M.Sc. ENTOMOLOGY SYLLABUS – Proposed from 2018-19

Preamble

The Department of Zoology restructured the M.Sc. Part I and II Syllabus comprising with an emphasis on freeing of the stakeholders for one entire semester to carry out research project work in industry or certified laboratories.

The semester I is common for both streams while Semester II onwards the stakeholders enter the field of specialization, entomology in this case.

The unique feature of M.Sc. Zoology part II autonomous syllabus of K. J. Somaiya College of Science & Commerce is the inclusion of dissertation for 600 marks instead of Semester IV. The standards of the dissertation should be appreciable and of good quality. Practical will be assessed on a continuous pattern during regular sessions. There will be no Semester-end Practical Exam. Assessment of dissertation will be based on an open viva for defence wherein the students and faculty of other colleges who belong to this stream of specialization are invited to interact during the presentation.

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Zoology

Semester I

18PS1ZO1

Phylogeny and Osteology

Module 1: Phylogeny & Systematics of non-chordates -

Phylogeny, salient features, classification up to class level (wherever applicable) of the following phyla-

1.1 Protista (Protozoa)

1.2 Porifera

1.3 Coelenterata

1.4 Ctenophora

1.5 Mollusca

1.6 Bryozoa

1.7 Brachiopoda

1.8 Echinodermata

1.9 Chaetognatha

1.10 Platyhelminthes and Nemethelminthes

1.11 Acanthocephala

1.12 Annelida

1.13 Sipunculoidea

1.14 Arthropoda

1.15 Onychophora – Peripatus: A connecting link between Annelida and Arthropoda

1.16 Hemichordata

Module 2: Type study – Sepia and Protochordate phylogeny

2.1 Type Study Sepia

2.1.1 Habit, habitat and morphology of Sepia

2.1.2 Systems: Digestive, Circulatory, Nervous and Reproductive (male and female)

2.1.3 Economic Significance of Sepia

2.2 Protochordates

2.2.1 Urochordata and its affinities.

2.2.2 Cephalochordata and its affinities

2.2.3 Vertebrate ancestry and origin of Vertebrates.

2.2.4 Changes leading to first vertebrates.

2.2.5 Salient features and phylogeny of Ostracoderms.

2.2.6 Affinities of Cyclostomes

a) resemblance with Cephalochordates

b) differences from fishes. c) vertebrate characters. d) specialized characters.

Module 3: Chordate phylogeny

3.1 Discovery of Coelacanth

3.2 Overview of fish phylogeny

3.3 Primitive tetrapods- Labrynthodonts

3.4 Crossopterigians- A blue print.

3.5 Dipnoi- a group that has failed to evolve as amphibian

3.6 Lissamphibia

3.7 Sphenodon- a living fossil

3.8 Extinct reptiles.

3.9 Adaptive radiation in Reptilia

3.10 Warm blooded reptile Archaeopteryx- a connecting link between Reptiles and Aves

3.11 Affinities of Aves and classification upto subclass

3.12 Origin of flight (theory of cursorial & arboreal origin)

3.13 Birds as glorified reptiles

3.14 Egg laying mammals- connecting link between reptiles and mammals

3.15 Classification of mammals up to orders

3.16 Dentition in mammals

3.17 Walking gait (Plantigrade, Digitigrade, and Unguligrade)

Module 4: Comparative osteology

(Axial and Appendicular skeleton of shark, bony fish, frog, varanus, pigeon and rabbit)

4.1 Skull

4.2 Jaw suspension

4.3 Vertebral column of tetrapods

Atlas, Axis, Typical Vertebra, Thoracic vertebra, Trunk vertebra, Caudal vertebra

4.4 Pectoral girdle

4.5 Pelvic girdle

4.6 Limbs of tetrapods

18PS1ZO2 Biomolecules and Cell Signalling

Module 1: Biomolecules – Carbohydrates, lipids

1.1 Carbohydrates

1.1.1 Classification: mono-, oligo- and poly-saccharides.

1.1.2 Monosaccharides

1.1.3 Oligosaccharides

1.1.4 Polysaccharides- homo- and hetero-polysaccharides.

1.1.5 Biological functions of carbohydrates.

*1.2 Lipids

1.2.1 Classification: simple and complex lipids

1.2.2 Fatty acids

1.2.3 Acylglycerols

1.2.4 Complex lipids

1.2.5 Biological functions of lipids.

1.3 Carbohydrate Metabolism

1.3.1 Glycolysis Reaction sequence, flow of carbon, Conversion of pyruvate to lactate and Acetyl coenzyme-A, significance of pyruvate-

lactate interconversion, aerobic and anaerobic glycolysis and energetic of glycolysis. Regulation of glycolysis

1.3.2 Gluconeogenesis: Reaction sequence from pyruvate, gluconeogenesis from amino acids, gl ycerol, propionate, lactate. Regulation of gluconeogenesis

*1.3.3 Glycogen metabolism: Glycogenesis, Glycogenolysis. Regulation of the two pathways.

1.3.4 Significance of following pathways: Hexose monophosphate shunt as a multifunctional pathway;* Uronic Acid Pathway, Glyoxalate cycle.

1.4 Lipid Metabolism

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

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

Module 2: Biomolecules –Nucleic acids and Proteins

2.1 Nucleic acids

2.2.1 Types, Components, Structure of DNA

2.2.2 Structure, types and functions of RNA

*2.2 Proteins

2.2.1 Amino acids: structure and classification

2.2.2 Organization of protein structure: Primary structure and peptide bond, secondary, tertiary and quaternary structure; conjugate proteins- haemoglobin, cytochromes, myoglobin, bonds involved in protein organization.

2.2.3 Properties of proteins: classification,

denaturation and protein folding.

2.2.4 Biological functions of proteins. Biologically important peptides: glutathione, octa-,

nona- and deca-peptides.

2.3 Complex biomolecules

2.3.1 Glycoproteins

2.3.2 Glycolipids

2.3.3 Lipoproteins

2.4 Protein Metabolism

2.4.1 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.

2.4.2 Metabolism of ammonia: Urea cycle

2.5 Metabolism of nucleic acids

2.5.1 Synthesis of ribonucleotides- a brief idea of de novo pathway and salvation pathway

2.5.2 Conversion of ribonucleotides to deoxyribonucleotides

2.5.3 Degradation of nucleotides

2.5.4 Integration of Metabolism, Energy demand and supply: Integration of major metabolic pathways of energy metabolism, intermediary metabolism; organ specialization and metabolic integration. Metabolism in starvation

Module 3: Biochemical Thermodynamics and Enzyme Kinetics

3.1 Biochemical Thermodynamics

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

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

3.1.3 Biological oxidation, Electron transport chain and mitochondria, Oxidative phosphorylation mechanism, uncoupling of oxidative phosphorylation and its significance.

3.1.4 Free radicals, antioxidants and antioxidant system.

3.2 Enzymes and enzyme kinetics

*3.2.1 Enzymes

Nomenclature and classification with numerical code; chemical nature of enzymes

*3.2.2 Mechanism of enzyme action: Fischer's Lock and Key Theory,

Koshland's Induced fit model, Mechanism of enzyme catalysis.

3.2.3 Enzyme kinetics: Michaelis Menten equation; Lineweaver-Burk plot; significance of Vmax and Km; factors affecting enzyme activity; enzyme activation and inhibition.

3.2.4 Regulatory enzymes:

a) Covalently modulated

b) allosteric regulation

c) Isoenzymes (LDH, CK, ALP, ADH)

*3.2.5 Non-protein enzymes- Ribozymes

*3.2.6 Advanced enzymes in human healthcare (e.g. fungal lactase, Hemicellulase, Trypsin chymotrypsin mix)

Module 4: Bio signalling

4.1.1 General features of signal transduction

4.1.2 G- protein coupled receptors

4.1.3 Receptor tyrosine kinases

4.1.4 Gated ion channels

4.1.5 Regulation of transcription by steroid hormones

18PS1ZO3 Evolution, Genetics and Developmental Biology-

Module 1: Evolution and molecular phylogeny

1.1 Evolutionary theories:

1. Darwinism
2. Lamarckism,
3. Hugo de Vries theory
4. Neo-Darwinism

1.2 Evolution of Horse

1.3 Evolution of Elephant

1.4 Human Evolution

1.5 Human Migration

1.6 Molecular Evolution

1.6.1 Patterns and modes of nucleotide substitutions

1.6.2 Nucleotide substitutions in DNA

1.6.3 Rate of substitution

1.6.4 Variation in evolutionary rate between genes

1.6.5 Molecular clock

1.6.6 Molecular Phylogeny

1.6.7 Phylogenetic tree and reconstruction methods

1.6.8 Horizontal gene transfer

1.6.9 Acquisition and origin of new functions

1.6.10 Multigene families

1.6.11 Gene duplication and conversion

Module 2: Genetics –Linkage, crossing over, gene mapping

2.1 Morgan's Experiment with Drosophila

*2.2 Gene recombination and role of chromosomal exchange

2.3 Constructing genetic linkage maps of Human Genome

2.3.1 The lod score method for analysing linkage of human genes

2.3.2 Human genetic maps

a) physical chromosome mapping: deletion mapping, cell hybridization mapping, mapping by in situ hybridization; correspondence of and physical maps.

*b) Practical application of chromosome mapping tracking the inheritance of an allele with coupled DNA markers

Module 3: Inborn Errors of Metabolism and Teratology

3.1 Inborn errors of metabolism

- Carbohydrate metabolism: G-6PD deficiency
- Lipid metabolism: Metabolic disorders of cerebrosides.
- Protein metabolism: PKU, Albinism
- Purine metabolism: Primary Gout
- Mineral metabolism and diseases:

- Hypocalcaemia, Hypercalcaemia and osteoporosis

3.2 Teratology

- Teratogens and their effects
- Sensitive period of teratogen
- Specificity of teratogen
- Thalidomide syndrome
- Teratocarcinoma and Teratoma
- Environmental teratogens

Module 4 Developmental Biology

*4.1 Basic concepts of Developmental Biology – cell fate, competence, commitment, trans-differentiation and differentiation, dedifferentiation, Cell specification

4.2 Cell aggregation and differentiation in Dictyostelium

4.3 Morphogenesis and cell adhesion- Differential cell affinity, cadherins and cell adhesion.

4.4 Axis formation and pattern formation: Drosophila and Xenopus.

4.5 Organogenesis

4.5.1 Vulva formation in Caenorhabditis elegans

4.5.2 Limb development

4.6 Metamorphosis

(a) Amphibian metamorphosis

(b) Metamorphosis in insects-

(i) Eversion and differentiation of imaginal discs

*(ii) Hormonal control of insect metamorphosis

(c) Programmed cell death

*4.7 Regeneration

(a) Regeneration in Hydra

(b) Regeneration of Salamander limbs

4.8 Aging: Senescence, life span and causes of aging

*4.9 Stem cell and their role in development

18PS1ZO4 Instrumentation and Research methodology

Module 1: Principles and applications of Microtomy, microscopy, Radioisotopes and Spectroscopy

1.1Microtomy

1.2 Principles and applications of microscopy

*a) Light microscopy,

*b) Phase contrast microscopy

c) Fluorescence microscopy

d) Polarized microscopy

e) Confocal scanning microscopy

f) Transmission electron microscopy:

*specimen preparation for electron microscopy, scanning electron microscopy

1.3 Principles and applications of radioisotopes:

* a) Use of isotopes in biological sciences

b) Units of radioactivity,

c) Detection and measurement of radioactivity by scintillation counting

d) Autoradiography

*1.4 Principles and application of filtration, distillation and extraction:

a) Ordinary filtration under suction pressure

b) Fractional distillation

c) Steam distillation

d) Technique of extraction with solvents

1.5 Spectroscopy:

a) Ultraviolet and visible absorption spectroscopy

b) Fluorescence spectroscopy

c) Nuclear magnetic resonance spectroscopy

d) Mass spectroscopy

e) Atomic absorption spectrophotometer.

Module 2: Principles and application of chromatography and Electrophoresis

2.1.1 *Planar chromatography (Paper and Thin layer): Preparation of stationary support, solvent, detection and measurement of components, applications.

2.1.2 2D chromatography

2.1.3 HPTLC

2.1.4 Column chromatography

2.1.5 Ion exchange chromatography

2.1.6 Gel chromatography

2.1.7 Affinity chromatography

2.1.6 Gas chromatography

2.1.7 HPLC

2.2 Electrophoresis

*2.2.1 Theory of electrophoresis

2.2.2 Horizontal agarose gel electrophoresis

2.2.3 Vertical polyacrylamide gel electrophoresis

2.2.4 Pulse field electrophoresis

2.2.5 Capillary electrophoresis

2.2.6 Isoelectric focusing of proteins

2.2.7 Two dimensional electrophoresis

Module 3: Research methodology & Scientific writing

3.1 Definition of research, objectives, motivation, types of researches

*3.2 Significance of research

3.3 Methods of research – how research is done, various processes, criteria

3.4 Selection of a research problem, defining a problem, research design

3.2 Scientific writing

3.2.1 Definition and scope – peer reviewed journal, scientific paper for commercial use, scientific book, abstract

3.2.2 Interpretation and report writing:

Meaning of interpretation; technique of interpretation; precautions in interpretation; significance of report writing; layout of research report; types of reports; *Presentation of research work oral, poster and writing research paper; Precautions for writing research report.

3.2.3 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.

3.2.4 Writing research proposal: Characteristics of a proposal; content and organization of a proposal; weakness in proposal seeking funding.

3.2.5 Writing a scientific paper – IMRAD format

3.2.6 Research Ethics: Ethical decision making, Sharing scientific knowledge, Sharing authorship, Plagiarism etc.

<u>Module 4: Biostatistics and case studies in research</u>

4.1 Biostatistics

1. Framing of hypothesis
2. * Standard deviation
3. * Standard Error
4. * Variance
5. ANOVA
6. Fischer's F-test
7. Use of Microsoft Excel - graphs, basic statistical analysis, 3D modelling
8. SPSS
9. R Software

4.2 Case studies

1. Human Animal Conflict: SGNP Leopard
2. North East India: Elephants
3. Olive Ridley Turtles: an effort to protect.
4. Vulture Deaths due to Diclofenac
5. Extinction of Indian Cheetah, Great Indian Bustard, Himalayan Quail
6. Organisations dealing with Conservation.

Semester I Practical

Course I 18PS1ZO1P

1. Study of animal type – Sepia
   a. Morphology
   b. Digestive System
   c. Nervous System
   d. Reproductive Systems (Male and Female)
   e. Mounting of Jaws, radula, statocyst, spermatophore
2. Study of systematic and major features of:
   a) Protozoa (Amoeba, Noctiluca, Paramoecium, Plasmodium)
   b) Porifera (Leucosolenia, Grantia, Euplectella, Euspongia)
   c) Coelenterata (Obelia colony, Physalia, Sea anemone, Madrepora)
   d) Mollusca (Chiton, Dentalium, Patella, Mytilus, Loligo, Nautilus)
   e) Echinodermata (Starfish, Sea urchin, Sea cucumber, Feather star)
   f) Minor Phyla (Comb jelly, Lingula, Sagitta)
   g) Hemichordata (Balanoglossus)
3. Study of systematics and major features of:
   a) Helminthes (Liverfluke, Tapeworm, Ascaris) Annelida (Nereis, Earthworm, Leech)
   b) Sipunculoidea: (Sipunculus),
   c) Arthropoda (Crab, Spider, Centipede, Beetle)

4. Study of Protochordates and Chordates

   a. Urochordata (Herdmania)

   b. Cephalochordata (Amphioxus)

   c. Agnatha (Petromyzon, Myxine)

   d. Pisces (Shark, Sting ray, Electric ray, Hippocampus, Eel, and any lung fish)

   e. Amphibia (Caecilian, Salamander, Frog, Toad)

   f. Reptilia (Turtle/Terrapin, Tortoise, Calotes/ Chameleon, Draco, Phrynosoma, Viper, Rattle snake, Hydrophis, Crocodile/Alligator/Gharial)

5. Comparative Osteology: Axial and Appendicular skeleton with reference to:

   a. Skull of Shark, Bony fish, Frog, Varanus, Pigeon and Rabbit

   b. Vertebrae of tetrapods

   c. Pectoral and Pelvic Girdles of tetrapods

   d. Limb bones of tetrapods

6. Study of ear ossicles, hyoid apparatus from chicken

7. Study of systematics and major features of

   a. Aves (Ostrich, Kiwi, Kite, Owl, and Duck)

   b. Mammals (Duckbilled platypus, Echidna, Kangaroo, Shrew, Bat, Loris, Seal/ Walrus, Dolphin, Sea Cow, Tiger, Giant panda, Tapir, Camel, Striped squirrel, Guinea pig, Porcupine, Rabbit)

Course II 18PS1ZO2P

1. Extraction of oil from fish liver – Comparative Study
2. Estimation of reducing sugars by DNSA method
3. Extraction of glycogen from given tissue
4. Isolation of polysaccharides from potato or egg shell
5. Problems based on Thermodynamics
6. Protein from Egg white by Peterson Lowry Method
7. Estimation of Amino acids from protease treated tissue by Ninhydrin method
8. Hormone Assay- Kit for hCG

Course III 18PS1ZO3P

1. Construction of Phylogenetic tree from NCBI
2. Identification of evolutionary evidence:

   i) Horse

   ii) Human

   iii) Elephant

3. Observation of morphogenetic movements in chick embryo
4. Limb induction in chick embryo
5. Testing for metabolic disorder from serum sample – G6PD kit
6. Effect of insulin on Chick embryo

Course IV 18PS1ZO4P

1. Identification of pictograms, symbols and signs of safety in laboratory practice
2. Preparation of standard solutions

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), par ts per million (ppm) with practical exercises. Types of solutions- Stock solutions practic al exercises.

3. Microtomy

   i) Fixation of tissue

   ii) Dehydration

   iii) Embedding, block preparation and trimming

   iv) Sectioning and slide preparation

   v) Staining and mounting

4. Case study on environment and wildlife- Project report submission

5. Extraction of desired data from a given research paper

6. Separation of pigments from leaves or flowers by adsorption column chromatography

7. Separation of amino acids by ion exchange chromatography using cation exchanger

8. identification of amino acids by 2D paper chromatography

Semester II

18PSZOET1 Insect Body and Integument	18PSZOET2 Taxonomy and Insect diversity	18PS2ZOET3 Insect Anatomy	18PS2ZOST4 Insect Anatomy and Type animal
Body form and integument	Introduction to Taxonomy	Insect Digestive System	Insect Nervous system
Insect head	Amemtabola and Hemimetabola	Insect respiratory System	Sense organs
Insect thorax and Muscles	Holometabola – 1	Insect circulatory System	Insect reproductive system
Insect abdomen and Genitalia	Holometabola - 2	Insect excretory System	Type animal - cockroach

18PS2ZOET1 – Insect Body and Integument

Module I Body form and Integument

1.1 Evolution of insect Body form

1.2 General body form and variations with examples

1.3 Integument – structure, biochemistry, sclerotization, regulation and function

Module II Insect Head

2.1 Head sclerites, sutures, eyes and ocelli

2.2 Types of antennae

2.3 Basic mouth parts

2.4 Types of mouth parts with examples

Module III Insect thorax and muscles

3.1 Sclerites of Pro, meso and metathorax

3.2 Basic wing venation

3.3 variations in wings with examples

3.4 basic structure of insect leg

3.5 Pro, meso and metathoracic legs

Module IV Insect abdomen and genitalia

4.1 Abdominal sclerites and variation

4.2 Basic structure of male genitalia and variations

4.3 Basic structure of female genitalia and variations

4.4 Evolution of genitalia

18PS2ZOET2 Taxonomy and Insect Diversity

Module I Introduction to taxonomy

1.1 Definition

1.2 History of insect classification

1.3 Recent insect classification

1.4 Various types of taxonomy

1.5 Taxonomic keys of identification

Module II Ametabola and Hemimetabola

2.1 Ametabola – Thysanura, Diplura, Protura, Collembola

2.2 Hemimetabola – Ephemeroptera, Odonata, Plecoptera, Grylloblattoidea, Orthoptera, Phasmida, Dermaptera, Hereoptera, Hemiptera

2.3 Hemimetabola – Embioptera, Blattaria, Mantoidea, Isoptera, Zoraptera, Pscoptera, Siphunculata

Module III Holometabola – 1

3.1 Thysanoptera, Neuroptera, Mecoptera,

3.2 Trichoptera, Strepsiptera, Siphunculata

Module IV Holometabola – 2

4.1 Diptera,

4.2 Coleoptera,

4.3 Lepidoptera, 4.4Hymenoptera

18PS2ZOET3 Insect Anatomy

Module I Insect Digestive system

1.1 Basic structure of alimentary canal

1.2 Histology of midgut

1.3 Salivary glands

1.4 Mechanism of digestion

1.5 Gut microflora

Module II Insect Respiratory system

2.1 Basic structure of respiratory system

2.2 Mechanism of gaseous exchange

2.3 Aquatic respiration in insects

2.4 Physiology of insect gills

Module III Insect circulatory system

3.1 Basic structure of circulatory system

3.2 Chemical composition of haemolymph

3.3 Haemocytes – types and function

3.4 Mechanism of circulation

3.5 Intermediary metabolism

Module IV Insect Excretory system

4.1 Organs of excretion

4.2 Structure and function of malphigian tubules

4.3 Accessory organs of secretion

4.4 Physiology and mechanism of secretion

4.5 Osmoregulation

18PS2ZOET4 Insect Anatomy and Type animal

Module I Insect Nervous system

1.1 Basic structure of Nervous system

1.2 The brain and neuron – morphology and anatomy

1.3 Sympathetic nervous system

1.4 Physiology of Nervous coordination

Module II Sense organs in Insects

2.1 Visual organs – ocelli, stemmata

2.2 compound eyes – structure, types and functions

2.3 mechanoreceptors

2.4 Chemoreceptors

Module III Insect reproductive system

3.1 Basic reproductive system – male

3.2 Basic reproductive system – female

3.3 Variation in male and female reproductive system

3.4 Egg maturation

Module IV Type animal – cockroach

4.1 Classification and diversity

4.2 Morphology

4.3 Digestive system

4.4 Nervous system

4.5 Reproductive system

4.6 Circulatory system

Semester II Practical

18PS2ZOET P1

1. Estimation of Chitin from insect integument
2. Study of head sclerites
3. Study of mouth parts
4. Mounting of mouth parts
5. Study of pro, meso and meta thoracic sclerites
6. Study of basic wing venation
7. Study of variation in wing venation
8. Permanent mounting of wing
9. Study of basic leg morphology
10. Permanent mounting of leg
11. Study of abdominal sclerites
12. Study of variation in abdominal sclerites
13. Study of basic male and female genitalia
14. Examples of male and female genitalia

18PS2ZOET P2

1. Using dichotomous key for identification
2. Study of ametabolus orders - Thysanura, Diplura, Protura, Collembola
3. Study of hemimetabolus orders - Ephemeroptera, Odonata, Plecoptera, Grylloblattoidea, Orthoptera, Phasmida, Dermaptera, Hereoptera, Hemiptera, Embioptera, Blattaria, Mantoidea, Isoptera, Zoraptera, Pscoptera, Siphunculata
4. Study of holometabolus orders - Thysanoptera, Neuroptera, Mecoptera, Trichoptera, Strepsiptera, Siphunculata, Diptera, Coleoptera, Lepidoptera, Hymenoptera

18PS2ZOET P3

1. Study of digestive enzymes from the gut of cockroach
2. Isolation of flora from the insect gut
3. Mounting of spiracles from cockroach
4. Study of variation in tracheal system
5. Estimation of uric acid from the water – mosquito larvae
6. Smear of insect haemolypmh
7. Blood proteins separation by TLC/paper chromatography
8. Mounting of Malpighian tubules
9. Variation of Malpighian tubules in insects

18PS2ZOET P4

1. Study of neuro secretary cells from cockroach
2. Variation in brain in insects
3. Mounting of cornea in cockroach
4. Variation in compound eyes in inesects
5. Variation in male reproductive systems in insects
6. Variation in female reproductive systems in females
7. Study of temperature regulation on hatching of cockroach ootheca
8. Dissection of digestive system in cockroach
9. Dissection of nervous system in cockroach
10. Dissection of reproductive system in cockroach.

Semester III

18PS3ZOET1 Insect Endocrinology and genetics	18PS3ZOET2 Field entomology, ecology, phylogeny	18PS3ZOET3 Insect physiology, immunology, Interactions and Industrial entomology	18PS3ZOET4 Applied Entomology
Insect Endocrinology	Field entomology	Insect Physiology and Immunology	Principles of Insect control
Insect Genetics	Evolution and Adaptation	Insects and other Organisms	Agriculture and forest entomology
Toxicology of Insecticides	Insect Ecology - 1	Insect Ecology - 2	Veterinary entomology
Development of an Insect	Phylogeny Techniques	Industrial entomology	Medical and forest entomology

18PS3ZOET1 Insect endocrinology and Genetics

Module I Insect Endocrinology

1.1 Neurosecretory cells

1.2 Corpora cardiaca

1.3 Corpora allata

1.4 Ecdysal glands

1.5 Midgut endocrine glands, gonadal endocrine glands

1.6 Hormones – structure and types

1.7 Endocrine regulation or reproduction, metamorphosis, diapause

Module II Insect Genetics

2.1 Nuclear DNA and Extra nuclear DNA

Introduction, repetitive DNA, Composition of Insect DNA, Structure of nucleus, chromosomal puffing, sex chromosomes, B – Chromosomes

2.2 Sex determination in insects

Module III Toxicology of insecticides

3.1 scope and definition of insecticides

3.2 history of chemical control, pesticides industry

3.3 Principles of toxicology. Evaluation of insecticide toxicity, synergists, potentiation, antagonism

3.4 Insecticide metabolism

3.5 Insecticide residues

3.6 Pest resistance to insecticides

Module IV Development of an Insect

4.1 Types with examples – egg, caterpillar, nymph, pupae

4.2 Metamorphosis – types, variation with examples

4.3 Parthenogenesis – definition, types.

18PS3ZOET2 Field Entomology, Ecology and Phylogeny

Module – I: Field Entomology.

1.1 Field Identification. Field kit for entomology. Identification of insects in the field. Various field characters based on morphology, habits and habitats.

1.2 Collection Method. Various collection methods – pitfall, Berlese funnel, Malaise trap, light trap, bait trap.

1.3 Documentation. Manual documentation. Photo documentation. Audio documentation. Importance of documentation.

1.4 Preservation Method. Dry and wet preservation. Labelling. Pinning. Maintaining the collection.

Module - II: Evolution & Adaptation.

2.1 Extinct Insect Orders.

2.2 Insect Origin. Evolution of insects from the ancestors. Comparative morphology of early insects.

2.3 Transition from Aquatic to Terrestrial. Changes leading to terrestrial adaptation.

2.4 Evolution of Flight. Various changes involved in evolution of flight. Various theories.

Module – III: Insect Ecology.

3.1 Courtships. Mating behaviour in insects. Factors involved in mating.

3.2 Mimicry & Camouflage. Types of mimicry with example.

3.3 Defence Mechanisms. Types of mechanisms used in defence.

3.4 Hibernation, Aestivation and torpidity. Factors involved. Examples.

3.5 Communication. Types of communication in insects.

3.6 Learning, memory and instinct. Types of learning behaviour.

Module – IV: Phylogeny techniques.

4.1 Morpho taxonomy. Various characters of morphology involved in taxonomy.

4.2 Molecular Phylogeny – DNA & Protein level. Basic techniques of protein and DNA isolation, purification and separation. Use of software to build phylogeny trees.

18PS3ZOET3 Insect Physiology, Immunology, Interactions and Industrial entomology

Module – I: Insect Physiology & Immunology.

1.1 Physiology of jumping, running, walking. Basic muscles involved and their physiology.

1.2 Physiology of flight. Flight muscles, regulatory hormones, physiology.

1.3 Insect immunology. Origin of innate immunity. Humoral immunity. Cells of immunity. Proteins of immunity. Fat bodies involved.

Module – II: Insect & Other Organisms.

2.1 Insect - Plant interaction. Types of positive and negative interaction. Leafyvory, frugivory, bark feeders, galls, pollination.

2.2 Insect - Animal interaction. Types of positive and negative interaction

2.3 Insect - Insect interaction. Types of positive and negative interaction

2.4 Parasitology – Pests of insects. Examples, pathogenicity, effect on insects.

Module – III: Insect Ecology.

3.1 Insect in food web. Insects involved in various trophic levels of food web, their role, energy transfer.

3.2 Insect migrations and distributions. Types and causes of migrations, dispersal.

3.3 Social insects. Examples, pheromone control.

3.4 Insect as environmental indicators. Insect of particular environment, examples.

Module – IV: Industrial Entomology.

4.1 Sericulture. Silkworm culture.

4.2 Apiculture. Honey bee culture.

4.3 Lac culture. Lac insect culture.

4.4 Insect as a food. Insects as food for humans, examples, advantages, disadvantages.

18PS3ZOET4 Applied Entomology

Module I Principles of Insect Control

1.1 Chemical control – classification and evolution of insecticides, types, mode of action, insecticide formulation and application

1.2 Biological control methods

1.3 Integrated Pest Management

Module II Agriculture and Forest Entomology

2.1 Pest - life cycle, control of pests of Mango, rice, jowar, cotton, fig and okra

2.2 Stored grain pests – examples, life cycle and control

2.3 Pests of forest plants – examples, life cycle, control

Module III Veterinary Entomology

3.1 Life cycle and control of Horse fly, blood sucking fly

3.2 Life cycle and control of Flesh fly, Hypoderma, Poultry louse, screw worm fly

Module IV Medical and Forensic entomology

4.1 Common insect vectors –life cycle, disease transmitted, control

4.2 Mode of transmission

4.3 Insects of forensic importance

in cockroach.

Semester III Practical

18PS3ZOET P1

1. Study of structure of various hormones
2. Isolation of DNA from leg muscle
3. Separation of DNA on gel electrophoresis
4. Identification of insecticides
5. Study of different types of eggs
6. Study of different types of caterpillars
7. Study of different types of nymphs
8. Study of different types of pupae

18PS3ZOET P2

1. Field visit to forest and recording diversity – submission of report
2. Study of extinct insect orders
3. Study of insect communication
4. Study of mimicry in insects
5. Construction of phylogenetic tree based on a given data
6. Evolution of an insect flight
7. Evolution of an insect leg
8. Study of morphotaxonomy – morphological characteristics of various orders

18PS3ZOET P3

1. Protein estimation from flight muscles
2. Protein estimation from leg muscles
3. Study of galls – collection, identification, structure, preservation
4. Study of social insects

5. Study of termite and ant nests
6. Protein estimation of silk of cocoon of various moth species
7. Study of Insect parasitology
8. Study of industrial entomology – sericulture, apiculture and lac culture
9. Study of fat bodies as an immune organs

18PS3ZOET P4

1. Study of parasites and parasitoids
2. Study of pests of mango, rice, jowar, cotton, fig, okra
3. Study of stored grain pests
4. Study of pests of forest tree
5. Field work – identification of insect pests of forest trees
6. Study of veterinary pests - Horse fly, blood sucking fly, Flesh fly, Hypoderma, Poultry louse, screw worm fly
7. Field visit –collection of veterinary pests
8. Common insect vectors
9. Insect of forensic importance

Semester IV – Dissertation

6 month field work or internship*

[* subject to post COVID scenario for 2020-21]

References

1. Ross, H.H., Ross C.A. & Ross J.R.P., Text book of Entomology, Ed. 4. John Willey & Bons, New York.

2. Richards, O.W. & Davis, R.G.: General Text Book of Entomology. Ed. 10. Chapman & Hall London.

3. Nayar, K.K. & Ananthkrishnan, T.N. & David. B.V.: General and Applied Entomology, Tata McGraw Hill Co Ltd., Bombay.

4. Mani. M.S.: General Entomology. End 3, Oxford & IBH Publishing Co., New Delhi.

5. Sondgrass, R.E.: Principles of Insect Morphology, Tata McGraw Hill, Rutl. Co. Ltd., Bombay, New Delhi.

6. Wigglesworth, V.B.: The Principles of Insects Physiology. Vlbs & Methuten & Co.Ltd., London.

7. Chapman, R.F.: The Insects Structure & Function, English University Press, London.

8. Comstock, J.H.: An Introduction to Entomology. Ithaca, New York.

9. Kerkut: G.A. & Gillbert, L.I.: Comprehensive Insect. Physiology, Biochemistry and Pharmacology. Vol. 1 to 13. Pergamon Press, Oxford & New York.

10. Beament, J.W.L. Tieherne, J.E. & Wigglesworth, V.B.: Advances in Insect Physiology, Academic Press, New York.

11. Tembhare, D.B.: A Text Book of Insect morphology, Physiology and Endocrinology. II End. S. Chand & Co., New Delhi.

12. Metcalf, C.L., Flint. W.P. & Metcalf. R.L.: Destructive and Useful Insects – Their habits & control End. 4, Ms Graw Hill, New York

13. Pradhan, S.: Insect Pests of Crops. III Edn. National Book Trust of India, New Delhi. 14.Imms – Text book of Entomology.

15. Essig – College Entomology.

16. Nayar & Anantkrishan – Text book of Entomology. 17.Askew – Parasitic Insects

18.Bhutani & Jotwani – Insects in Vegetable

19.Bhutani & Jotwani – Insects in Fruits

20.Theopald – Economic Entomology

21. Hill Denis – Pest of stored products and their control

22.Fernald & Schafferd – Applied Entomology

23.Tembhare – Insect Endocrinology and Physiology

24.Tembhare - Modern Entomology

25. Maxwell & Lefroy – Manual of Entomology

26.M.S.Mani – Insects.

27. Jha – Pests of stored grains.

28.Wigglesworth, V.B. - Insects Hormones.

29. Joshi P.V. Keetak nirikshakancha sobati. Continental prakashan, Pune. Marathi book.