

Course Outcomes for B.Sc, Zoology (Hons)

Semester I Honours Course ZOOA

CC1: Non Chordata-I (Protists to Pseudocoelomates)

- ❖ Students will be able to appreciate the diversity of life and will develop a critical understanding of how animals changed from a primitive cell to a collection of cells to a complex body plan.
- ❖ The basic concept of biosystematics and the taxonomic status of the non-chordates up to nematoda.
- ❖ Knowledge about some of the important and common protozoan, helminths of parasitic nature causing diseases in human beings.
- ❖ Understanding of some special features like polymorphism Cnidaria, conjugation in Paramecium, parasitic adaptation in helminthes.
- ❖ Knowledge about the staining technique and slide preparation of protozoan animals and identification of few selective animals from all groups.

CC2: Molecular Biology

- ❖ Students will develop a thorough grasp over the concepts, and relevance of molecular biology in the present-day world
- ❖ Understanding of the molecular structure of genetic materials and the mechanism of gene expression, regulation and DNA repair mechanism
- ❖ Concept about some molecular biology techniques like PCR, Western blot etc
- ❖ Students will be able to perform DNA isolation, gel electrophoresis and DNA/RNA staining.

Semester – II Honours Course ZOOA

CC3: Non Chordata-2 (All Coelomate Phyla)

- ❖ Upon successful completion students will have knowledge about the general characters and classification of non-chordates (from annelida to hemichordata)
- ❖ Understanding of some special features like metamerism in annelids, Metamorphosis in insects, etc.
- ❖ Identified a few selective animals from all groups,
- ❖ Anatomical study of different systems by dissecting cockroaches.

CC4: Cell Biology

- ❖ Students will acquire knowledge about Ultra-structure, composition, function of different cell organelles and how different pathways are related to cellular functioning in healthy and diseased states
- ❖ Concepts about different cell biology techniques like preparation of barr body, temporary squash of cell division from onion root tip and grasshopper testis, DNA staining by Feulgen and cell viability assay by trypan blue will develop.

SEM III Honours Course ZOOA

CC5: Chordate

- ❖ The general characters and classification of chordates are described.
- ❖ Students can gather knowledge in comparative anatomy and development systems of chordates.
- ❖ They can discuss some and very important phenomena in Chordates.
- ❖ They could identify the taxonomic status of the entire chordates.
- ❖ In laboratory course students have a good exposure to various Museum specimens of Zoological importance and anatomical study in dissection.

CC6: Animal physiology

- ❖ Students attained knowledge about composition and function of certain systems like bone and cartilage, nervous system, muscular system, reproductive system, and endocrine system.
- ❖ They learnt about structure, classification, and function of different tissue in our body.
- ❖ Students can learn the preparation of permanent slide of different tissue with Microtomy machine.
- ❖ They could prepare temporary mount of tissues like squamous epithelium, striated muscle and nerve cells.

CC7: Biochemistry

- ❖ Students can acquire the knowledge of macromolecules such as carbohydrates, protein and fat, their types and significance.
- ❖ They understand the knowledge of cholesterol and its biological significance. The knowledge of enzymes, mechanism of enzyme action and factors affecting the enzyme activity can also be understood from this course.
- ❖ In laboratory course students can analyse qualitatively carbohydrates, proteins and lipids, urea and uric acid and quantitatively proteins by Lowry method. The principle and applications of paper chromatography of amino acids are demonstrated experimentally.

SEC (A) 1: Apiculture

- ❖ Students could acquire knowledge on Biology, rearing, diseases, and economic importance of bees and also their enemies.
- ❖ They also learnt about the entrepreneurship in Apiculture.

SEC (A) 2: Sericulture

- ❖ Students could acquire knowledge on Biology, rearing and economic importance of silkworm and their diseases.
- ❖ They also learnt about the entrepreneurship in silk industry.

SEM IV Honours Course ZOOA

CC8: Comparative anatomy of vertebrates

- ❖ Students will learn the types, composition, and function of integumentary system, comparative anatomy of digestive system, respiratory system, circulatory system, urinogenital system, nervous system.
- ❖ Students will learn about the skeletal system of mammals by studying the axial and appendicular skeleton.
- ❖ Students will learn about different types of scales, axial and appendicular skeleton of toad, pigeon, guineapig, and skull of dog.

CC9: Animal Physiology: Life Sustaining Systems

- ❖ Students will gain knowledge about the components different systems such as digestive system, respiratory system, circulatory system, renal system, and they will come to know about the function of those systems.
- ❖ Students will learn about thermoregulatory and osmoregulatory mechanisms.
- ❖ Students will learn to detect the blood group, haemoglobin content of blood, learn to measure the blood pressure.
- ❖ Students will understand about the haemin crystals and haemochromogen crystals and will learn to identify blood cells from human blood and from cockroach haemolymph.

CC10: Immunology

- ❖ Students will understand about the immune system, cells and organs involved. Will learn about the mechanism of action of immune system.
- ❖ Students will gain knowledge about the antigens and their properties.
- ❖ Students will understand about mechanism of function of antibody, types of antibodies, MHC molecules, types of cytokines and their functions.
- ❖ Students will come to know about the complement system, hypersensitivity reactions and will learn about the types of vaccines and their mechanism of action.
- ❖ Students will attain knowledge about the histological structure of lymphoid organs.
- ❖ Students will understand the mechanism of ELISA action.

SECB1: Aquarium fish keeping

- ❖ Students will learn about freshwater and marine aquarium fishes, the feeding of fishes, maintenance of aquarium.
- ❖ Students will understand about scope of fishery industry and will learn about the live fish transport processes.

SECB2: Medical diagnostic technique

- ❖ Students will understand and learn about different methods used in analysis of blood and urine.

- ❖ Students will learn about different biochemical and microbiological tests.
- ❖ Students will come to know about types of tumors and learn to analyze tests such as X ray, MRI, PET, CT scan.

SEM V Honours Course ZOOA

CC 11: Ecology

- ❖ After completing this course, students will be able to understand the need and importance of Autecology and synecology, Levels of organization, Laws of limiting factors, and Study of Physical factors and the Biosphere.
- ❖ After completing this course, students will be able to know the need and importance of the ecosystem, food chain, energy flow, biotic and abiotic factors, and animal ecology.
- ❖ They will be able to know the concepts of population, community, wildlife protection Act and conservation. Moreover, they will acquire knowledge on determining the water sample's CO₂, O₂ and pH. After an educational tour, they can prepare a report on a National Park/Biodiversity Park/Wildlife sanctuary/ any place of ecological interest/ ecological uniqueness.
- ❖ Based on studies, they can engage in field-based research activities on different aspects of Ecology.
- ❖ They will also be able to design experiments and analyze different biological problems that have a good impact on the national and international levels.

CC12: Principle of Genetics

- ❖ After completing this course, students will be able to understand the need and importance of Mendelian Genetics and its Extension, Linkage, Crossing Over and Linkage Mapping, Sex Determination, chromosomal aberrations and mutations, Extra-chromosomal Inheritance, Genetic Fine Structure, Transposable Genetic Elements. Based on studies, they can engage in field-based research activities on different aspects of Genetics and will be able to solve genetic problems.
- ❖ They will also be able to design experiments and analyse different biological problems with the help of Chi-square analysis, which have a good impact on the national and international levels. Moreover, genetic disorders can be studied based on pedigree studies and chromosomal aberrations.
- ❖ They will also be able to design experiments and analyse different genetical problems at a clinical level that have a good impact on society.

DSE A1: Parasitology

- ❖ After completing the course, the students will be able to understand the host-parasite relationship, the study of life cycles of parasites, the mechanisms for transmission, virulence and pathogenicity of parasites, diagnose the causative agents, pathogenesis and treatment for essential diseases like malaria, leishmaniasis, trypanosomiasis, toxoplasmosis, schistosomiasis, cysticercosis, filariasis etc., and the importance of prevalence and epidemiology in parasitic infection.
- ❖ They will also be able to know the biology and importance of parasitic arthropods and parasite vertebrates.
- ❖ They will also be able to design experiments and analyze different epidemiological diseases at a clinical level that positively impact society.

DSEA2: Biology of Insects

- ❖ After completing the course, the students will be able to understand the general idea of Insect taxonomy, the general morphology of Insects, physiology of Insects regarding the digestive, respiratory, endocrine and nervous systems.
- ❖ Students will be able to learn about the photoreceptors, metamorphosis and neuroendocrine control of the metamorphosis of Insects.
- ❖ Students will understand the mechanical and biological vectors, different kinds of antennae, legs and mouth parts of insects, study the beneficial insects and pests, and the mounting process and methodology of insect collection, preservation and identification.
- ❖ This study will help students to build their career opportunities as Entomologists and Agricultural scientists.

DSE B1: Endocrinology

- ❖ After completing the course, the students will be able to understand the general idea about the endocrine system concerning knowledge of the human body.
- ❖ Students will be able to understand the Neuro-secretions, Neuro-hormones, Structure and functions of the hypothalamus and Hypothalamic nuclei, structure and function of different endocrine glands and regulation of hormone action.
- ❖ Students will understand Tissue fixation, embedding in paraffin, microtomy and slide preparation, and the endocrine gland study.
- ❖ This study will help students to build their career opportunities as pathologists, clinicians and allied medical fields.

DSE B2: Reproductive Biology

- ❖ After completing the course, the students will understand the general idea about Reproductive Endocrinology, functional anatomy of male and female reproduction, reproductive health regarding male and female fertility, *in vitro* fertilization, i. e. IVF, IUI and modern contraceptive technologies.
- ❖ Students will be able to learn about the animal house set-up and maintenance, breeding techniques, and the care of routine and experimental animals.
- ❖ Students will understand tissue fixation, embedding in paraffin, microtomy, slide preparation and study of the endocrine glands.
- ❖ This study will help students to build their career opportunities as pathologists, clinicians and allied medical fields.

SEM VI Honours Course ZOOA

CC13: Developmental Biology

Students will be able to understand-

- ❖ the process of development of complete organism from a single cell
- ❖ the process of organogenesis, development of extra embryonic membrane and and physiology of placenta
- ❖ the concept of molecular induction, differential genetic expression and functional network necessary for the establishment of complex individual structure
- ❖ the perception of *In-vitro* fertilization, stem cell therapy in bone marrow transplantation alongwith cartilage regeneration.
- ❖ the process of Identification of non-chordate larvae that finally may help to examine the evolutionary history of the taxa based on developmental affinities.
- ❖ Overall studies may help to generate the knowledge about the role of developmental biology in the generation of congenital diseases.

CC14: Evolutionary Biology

Students will be able to understand-

- ❖ The theories of evolution along with evidences in support of evolution and role of mutation, migration, natural selection, sexual selection, genetic drift as well as interaction among them over ecological scale and evolutionary time.
- ❖ The origin and evolution of life along the geological time scale upto man

- ❖ The concept of species, different isolating mechanisms, adaptive radiation, population genetics and extinction.
- ❖ The phylogenetic tree concept and its construction using parsimony, convergent and divergent evolution.
- ❖ The structure of fossils from models/pictures as well as homology and analogy from suitable specimens.
- ❖ Overall studies may help them to develop evolutionary hypotheses for a wide variety of biological phenomena and apply the concept of evolutionary principles in the research dealing with evolutionary biology.

DSE A1: Animal Cell Biotechnology

Students will be able to understand-

- ❖ Concept, scope of Biotechnology and its application in human health
- ❖ Techniques of Gene Manipulation, sample isolation, identification and analysis, cell culture and fermentation
- ❖ Practically techniques like genomic and plasmid DNA isolation, agarose gel electrophoresis, western blot, southern blot, DNA finger printing, PCR, preparation of culture media, packing of plastic wares and glassware for sterilization etc. by hands on training.
- ❖ Overall studies may help them to develop their knowledge as well as skill of biotechnological approaches both theoretically and practically. This in turn also facilitates them to apply the concept of techniques regarding cell culture, sample separation and isolation by molecular methods in the research dealing with disease and human health in future.

DSE A2: Animal Biotechnology

Students will be able to understand-

- ❖ Genomic structure of *E coli* and *Drosophila*
- ❖ Techniques of Gene manipulation like recombinant DNA technology, cloning and construction of genomic and cDNA libraries
- ❖ Concept on certain molecular Biology techniques such as electrophoresis, blotting, PCR, DNA finger printing as well as their application
- ❖ Perception of cell culture, cloning and transgenesis for the field of research, diagnosis of genetic diseases and pharmaceuticals.
- ❖ Practically techniques like genomic and plasmid DNA isolation, western blot, southern blot, DNA finger printing, PCR by hands on training.
- ❖ Overall studies may help them to develop their knowledge as well as skill of biotechnological approaches for the identification of genetic diseases and followed by gene therapy for the same.

Preparation of project report on animal cloning and application and ethical issues also assists them to conduct research on metabolic disorder and human health in future

DSE B1: Animal Behavior and Chronobiology

Students will be able to understand-

- ❖ The patterns of behavior: stereotype, instinctive and learning behaviour, social and sexual behaviour, Chronobiology and Biological rhythm of animal.
- ❖ The nesting behavior of birds and insects, geotaxis behavior of earthworm, response of woodlice to dry and humid condition and phototactic behaviour in insect larvae.
- ❖ the circadian functions in humans by preparing a project on it.
- ❖ Overall studies may help them to get knowledge about the development of learning behaviour and its imprinting, process of communication within social insects; reason of cooperation and selfishness demonstration, mate choice, parental care as well as conflict within families, adaptive movement, regulatory factor of biological rhythm and effect on migration. Visit to forest/Biodiversity Park/Wildlife sanctuary/Zoological Park aids in study of behavioural patterns of animals against different variables in natural/in situ/ex situ condition.

DSE B2: Fish and fisheries

Students will be able to understand-

- ❖ About the feeding habits, reproduction, morphology, physiology of cultivable fishes.
- ❖ Types of fisheries and aquaculture, depletion of resources and application of GIS for identification of status as well as problems and necessary law as well as regulations regarding the same.
- ❖ Informations about the management of hatcheries/aquarium, fish diseases and their remedies, fish by products also about transgenic and zebra fish with special reference to their utility in research.
- ❖ The process of identification of different types of fish specimens and air breathing organs.
- ❖ The use of adaptively structured crafts and gears used in fisheries
- ❖ The importance of regular assessment water quality (pH, salinity, Alkalinity) for sustenance of fish health, growth and productivity.
- ❖ Overall studies may help them to get knowledge about the fish farm management, preservation and processing of harvested fish, fish disease identification and remedies as well as use of remote sensing for resource management. Preparation of project report on a visit to a fish farm/pisciculture unit/Zebrafish rearing lab facilitates them to conduct research on fish biology, regulatory environmental/aquatic parameters, morphometric diagnosis of diseases and crafts-gears used in fisheries.

Programme Outcome for B.Sc Zoology (Hons)

After successfully completing B.Sc. in Zoology:

- ❖ The students will gain overall knowledge on the animal world, their habits, morphology, evolution, and the role in the environment. This will inculcate to them the importance of every surviving animal in the earth and necessity of their presence for the survival of the ecosystem.
- ❖ The study of Molecular Biology, Biochemistry, Immunology, Parasitology, and Developmental Biology will help the students to gain deep knowledge in the life processes and will provide them scope in research. Biotechnology will provide impetus to the students to the use of various technologies in the field of biology.
- ❖ The use of animals in the welfare of human society like Apiculture, Sericulture, Poultry, Lac-culture, etc. Research in this field will provide different job-oriented courses which will be beneficial to the students.
- ❖ Visits to national parks or sanctuaries or biosphere reserves help students learn various conservation techniques, both in-situ and ex-situ, for animals and plants. This forest study will help students understand the importance of forests and their resources. This study provides an understanding of the status of various animals in their ecosystem and the need for conservation of threatened or endangered species.
- ❖ The study of pathogenic microbes will help the students to know about the mode of infection of those pathogens. Moreover, the control measures and the prophylactic measures will give a clear idea about how to manage the diseases and to design new medicines in combating the infections caused by harmful microbes.
- ❖ The study of taxonomy enables students to learn about the diversity and variability of the animal world. Taxonomy helps them identify unknown specimens and groups of animals in a systematic way through phenotypic or genotypic or behavioural characteristics.
- ❖ The concept of Ecology will enable the students to have an idea about the various pollutions in the ecosystem that are disturbing the balance of nature. The concept of sustainable development teaches the students to learn the optimum uses of the non-renewable resources of the earth and to apply methodologies for the use of renewable resources in the survival of mankind.
- ❖ The study of different ecosystems, including marine, forest, aquatic, wetlands, etc., gives students a better understanding of the diversity of ecosystems and their differences and interrelationships. The study provides an idea of the flora and fauna community of that ecosystem and the endemic species of the respective ecosystem.

Course Outcomes for B.Sc, Zoology (General)

SEM I General Course ZOOG

CC1: Animal diversity

- ❖ The course emphasized on the basic understanding of animal classification along with the general characteristic features ranging from protozoa to mammal.
- ❖ Distinction of all phylum /classes features of animal kingdom can be achieved by learning this course area with some sample model organisms of different phylum.

SEM II General Course ZOOG

CC2: Comparative anatomy and Developmental Biology

- ❖ To understand overall comparative composition and function of different organ systems of animal physiology can be gathered from this course part.

SEM III General Course ZOOG

CC3: Physiology and Biochemistry

- ❖ The mechanism of action through various system in animals' body can be attained from this section like digestive system, respiratory system, cardiovascular, nervous and renal system.
- ❖ Also, knowledge of macromolecules such as carbohydrates, protein and fat, their types and significance and metabolism can be gathered. Enzymes classification and factors affecting the enzyme activity is also covered under this area of course.

SEC A 1: Apiculture

- ❖ Students could acquire knowledge on Biology, rearing, diseases, and economic importance of bees and also their enemies. They also learnt about the entrepreneurship in Apiculture.

SEM IV General Course ZOOG

CC4: Genetics and Evolutionary Biology: (SEM IV)

- ❖ Theories of classical genetics, genetic variation through linkage and crossing over, chromosomal aberrations and sex determination etc is understandable by this section.
- ❖ Theories of evolution, process of evolutionary changes and speciation is also covered hereby in this course area.

SEC B 2: Aquarium Fish Keeping

- ❖ Students could acquire knowledge on Aquarium fish keeping through the knowledge of Biology of aquarium fishes where fresh water and marine water fishes are taught in detail.
- ❖ Food, feeding of fishes, live fish transportation, maintenance of aquarium are the knowledges they could acquire in detail.

SEM V General Course ZOOG

DSE A1: Applied Zoology

- ❖ Students will acquire knowledge on overview of parasitism, morphology, life cycle, and economic/medical importance of certain protozoan, helminthic nematode, arthropod and vertebrate parasites causing direct or indirect harm to mankind.
- ❖ Theoretical knowledge about the methods and practice of animal husbandry, poultry farming and fish technology.
- ❖ Students will gain practical knowledge through visiting a poultry farm or fishery.

DSE A2: Aquatic biology

- ❖ Students will acquire knowledge about different aquatic ecosystems.
- ❖ Students will learn about different ecological parameters of aquatic ecosystems.
- ❖ Students will gain knowledge about saline water ecosystems their compositions.
- ❖ They will learn about different mechanisms of management of aquatic resources.

SEC A 3: Sericulture

Students could acquire knowledge on Biology, rearing and economic importance of silkworm and their diseases. They also learnt about the entrepreneurship in silk industry.

SEM VI General Course ZOOG

DSEB1: Biology of insects

Students will gain knowledge about morphology, feeding habits of insects.

Students will understand the concept of vectors and will learn how some insects play role as vectors of certain diseases and prevention measures of those diseases.

DSEB2: Ecology and Wildlife Biology

Students will understand the concept of ecosystem and factors of ecosystem.

Students will understand about the concept of population and population attributes such as life tables, fecundity tables, survivorship curves, population regulations, growth curves.

Students will learn about the concept of community, structure of ecosystem and function of ecosystem.

Students will gain knowledge about conservation of different wild animals.

Students will come to know about different equipment used in wildlife studies and processes used in identification of wild animals.

Students will learn different processes used to study of an aquatic ecosystem.

SEC B 4: Medical Diagnosis

Students learnt about different methods used for analysis of blood and urine, and also certain biochemical and microbiological methods used for medical diagnosis. They acquired knowledge about some common non-infectious and infectious diseases.

Program Outcome for B.Sc Zoology (General)

- ❖ Knowledge on animal diversity and basic classification system can be gathered by this programme along with various features of different ecosystems.
- ❖ Economic zoology focuses on various parts, like: sericulture, apiculture, aquaculture for creating idea about the different dimensions zoology from where entrepreneurship concept can be developed.
- ❖ On the other hand, Industrial microbiology, recombinant DNA technology and medicine and diagnostic techniques helps to build career opportunities