

M.Sc.Zoology

SEMESTER I

Structure and function of Invertebrates

CO1. Students will be able to understand the modern scheme of animal classification and classical and molecular taxonomic parameters.

CO2. Conceptualization of ultrastructure of protozoans and its modes of locomotion.

CO3. In-depth study about the poriferans and their canal system.

CO4. This study will help to distinguish between zooids in the Coelenterate colonies.

CO5. The study will help them to understand the origin, extinction, and causes of differential rates of diversification in metazoa.

CO6. They will acquire knowledge about the reproductive systems in Platyhelminthes and Aschelminths.

CO7. Student will understand the role of coelom, symmetry and metamerism in animal classification.

CO8. Detailed study of evolution of nephridial system will help to conceptualize the mechanism of excretion in annelids

CO9. They will learn about feeding behaviour in Porifera, Annelida and Echinodermata.

CO10. Student will learn about comparative study of respiratory systems in Arthropoda and Mollusca.

CO11. The theory of taxonomic position of Peripatus and Neopilina will help the student to understand the connecting link between the Annelida and Mollusca.

CO12. Neuroanatomical study in selected group of molluscs will help to understand the evolution of nervous system of Mollusca.

CO13. Student will be studying the locomotion and feeding behaviour in Echinodermata through the unique water vascular system.

CO14. Students will be able to gain knowledge on phylogenetic relationship between minor and major phyla.

General Physiology

CO1. Students will be able to learn enzymology i.e., the classification, mechanism of action of enzymes, and regulation of enzyme activity.

CO2. The students will be able to get an insight about pigments, their types and distribution in the respiratory mechanism of animals at cellular level.

CO3. Students will be able to gain knowledge about the chemical nature, biosynthesis and mechanism or action of neurotransmitters.

CO4. Understanding the concept of regulation of heart-beat and blood pressure.

CO5. Detailed study of mechanism of bioluminescence and light producing organs in invertebrates and vertebrates

CO6. Perception of Osmoregulation, concept of thermoregulation, Heat balance in animals, Adaptations to temperature extremes, torpor, aestivation and hibernation, counter current heat exchangers.

CO7. Understanding the concept of colour change mechanism in different groups of animals. CO8. Study about classification and metabolism of biological macromolecules i.e., carbohydrate, lipid and protein and their metabolic pathways.

CO9. To understand the physiology of hydro mineral metabolism.

CO10. Learn and understand the chemistry and function of cerebrospinal fluid.

CO11. Study of reflex action and reflex arc will give an insight to the basic concept of unconscious and involuntary response.

CO12. Understanding of adaptations to stress and strain- basic concept of environmental stress and strain, acclimatization, avoidance and tolerance, stress and hormones.

Cell Biology and Genetics

CO1. Description of transport across the plasma membrane. Understanding transepithelial transport, maintenance of cellular pH, cell excitation, bulk transport, receptor mediated endocytosis, protein sorting and targeting to organelles.

CO2. To understand and study morphology and functional characteristics, of cell organelles. CO3. Conceptualization of cell signaling and signal transduction pathways to get knowledge about their role behind all the processes.

CO4. Description of cellular shape, motility and energetics- cytoskeletal elements in cell shape and motility, structure and dynamics, role in cell locomotion and mitosis.

CO5. A detailed study of intercellular communication, extracellular matrix, cell-cell and cell-matrix adhesion, gap junctions, cellular energetics, oxidation of glucose and fatty acids, the proton motive force, F₀F₁ ATP synthase, mechanism and regulation of ATP synthesis.

CO6. Understanding of Mendel's principle, its extension and chromosomal basis.

CO7. Gain the knowledge about of types, causes and detections of mutations.

CO8. Student will able to understand the structural and numerical alterations of chromosomes and the extra chromosomal inheritance.

CO9. A study of Microbial genetics in detailed to know the reproduction in bacteria.

CO10. Human genetics, developing skills in human genetics with capability for karyotyping and nomenclature of metaphase chromosome bands.

Advanced Reproductive Biology

CO1. To study the various methods of asexual and sexual reproduction in Protozoa.

CO2. Familiarity with the process of regeneration in Hydra, Dugesia and Annelid worms

CO3. Learn the process of metamorphosis and vitellogenesis in insects

CO4. Understanding with the process of spermatogenesis, oogenesis, fertilization, with an account of different events involved in it.

CO5. To understand about the basic concepts of developmental biology i.e., cleavage, blastulation, gastrulation and embryonic induction.

CO6. To study the structure and function of male accessory sex glands.

CO7. Elucidation of morphology and biochemistry of sperm and abnormalities related to it.

CO8. Detailed study the molecular mechanism of sperm capacitation and decapacitation.

CO9. To understand the function of pheromones and their role in sexual behavior of mammals. CO10. To gain knowledge on the neuro-hormonal control of fish reproduction and mechanism of vitellogenesis in fishes.

CO11. Gain knowledge on the mechanism of morphogenetic gradient and organizer concept. CO12. Illustration of the mechanism of cryopreservation of gametes, embryo and test tube baby CO13. To study about the mechanism of in-vitro fertilization and its significance.

SEMESTER II Structure and Function of Vertebrates

CO1. Description of origin of chordates.

CO2. Students will be able to understand general characters and affinities of Cephalochordate. CO3. Detailed study of characteristic features of Agnatha and development of Amocoetus larva. CO4. Student will be able to study the general characters and affinities of Dipnoi.

CO5. Students will be able to understand organs and mechanism of aquatic and terrestrial respiration invertebrates.

CO6. Descriptive study of vertebrate integument and its derivatives.

CO7. Detailed study about different types of jaws in vertebrates.

CO8. Student will learn about urino genital system in amniotes and anamniotes.

CO9. Descriptive study of origin of birds and their migration.

CO10. A detailed insight of autonomous nervous system in vertebrates and evolution of circulatory system

CO11. Description of sensing the environment through Echolocation, Electroreception & Lateral line system.

CO12. Illustration of Human origin and evolution.

Comparative Endocrinology

CO1. To understand the hormones and functions in Coelenterate Helminths.

CO2. Detailed study of anatomical and structural organization of neuroendocrine organs and nervous system in invertebrates.

CO3. To study in detail the neuroendocrine system in crustacean.

CO4. To understand the concept of endocrine control of metamorphosis, reproduction and colour change mechanisms in crustacea.

CO5. Detailed study of cephalic neuroendocrine system in insects: structure and hormones. CO6. To learn and understand the endocrine control of metamorphosis and reproduction in insects.

CO7. A detailed study of hormones, structure and functions of Pineal organ, Pituitary, Parathyroid ultimobranchial glands, thyroid gland

structure, Adrenal gland, Hypothalamohypophysial system, Gastro-entero-pancreatic endocrine system and Gonadal hormones in vertebrates.

Molecular Biology and Biotechnology

CO1. To understand the C-value paradox and Cot $\frac{1}{2}$ value., Repetitive DNA. Structure of chromosome. Organization of chromatin fiber, forms of DNA. mitochondrial DNA

CO2. To understand the molecular mechanisms of replication and its regulation in prokaryotes and eukaryotes

. CO3. Imparting knowledge regarding gene mutation, types of gene mutations, DNA damage and repair.

CO4. Conceptualization of about mobile DNA elements, transposable elements in bacteria, composite transposons, bacteriophage Mu transposition, Tn 10 transposition, SINES and LINES, Retroviruses and retrotransposons.

CO5. Developing concept of regulation of gene activity in prokaryotes and eukaryotes at transcriptional and posttranscriptional level.

CO6. Describing structural and functional organization of a typical eukaryotic gene, transcription factors, enhancers and silencers, and non-coding genes.

CO7. Description of siRNA and miRNA basics, regulation of transcription and translation of proteins by miRNA.

CO8. To understand the prokaryotic and eukaryotic translation, genetic code, altered code in elongation, termination factors, fidelity of translation, post translational modifications.

CO9. Imparting knowledge of basic recombinant DNA techniques, preparation of restriction maps and mapping techniques.

CO10. Understanding of method and applications of nucleic acid probes, blotting techniques, CO11. DNA fingerprinting and polymerase chain reaction.

CO12. Developing skill to understand biology of cloning and expression vectors.

CO13. Description of gene cloning strategies by transformation of *E. coli* and other cells with rDNA; methods of selection and screening of transformed cells.

CO14. Exposure to principles of DNA sequencing, automated sequencing methods; synthesis of oligonucleotides, primer design.

CO15. Conceptualizing the Micro-arrays techniques along with its application

CO1. Understanding different types of placenta and foetal membranes in mammals.

CO2. To study in detail about the types of eggs and cleavage patterns: concepts in pattern formation, animal-vegetative axis, gradients, origin and specification of germ layers.

CO3. To learn and understand the concept of placental types, structure, functions and hormones of placenta.

CO4. Detailed study on the metamorphosis in Amphibia.

CO5. Understanding of process of regeneration in vertebrates.

CO6. Detailed view of cell death.

CO7. Concept of aging genes involved in alteration in timing of senescence.

CO8. Students will understand the concept of polymorphism in insect

CO9. Explanation of embryonic stem cells and their applications.

CO10. Acquaint with various techniques and tools of embryology

CO11. To learn about basic contraception techniques.

CO12. Familiarize with concept of anti-androgen and spermiogenic compounds.

CO13. Student will learn about role of mutants and transgenics in human welfare.

SEMESTER III Parasitology and Immunology

CO1. Student will learn and understand about the life cycle, mode of transmission, infection and treatment of diseases caused by parasite like Vibrio cholera, Clostridium titani, Yersinia pestis, Influenza virus, H1N1 viruses.

CO2. Student will learn and understand about the life cycle, mode of transmission, infection and treatment of diseases like Covid 19, Dengue and Hepatitis.

CO3. Overview of toxins and antitoxins.

CO4. Understanding the mode of infection of parasites and detailed understanding of their management.

CO5. An overview of the immune system, principles of innate and adaptive immunity. Evolution of innate and adaptive immune system.

CO6. Understanding of antigen recognition by immune cells, role of TLRs.

CO7. Conceptualization of generation of diversity in immunoglobulins and T- cell receptor gene rearrangement.

CO8. Illustration of antigen processing and presentation to T lymphocytes by antigen presenting cells and understanding the role of MHC complex.

CO9. An overview of development and survival of lymphocytes, humoral immune response, production of effector T- cells and effector mechanisms.

CO10. Conceptualization of regulation of immune response, mucosal immunity, immunological memory, cytokines and chemokines. T- cell mediated regulation of immune response.

CO11. Illustration of allergy and hypersensitivity diseases, autoimmunity, transplant rejection and responses to alloantigens.

Special Group-Entomology-I Insect Morphology and Physiology

CO1. Insect are the most perfect group of animals on this earth. Each and every organ/ system is effectively modified to sustain in its

environment. Therefore, it is of vital importance to study the morphology of head, thorax, abdomen, antennae, legs and genitalia.

CO2. Insect are the most perfect fliers and have the most perfect flight mechanism, therefore knowledge of wing structure and flight mechanism is necessary to evaluate and to use this principal for our use.

CO3. Insects feed on almost all organic matter on this earth-dried up leather to newspaper and dung. The mouth is accordingly modified into various patterns for efficient feeding. The digestive system also varies depending upon their feeding behavior.

CO4. Insect are the only animal on earth in which the respiratory system is completely separated from circulatory system. It is the only animal without respiratory pigment in their blood. The evolutionary significance and modification of these systems is important for basic studies.

CO5. Insect thrive in various environmental systems and conditions and need tremendous modification to extract oxygen for respiration.

CO6. The endocrine system in insect can be compared to the human because of its complicated mechanism and its functional similarity. Since the endocrine system has developed from the nervous system, the brain of insect is highly evolved to perform complex evaluation. Each cell of the nervous system performs differently in different condition.

CO7. Sense and pheromones use for communication in insects can be manipulated for pest control and therefore need thorough investigation.

CO8. The success of insect is because of its fecundity and short life cycle with many generations per year. The efficiency of its reproductive

system and the use of specialized reproductive mechanism: viviparity, polyembryony, paedogenesis and parthenogenesis and study of embryonic development and metamorphosis is necessary to control insect population for the benefit of human.

Special Group-Entomology-II Classification and Industrial Insects

CO1. Since 75% of world animal fauna is composed of insect study of their classification for their categorization and evaluation is important.

CO2. Starting with the very primitive orders i.e., Thysanura and Collembola which were the first stock of insects on this earth, they diverted to specialised organism feeding and living on birds and mammals as ectoparasite(Mallophaga and Siphunculata, Siphonaptera) to plant feeding and swarm forming (Orthoptera); specialized insect with sucking mouth parts feeding on blood and plant sap (Hemiptera) to the most beautiful and fascinating creation- butterflies (Lepidoptera) and the most populated group of insect of this earth- Beetles (Coleoptera). The study of these groups is of immense significance in entomology.

CO3. Industrial entomology is a much-needed branch which helps to financially substantiated framers and other marginalized people (Tribals/ Forest dwellers).

CO4. Detailed studies of economically important insects i.e., honey bee and silkworm.

CO5. Student will perceive about the bacterial and viral diseases in silkworm.

CO6. Detailed study of Lac insect-biology, lac cultivation and economic importance.

CO7. Detailed study of Eri sericulture includes life cycle, host plantrearing and silk production.

CO8. To know types of honey bee, life cycle, colony formation and apiary products.

Core (Subject Centric)- I Wild Life and Avian Biology

CO1. A descriptive study of the nature of ecosystem, production, food webs, energy flow, biogeochemical cycles, the resilience of the ecosystem, and ecosystem management.

CO2. Illustration of prey-predatory relationship, predator dynamics, optimal foraging theory and predatory dynamics.

CO3. The student will be able to understand the importance of various international conservation bodies like IUCN, UNDP, FAO, WWF, Red data book (of rare and endangered animals).

CO4. An overview of the avian systematic- their classification and sub-grouping based on morphology and other parameters.

CO5. Understanding the diversity and breeding biology of birds.

CO6. Description of biodiversity assessment and conservation of birds.

CO7. The student will study about bird study equipment, area of study, field data recording, bird photographyetc, to make them interested in Bird-watching.

CO8. The student will be able to study different types of nests, nest building, nest defense and modes of parental care.

SEMESTER IV

Biotechniques, Biostatistics, Ethology, Toxicology and Bioinformatics

CO1. Description of mean, median, mode and SD, Student 't' test and probability ztest, Chi square test.

CO2. Understanding the requirements for cell culture; aseptic technique; primary culture; cell lines.

CO3. Detailed study of toxicants related to Environment.

CO4. Familiarizing with various Applications of Bioinformatics.

CO5. To get an insight into the advancement in computerized biology information, introduction to genomics and proteomics databases.

CO6. Construction of phylogenetic trees using molecular data,

CO7. Illustration of protein data bases.

CO8. An introduction to Genbank, UCSC, ENSEMBL, EMBL, DDBJ, protein sequence databases: Swissprot, PDB, BLAST, PSI- BLAST (steps involved in use and interpretation of results).

CO9. An overview of databank search- data mining, data management and interpretation, multiple sequence alignment, genes, phylogenetic analysis. CO10. Developing compassion towards other animals through animal ethics.

Special Group-Entomology-I Sense organs, social life and Agriculture pests

CO1. Learning and understanding of different sense organs.

CO2. To understand social life and social behaviour of insects.

CO3. Importance and control measures of Agriculture pests.

CO4. Identifying pests of agricultural crops by analyzing ecology, pest status, features responsible for evolutionary success of insect species along with factors responsible for achieving the status of a pest.

CO5. An overview of identification, seasonal history, biology, nature of damage and control measures of pests, of cereals, pulse crops, cotton, vegetables, oil seeds, fruit crops, sugarcane and stored grains.

CO6. To understand the structure and functions of simple and compound eyes.

CO7. To understand the mechanism of light production and sound production in insects.

CO8. To study the sense organs of insects (mechanical and chemical) and their detailed structure this modifies from species to species.

CO9. To study the mechanism of immunity in insects so as to help in pest control management.

CO10. The household harmful insects- termites and ants studied with respect to their social life, polymorphism, nest building and social behaviour.

CO11. Parasitic Hymenoptera are used as biological control agents in agricultural fields. Its biology and its host specificity is studied to understand the mechanism of attack and damage.

CO12. Locust swarms are a major international hazard. Therefore, study of its migration is important

CO13. Rice, cotton and sugarcane, are major crops of central India. Pests of these cash crops are studied with respect to their identification, life history, damage and control measures.

Special Group-Entomology-II Pest control measures and Insect vectors

CO1. To get thorough knowledge about the pest control measures i.e., from biological to the chemical.

CO2. Chemicals are used for insect control in agricultural fields, they belong to different groups (Inorganic, Chlorinated Hydrocarbons, Organophosphates). It is of vital importance to study their properties, mode of action and method of application and also evaluate their toxicity level with respect to human and domestic animal.

CO3. Various natural organic compounds extracted from plants can be used to control insect pests and therefore it is necessary to study their properties, mode of action and method of application.

CO4. Biological control method is the safest method to control insect pest. Biological control agents (parasitoid, pathogen and predators) present in nature can be effectively and safely used for pest control.

CO5. The study on the uses of these biological control agents along with their life cycle and relationship with pest is the basic need to document its evaluation in a biological control program.

CO6. Microorganisms are effective pathogens infecting insects. The various types of viruses and bacteria in nature need to be categorized,

evaluated, mass produce and released in fields for various control measures.

CO7. The student also studies the use of all the above methods and also radiation, chemosterilants, hormones and pheromones in a systemic manner for IPM which is sustainable with little damaged to the environment.

CO8. Insects directly and indirectly (by acting as vectors of various diseases) cause major diseases in human and domestic animals. It is necessary to study these insects (Mosquito, flies, lice and fleas) with respect to their life cycle, nature of damage and control measures.

Radiation and Chronobiology

CO1. Student will study general classification of radiation, ionizing radiation, linear energy transfer, radiation dose and units.

CO2. To develop understanding of principles of radiation dosimetry, direct and indirect effects.

CO3. To study radiation sensitizers and protectors.

CO4. Learning and understanding Health consequences after total body irradiation from radiation accidents.

CO5. Detailed study of long-term radiation risks from low radiations doses.

CO6. Study in detailed about radiation induced cancer. CO7. Descriptive study of radiation effects in the developing embryo and fetus, radiation induced heritable diseases.

CO8. Description of milestones in clock research, biological rhythms, advancement in Chronobiology.

CO9. Learning and understanding of entrainment, masking and zeitgeber cycles, organization of circadian system in multicellular animals.

CO10. Understanding the central and peripheral clock system, circadian pacemaker system in invertebrates and vertebrates.

CO11. To develop understanding of diversity and complexity of the clock system, molecular Biology of the circadian pacemaker system.

CO12. Illustration of the relevance of biological clocks for human welfare - Clock function (dysfunction).

CO13. Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.

CO1. Description of transport across the plasma membrane. Understanding transepithelial transport, maintenance of cellular pH, cell excitation, bulk

Program Outcome (PO)

PO1: Understand the Structure and Functions of Nonchordates and Chordates, General Physiology, Advanced Reproductive Biology, Molecular Biology and Biotechnology.

PO2: Perform the laboratory procedures in the areas of Nonchordate and Chordate Taxonomy, General Physiology and Molecular Biology.

PO3: Analyse the relationship among man and parasites. Understand the concepts of Immunology. Understand the Ecosystems and Communities,

Adaptations and Animal Behaviour. PO4: Perform the laboratory procedures in Immunology and Environmental Biology.

PO5: It helps to provide holistic career development in securing job for lifelong learning.

PO6: It develop research attitude in various branches of Zoology.

M.Sc. Chemistry

Program Outcome (PO)

PO1- It helps to grab research opportunities to pursue Ph.D.

PO2- It helps to develop the ability to crack the target of CSIR-NET examination.

PO3- It creates job opportunities at pharmaceuticals as chemists, in material industries, in food products, in petrochemicals.

PO4- It develops the skill in problem solving and analytical reasoning as applied to scientific problems.

PO5- It develops the skill in handling sophisticated instruments like Spectrophotometer, Titration analyzer, Polarimeter, Refractometer, Flame-photometer.

PO6- It helps to carry out scientific experiments, to record the data and analyze the results.