Department of Zoology

Programme Outcome

Programme Specific Outcomes for Zoology

- the opportunity to develop a knowledge and understanding of living organisms at several levels of zoological and biological organization from the molecular, through to cells and whole organisms and ecosystems; all from an evolutionary perspective;
- an understanding of zoological systems and processes in theory and practice; exposure to a range of zoological concepts and core information on evolution; training in relevant laboratory and field work skills;
- an opportunity to develop a range of transferable skills (information and communication technology, team working, written and oral communication, time management, planning, data collection and presentation) and the capacity to give a clear and accurate account of the subject;
- an opportunity for you to develop the ability to think critically and to show that you can pursue independent study;
- an independent research project on a zoological topic;
- an education and training suitable for a wide variety of careers and to prepare you for higher degrees and careers in biological sciences research;
- the capability of life-long learning, study and enquiry.

Knowledge and Understanding

1. Students will be able to identify the major groups of organisms with an emphasis on animals and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of animals that differentiate them from other forms of life.
2. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped animal morphology, physiology, life history, and behavior.

3. Students will be able to explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behavior of different forms of life.
4. Students will be able to explicate the ecological interconnectedness of life on earth by tracing energy and nutrient flows through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems.

5. Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology.

Having successfully completed this programme you will be able to demonstrate knowledge and understanding of:

K1. fundamental knowledge & understanding of biology and zoology;

K2. the relevant knowledge of core concepts, principles, themes, terminology, and classification systems in the Zoological disciplines covered;

K3. theory and practice of acquisition, analysis and interpretation of zoological data across a range of biological applications;

K4. detailed knowledge and advanced understanding within zoology options selected from the range available:

K5. the principles of nutrient and energy flow through individuals, populations and communities;

K6. describe and exemplify patterns of distribution of organisms in relation to biotic and abiotic factors;

K7. demonstrate knowledge of population processes, dynamics and interactions, and associated theoretical models;

K8. demonstrate knowledge of community structure, development, biodiversity, and associated theoretical models;

K9. demonstrate awareness of human interactions with natural populations and ecosystems, including habitat modification, pollution, exploitation and conservation;

K10. carry out routine investigations as instructed, using ecological methodologies and data analyses;

K11. appreciate the different levels of studying the behaviour of animals;

K12. describe mechanisms for the life processes and appreciate how the physiology of an organism makes it fit for its environment;

K13. show knowledge of the main principles of genes and gene expression;

K14. understand how the diversity of organisms on earth evolved, and how they identified and classified;

K15. appreciate the ecological and evolutionary interactions of organisms with each other and the environment;

K16. have an understanding of the cellular and genetic mechanisms of animal development;

K17. understand how the principles of genetics underlie much of the basis of modern molecular biology;

K18. understand how the chemistry and structure of the major biological macromolecules, including proteins and nucleic acids, determines their biological properties;

K19. know and understand the structure and function of various types of cells in unicellular and multicellular organisms, the structure and function of cell membranes, cell differentiation

Learning outcome **CC1: Non-Chordates I**

Unit 1: Basics of Animal Classification

- describe the function of classification
- distinguish between taxonomy and systematics and be able to identify a classification as systematic or taxonomic
- describe the reasons for preferring natural classifications over artificial classifications
- describe the reason that classical taxonomy is an hierarchical scheme of classification
- describe the role that key characteristics play in taxonomy
- describe why consistency is both valuable for taxonomy and hard to achieve.
- Rules of Zoological nomenclature

Unit 2: Protista and Metazoa

- Student possesses the general knowledge of life functions of representatives of the kingdomsProtista and Animalia and of relations between the different groups of heterotrophs; knows the phylogenetic relationships between the major taxa of Animalia
- Movement in Euglena, *Paramoecium*
- Process of conjugation in *Paramoecium* and its significance
- Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*
- Evolution of symmetry and segmentation of Metazoa

Unit 3: Porifera

- Describe common and distinctive features of Porifeans and classification upto class
- Description of the canal system in sponges and spicules and its significance

Unit 4: Cnidaria

- Describe distinguishing characteristics of the phylum Cnidaria and Classification up to classes
- Describe cnidarian body symmetry, forms, anatomy, and specialized stinging cells;
- Describe diploblastic and tissue-level organization
- Metagenesis in *Obelia* & *Aurelia*
- processes that build, structure and destroy coral reefs; the interaction of the major biological, geochemical and hydrodynamical mechanisms that govern the functioning of the reef ecosystem. Topics include the biology of reef organisms and the processes that threaten reef ecosystems worldwide.

Unit 5: Ctenophora

- General characteristics of the phylum

Unit 6: Platyhelmonthes

- describe the general characteristic features of the group of animals and Classification up to classes
- Life cycle and pathogenicity and control measures of two parasitic species of the phylum ;- *Fasciola hepatica* and *Taenia solium*

Unit 7: Nematoda

- describe the salient features of the phylum and Classification up to classes
- Life cycle and pathogenicity and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti*

Learning outcome **CC2: Ecology**

Unit I: Introduction to Ecology

- define ecology
- distinguish among allied scientific disciplines (environmental science, conservation biology, restoration ecology, and environmental engineering) and compare their purposes with that of ecology.
- describe at least 6 ecosystem services important to human ecology.
- define the subdisciplines of ecology.
- place the subdisciplines of ecology into a hierarchical organizational scheme based on physical scale

- explain in what manner the concept of emergent properties justifies studying ecology within an hierarchical framework.
- describe the scientific method.
- describe the application of the scientific method to ecological experimentation.
- Describe laws of limiting factors like temperature, light etc.

Unit II: Population ecology

- define demography and describe a life table.
- give the name of and define the following symbols used in demographic studies: x, n_x, l_x, d_x, q_x, e_x, b_x, m_x, R_0, T_c.
- draw Type I, II, and III mortality curves and determine where, on the graph, the death rate is maximal and minimal.
- describe changes in age-specific death rates that lead to Type I, II, and III mortality curves.
- define life expectancy and name the elements of the life table necessary to calculate and estimation of life expectancy.
- calculate the net replacement rate from age-specific survivorship and birth rates and define net replacement rate.
- derive the geometric growth equation using the net replacement rate and use the equation to predict population growth.
- write the equation for exponential population growth and define each variable and term.
- contrast predictions of the geometric and exponential models by drawing a graph of each.
- define the intrinsic rate of natural increase and relate it to the net replacement rate.
- correctly apply either exponential or geometric population growth models to given scenarios.
- define logistic population growth and correctly argue that it represents density-dependent population growth.
- write the equation for logistic population growth rates and define each of the variables and terms in the equation.
- draw a logistic (sigmoid) population growth curve and estimate the population growth rate at specified points on the curve using the concept of tangents to a curve.
- define asymptote, K, and r.
- name the assumptions of the logistic population growth model and predict the effect of a violation of each assumption on logistic population growth.
- define lag time and, using graphs, predict its effect on the outcome of logistic growth models.
- distinguish between density-dependence and density independence.
- distinguish between scramble and interference competition.
- explain how dispersal, social behavior, and territoriality can act as density-dependent population regulatory mechanisms

Unit III: Community ecology

- distinguish between biotic assemblages and communities.

- describe emergent properties of communities
- define species richness, diversity, and evenness.
- distinguish between dominance and information-based diversity indices.
- calculate the Simpson, Shannon-Weiner diversity indices.
- relate changes in environmental heterogeneity to changes in biodiversity.
- relate changes in environmental quality to changes in biodiversity using the concept of size symmetry.
- contrast direct with indirect effects and give examples involving competition, mutualism, and parasitism.
- define the ecological concept of dominance.
- define keystone species and their impact on biodiversity.
- distinguish top-down from bottom-up effects given scenarios involving multi-trophic level interactions.
- explain how zonation comes about and how the resulting edge effects affect diversity.
- define ecological succession.
- distinguish between primary and secondary succession.
- describe pioneer, intermediate, and climax seres.
- criticize Clementsian succession.
- describe alternative models of succession (Assembly Rules, Inhibition Model, and Tolerance Model).

Unit IV: Ecosystems

Students will be able to:

- define ecosystems and emergent properties associated with ecosystems
- list, define and relate ecosystem measurements (biomass, energy flow, and nutrient flow) to ecosystem emergent properties.
- define a food web.
- define and diagram flows of material or energy between trophic levels.
- name the levels of the trophic pyramid
- define decomposers and transformers and explain the challenge they raise to the hypothesis that the trophic pyramid is an accurate depiction of natural community structure.
- define and give a hypothetical example of a trophic cascade.
- define standing crop and distinguish it from productivity.
- explain how the laws of thermodynamics constrain energy and material flows in ecosystems.
- define primary production.
- describe the methods for determining primary production in terrestrial and aquatic ecosystems.
- relate standing crop to production.
- distinguish gross and net primary production.
- relate net primary production to net biomass change.
- define production efficiency and state general levels of efficiency (both for GPP and NPP).

- define eutrophication and list the anthropogenic reasons for it.
- define secondary production.
- distinguish between herbivores and detritivores.
- distinguish between gross and net secondary productivity.
- relate primary and secondary producer efficiency to Lindeman efficiency.
- define nutrient cycling and associated terms (nutrient pool, flux rate, source, sink).
- diagram the global nitrogen cycle

Unit V: Applied Ecology

- definition of conservation of wild animals
- types of conservation :- in situ and ex situ conservation methods
- management strategies for conservation of wild animals
- idea about national park, wildlife sanctuary and biosphere reserve
- Wildlife Protection Act of India

B.SC PART-II (H)

PAPER-V

A) COs for the course of 'ZOOGEOGRAPHY AND ADAPTATION'.

CO1) Schematically describe the different events of the Geological time scale.

CO2) Name the different Zoogeographical realms with examples of different flora & fauna.

CO3) Describe the various types of morphological and physiological adaptations in fish & whale.

CO4) Briefly discuss how desert animals adapt to the extreme environmental conditions, with emphasis on the physiological adaptations in camel.

CO5) Describe the different adaptive significances of mimicry and coloration with examples.

B) COs for the course of 'EVOLUTIONARY BIOLOGY'.

CO6) Write down the chemical basis of origin of life, highlighting on the Haldane-Oparin concept.

CO7) Describe the various postulates in relation to the Modern Synthetic Theory of Evolution.

CO8) Describe the role of Isolation in Speciation.

CO9) Describe the major postulates of Hardy-Weinberg Equilibrium.

CO10) Discuss the major factors that deviate Hardy-Weinberg Equilibrium, emphasizing on Genetic Drift.

PAPER-VI

A) **COs for the course of 'CELL BIOLOGY'**.

CO1) Discuss about the Fluid-Mosaic Model of Plasma Membrane. Add a note on the functions of Golgi Apparatus & Ribosme.

CO2) Describe the structure of mitochondria. Add a note on Oxidative phosphorylation.

CO3) Describe the structure of mRNA. Write down the structural features of clover leaf model of tRNA.

CO4) Define DNA packaging. Discuss the structure of nucleosome, for the formation of metaphase chromosome.

CO5) Describe the role of cyclin-CDK in regulation of cell cycle. Briefly discuss the significance of Synaptonemal Complex.

CO6) Name the various types of cytoskeletal elements present in cell. State the role of spindle apparatus in cell division.

B) **COs for the course of 'GENETICS'**.

CO7) Describe the Mendel's Laws of Heredity with suitable examples and crosses.

CO8) Discuss about the deviations of Mendel's Laws, with special emphasis in Incomplete dominance, Multiple Allelism, Pleiotropism, Co-dominance.

CO9) Describe the genetic basis of Human blood group, explaining it with suitable crosses.

CO10) Describe the mechanism of crossing over highlighting on The Holliday Model.

CO11) Define Linkage. Define the different types of linkage and explain them with suitable examples.

CO12) Define autosomal inheritance. Describe a few examples of autosomal inheritance in man.

CO13) Discuss the mechanism of sex determination in Drosophila with special reference to sxl and tra genes.

CO14) Define Genic balance theory. Describe the chromosomal basis of sex determination in Drosophila.

CO15) Define Sex linked inheritance. Colorblindness is a recessive sex linked disorder. Explain with examples.

PAPER-VII

A) COs for the course of 'BIOCHEMISTRY, BIOLOGICAL TOOLS & TECHNIQUES'.

CO1) Write notes on the following: Optical Isomerism, Hydrophobic & Hydrophilic Interaction, S-S bond.

CO2) State the significances of pH & buffer in organism. Add a note on the importances of osmosis & diffusion.

CO3) Write notes on the following: epimerism, anomerism, mutarotation & D-L isomerism.

CO4) Define Ramachandran Plot. Describe the secondary structure of protein, highlighting on the different bonds that stabilize them.

CO5) Classify enzymes with suitable examples. State how temperature, pH and substrate concentration affect enzyme activity.

CO6) Write and deduce the Michaelis-Menten equation of Enzyme Kinetics. Write down the role of inhibition on enzyme action.

CO7) Distinguish between light and electron microscope. Discuss the working principle of bright field microscope.

CO8) Discuss the working mechanism of SEM & TEM with a labeled diagram.

B) **COs for the course of 'METABOLISM AND PHYSIOLOGICAL PROCESSES'**.

CO9) Describe the various reactions of glycolysis. Discuss how glycolysis is regulated.

CO10) Describe the Pentose Phosphate pathway. Gluconeogenesis is almost the reverse of glycolysis. Explain.

CO11) Distinguish between oxidative and non-oxidative deamination. Describe the steps of reactions of transamination.

CO12) Distinguish between saturated and unsaturated fatty acids. Discuss the steps of reactions involved in an even and odd chain fatty acid.

CO13) Discuss the steps of reactions of TCA cycle. TCA cycle is amphibolic in nature. Expain.

CO14) Describe the mechanism of oxygen transport. Add a note on co-operative binding of oxygen with hemoglobin.

CO15) Distinguish between Bohr & Haldane Effect. Discuss the mechanism of CO_2 transport in human blood.

CO16) Discuss the mechanism of nerve impulse propagation and muscle contraction.

B.SC PART-III (H)

PAPER-IX

C) **COs for the course of 'ETHOLOGY AND BIODIVERSITY CONSERVATION'**.

CO1) Distinguish between Innate and Learned Behavior. Briefly discuss the mechanism of Fixed Action Pattern.

CO2) Define Egocentric behavior. Write notes on: altruism and kinship.

CO3) Define mating system. Discuss the different mating strategies seen in animals.

CO4) What is meant by conservation? Distinguish between in-situ and ex-situ conservation.

CO5) India is a country of Mega-diversity. Explain.

CO6) Discuss the different management strategies for Tiger and Rhinoceros conservation in India.

D) **COs for the course of 'ECOLOGY'**.

CO7) Describe the different components of ecosystem with suitable examples.

CO8) Define Limiting factor. Discuss the role of temperature on the growth and development of biota.

CO9) What is meant by ecological efficiency? Describe the different models of energy flow in ecosystem.

CO10) Write notes on the following: natality, mortality, population density. Discuss the different factors affecting population density.

CO11) Define Resource partitioning. Define niche. Explain the terms- spatial and multidimensional niche.

CO12) Define Ecological succession. Describe the various theories and models of ecological succession.

CO13) Discuss the salient features of Indian Rain Forest.

E) COs for the course of 'BIOMETRY'.

CO14) Discuss the importances of biometry in zoology with examples.

CO15) Write notes on the following: theories of probability, goodness of fit & student-t-Test.

CO16) Discuss the properties and importances of Sampling.

F) **COs for the course of 'APPLIED ZOOLOGY'**.

CO17) Define Induced breeding. Discuss the steps followed in Induced Breeding.

CO18) Discuss the diseases and pests & their control in *Bombyx mori*.

CO19) Name some common diseases with their causative agent and control measures in Fowl. Add a note on the advantages and disadvantages on Deep Litter system.

CO20) Describe the different cattle breeds in India with suitable examples.

CO21) Discuss the various methods of mechanical and chemical control of pests.

CO22) Define Intergrated Pest Management (IPM). Describe the life and control measures of *Nilaparvata*.

G) **COs for the course of 'MICROBIOLOGY, PARASITOLOGY & MEDICAL ENTOMOLOGY'**.

CO23) Discuss the various flora present in human gut and their protective role.

CO24) Distinguish between gram positive and gram negative bacteria. Describe the structure of bacteria with a diagram.

CO25) Write notes on; phoresis, commensalism, parasitism and mutualism.

CO26) Describe the various morphological and physiological changes associated with host-parasite interaction.

CO27) Describe the life cycle and pathogenicity of *Wuchereria bancrofti* and *Ascaris lumbricoides*.

CO28) Discuss the life cycle and control measures of *Anopheles* & *Culex*.

PAPER-X

A) **COs for the course of 'MOLECULAR BIOLOGY AND BIOTECHNOLOGY'**.

CO1) DNA replication is semi-conservative & semi-discontinuous. Explain. Discuss the various factors and enzymes involved in DNA replication.

CO2) Describe the process of DNA replication in *E.coli*.

CO3) Discuss the various structural and numercal changes associated with chromosomal aberration.

CO4) Write down the causes and symtoms of Down & Turner syndrome.. Write down the chromosomal arrangement in Down, Turner, Klinefelter & Cri-du0chat syndrome.

CO5) Describe the process of transcription in prokaryotes and eukaryotes.

CO6) Discuss the properties of genetic code. Describe Wobble Hypothesis.

CO7) Discuss the steps of translation in prokaryotes. Add a note on tRNA charging.

CO8) Define Operon. Distinguish between Inducible and Repressible Operon. How does the Lac Operon operate in presence and absence of lactose?

CO9) Briefly discuss the different types of tumor. Differentiate the properties of normal and transformed cells.

CO10) Describe the biochemical basis of PKU and albinism. Describe the molecular mechanism of Sickle-cell anemia & Thalassemia.

CO11) Define Recombinant DNA. Describe the properties of restriction enzymes and vectors used in genetic engineering.

CO12) Describe the steps of DNA cloning. Discuss the applications in biotechnology in modern days.

CO13) Describe the DNA fingerprinting and its applications.

B) COs for the course of 'HUMAN IMMUNOLOGY'.

CO14) Describe the structure of an antibody. Discuss the various properties of different classes of antibodies.

CO15) Give an outline classification of various cells and organs involved in immune system.

CO16) Distinguish between: innate and adaptive immunity; humoral and cell mediated immunity. Describe the properties of antigens.

C) **COs for the course of 'DEVELOPMENTAL BIOLOGY'**.

CO17) Describe the process of germ cell migration in mammals. Distinguish between spermatogenesis and oogenesis.

CO18) Describe the process of spermatogenesis and oogenesis with diagram.

CO19) Discuss the different physical and biochemical events associated with fertilization.

CO20) Describe with examples the different types of eggs. Comment on the role of yolk in cleavage.

CO21) Define Inductance and Competence. Discuss the role of induction and competence in development of eye in chick.

CO22) Describe the development of extra-embryonic membrane in chick. Classify mammalian placenta with suitable examples.

CO23) Describe the various steps for the development of heart in chick.

CO24) Define regeneration. Describe the basic mechanism of regeneration in *Hydra*.

D) **COs for the course of 'ENDOCRINOLOGY'**.

CO25) Describe the location of the major endocrine glands in vertebrates and invertebrates. Name the major hormones secreted from them.

CO26) Discuss the functions of pituitary hormones, stating their chemical nature.

CO27) Write notes on the following: gigantism,acromegaly,cretinism, myxoedema, goiter.

CO28) Describe the process of synthesis of thyroid hormones. Describe the functions of thyroid hormones.

CO29) Give an outline of the various parts of adrenal gland, focusing on the hormones secreted from them.

CO30) Describe the process of formation of adrenal steroids and adreno-medullary hormones.