester II**

Scheme of Examination

The performance of learners will be evaluated in two parts for the Theory component of the Course:

1. Internal Assessment with 40% marks
 2. Semester End Examination (written) with 60% marks
- The Practical component of the Course will be evaluated by conducting Semester End Practical Examination of 50 marks.

Internal Assessment Theory (40%)

It is the assessment of learners on the basis of continuous evaluation as envisaged in the Credit Based System by way of participation of learners in various academic and correlated activities in the given semester of the program.

Marks: 40

Evaluation will be conducted on the basis of Seminar/ Presentation given by the student on a topic chosen from the syllabus for each paper. The marking scheme shall be:

- Content of Presentation: **10 marks**
- Quality of Presentation: **10 marks**
- Presentation skills: **10 marks**
- Question-Answer discussion: **10 marks**

Semester End Assessment Theory (60%)

Marks: 60

Duration: 2 hours

Theory question paper pattern:

- There shall be five questions of 12 marks each. On each unit there will be one question and the 5th question will be based on the entire syllabus.

OR

There shall be four questions of 15 marks each, each question based on one unit.

- All questions are compulsory with internal choice within the questions.
- Questions may be subdivided and the allocation of marks depends on the weightage of the topic.

Semester End Assessment Practical

Marks: 50

Duration: 5 hours
