



शिवाजी कॉलेज
(दिल्ली विश्वविद्यालय)
Shivaji College
(University of Delhi)



NAAC ACCREDITED "A" GRADE COLLEGE

Zoology

Learning Outcomes

First semester

Honours

ZH Core-I: Non-Chordata I: Protists to Pseudocoelomates

Upon completion of the course, students should be able to: · Learn about the importance of systematics, taxonomy and structural organization of animals. · Appreciate the diversity of non-chordates living in varied habit and habitats. · Understand evolutionary history and relationships of different non-chordates through functional and structural affinities. · Critically analyse the organization, complexity and characteristic features of non-chordates making them familiarize with the morphology and anatomy of representatives of various animal phyla. · Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem. · Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

ZH Core II: Perspectives in Ecology

Upon completion of the course, students should be able to: · Demonstrate an understanding of key concepts in ecology with emphasis on historical perspective, role of physical factors and concept of limiting factors. · Comprehend the population characteristics, dynamics, growth models and interactions. · Understand the community characteristics, ecosystem development and climax theories. · Know about the types of ecosystems, food chains, food webs, energy models, and ecological efficiencies. · Apply the basic principles of ecology in wildlife conservation and management. · Inculcate scientific quantitative skills, evaluate experimental design, read graphs, and analyse and use information available in scientific literature.

Life Sciences

LS core I: Animal Diversity

Upon completion of the course, students will be able to: • Learn Morpho-taxonomy and structural organization of non-chordate and chordate groups. • Acquire knowledge of diversity of non-chordate and chordate groups. • Learn evolutionary relationships and phylogeny of non-chordates and chordates through functional and structural similarities. • Understand the economic importance of non-chordates and chordates and their significance in the ecosystem. • Promote shared learning through practical classes, class room presentations and projects.

Second semester

Honours

ZH Core-III: Non-Chordata II: Coelomates

Upon completing the course, students should be able to: · Learn about the importance of systematics, taxonomy and structural organisation of animals. · Appreciate the diversity of non-chordates living in diverse habits and habitats. · Understand evolutionary history and relationships of different non-chordates through functional and structural affinities. · Critically think about the organisation, complexity and characteristic features of non-chordates. · Getting familiarised with the morphology and anatomy of representatives of various animal phyla. · Comprehend the economic importance of non-chordates, their interaction with the environment and their role in the ecosystem. · Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

ZH Core IV: Cell Biology

Upon completion of the course, students should be able to: · Understand fundamental principles of cell biology. · Explain structure and functions of cell organelles involved in diverse cellular processes. · Appreciate how cells grow, divide, survive, die and regulate these important processes. · Comprehend the process of cell signalling and its role in cellular functions. · Have an insight of how defects in functioning of cell organelles and regulation of cellular processes can develop into diseases. · Learn the advances made in the field of cell biology and their applications.

Life Sciences

LS Core II: Comparative Anatomy and Developmental Biology of Vertebrates

Upon completion of this course, students should be able to: • Know about the levels of organization among different groups of vertebrates. • Understand that different organs and organ systems integrate with each other to impart proper regulation of a particular function. • Understand how the various organs evolved during the course of evolution through succession. • Know the evolution of different concepts in developmental biology. • Be able to understand the process of gamete formation from stem cell population to mature ova and sperm. • Be able to comprehend the sequence of steps leading to the formation of gametes and development of embryo.. • Learn the mechanisms underpinning cellular diversity and specificity in animals. • Study the methods and tools related to developmental biology which help to understand different processes of embryogenesis.

Generic Elective paper

Paper-GE Human Physiology (Paper offered to students opting for Zoology as their GE, not meant for Zoology hon. students or students having main or core Zoology)

Upon completion of the course, students will be able to: · Know the principles of normal biological function in human body. · Outline basic human physiology and correlate with histological structures. · Understand how animals maintain an internal homeostatic state in response to changes in their external environment.

Second year

Third semester

Honours

ZH Core V: DIVERSITY OF CHORDATES

Upon completion of the course, the students will be able to: · Understand different classes of chordates, level of organization and evolutionary relationship between different subphyla and classes, within and outside the phylum. · Study about diversity in animals making students understand about their distinguishing features. · Appreciate similarities and differences in life functions among various groups of animals in Phylum Chordata. · Comprehend the circulatory, nervous and skeletal system of chordates. · Know about the habit and habitat of chordates in marine, freshwater and terrestrial ecosystems.

ZH Core VI: Physiology: Controlling and Coordinating Systems

Upon completion of the course, students will be able to: • Know the fundamentals and understand advanced concepts to develop a strong foundation that will help them to acquire skills and knowledge to pursue advanced degree courses. • Comprehend and analyse problem-based questions • Recognize and explain how all physiological systems work in unison to maintain homeostasis in the body and use feedback loops to control the same • Learn an integrative approach to understand the interactions of various organ systems resulting in the complex overall functioning of the body. Synthesise ideas to make connections between knowledge of physiology and real-world situations, including healthy lifestyle decisions and homeostatic imbalances • Know the role of regulatory systems, viz. endocrine and nervous systems and their amalgamation in maintaining various physiological processes.

ZH Core VII: Fundamentals of Biochemistry

• Upon completion of the course, students should be able to: Gain knowledge and skill in the fundamentals of biochemical sciences, interactions and interdependence of physiological and biochemical processes. • Get exposed to various processes used in industries and gain skills in techniques of chromatography and spectroscopy. • Demonstrate foundation knowledge in biochemistry; synthesis of proteins, lipids, nucleic acids, and carbohydrates; and their role in metabolic pathways along with their regulation. • Know about classical laboratory techniques, use modern instrumentation, design and conduct scientific experiments, and analyze the resulting data. • Be knowledgeable in proper procedures and regulations in handling and disposal of chemicals.

SEC (Skill Enhancement Course): MEDICAL DIAGNOSTICS for Honours course

Gain knowledge about various infectious, non-infectious and lifestyle diseases, tumours and their diagnosis · Understand the use of histology and biochemistry of clinical diagnostics and learn about the molecular diagnostic tools and their relation to precision medicine. · Develop their skills in various types of tests and staining procedure involved in haematology, clinical biochemistry and will know the basics of instrument handling. · Learn scientific approaches/techniques used in the clinical laboratories to investigate various diseases and will be skilled to work in research laboratories. · Gain knowledge about common imaging technologies and their utility in the clinic to diagnose a specific disease.

Life Sciences

LS core III: Physiology and Biochemistry

Upon completion of the course, students would be able to: • Have an increased knowledge of human physiology and be able to appreciate its functions. • Understand the functions of major physiological systems in body. • Recognise and identify principal tissue structures. • Understand the metabolic pathways of carbohydrates, proteins, and fats; and appreciate how the cells harness energy. • Understand the importance of enzymes, mechanism of working and kinetics. • Relate how biochemical systems interact to yield integrated physiological responses. • Understand the principles and approach to experimental design. • Perform, analyse, and interpret basic experiments and observations in physiology and biochemistry.

SEC (Skill Enhancement Course): MEDICAL DIAGNOSTICS for Life Sciences

After completing this course, the students should be able to: • Gain knowledge about various infectious, non-infectious and lifestyle diseases, tumors and their diagnosis. • Understand the use of histology and biochemistry of clinical diagnostics and learn about the molecular diagnostic tools and their relation to precision medicine. • Develop their skills in various types of tests and staining procedure involved in hematology, clinical biochemistry and will know the basics of instrument handling. • Learn scientific approaches/techniques used in the clinical laboratories to investigate various diseases and will be skilled to work in research laboratories. • Gain knowledge about common imaging technologies and their utility in the clinic to diagnose a specific disease.

Generic Elective papers

GE paper - Food, Nutrition and Health

Upon the completion of the course, students will be able to: • Have a better understanding of the association of food and nutrition in promoting healthy living. • Think more holistically about the relationship between nutrition science, social and health issues. • Move on to do post-graduation studies and can apply for jobs as food safety officers, food analysts, food inspectors, food safety commissioners or controllers for jobs in organizations like FSSAI. • Specialize in various fields of nutrition.

Fourth semester

Honours

ZH Core VIII: Comparative anatomy of Vertebrates

Upon completion of the course, students should be able to: • Explain comparative account of the different vertebrate systems • Understand the pattern of vertebrate evolution, organisation, and functions of various systems. • Learn the comparative account of integument, skeletal components, their functions, and modifications in different vertebrates. • Understand the evolution of heart, modification in aortic arches, structure of respiratory organs used in aquatic, terrestrial and aerial vertebrates; and digestive system and its anatomical specializations with respect to different diets and feeding habits. • Learn the evolution of brain, sense organs and excretory organs to a complex, highly evolved form in mammals; • Learn to analyse and critically evaluate the structure and functions of vertebrate systems, which helps them to discern the developmental, functional, and evolutionary history of vertebrate species. • Understand the importance of comparative vertebrate anatomy to discriminate human biology.

ZH Core IX: Physiology: Life Sustaining Systems

Upon completion of the course, students should be able to: • Have an explicit knowledge of fundamentals and understanding of advanced concepts to develop a strong foundation that will help them to acquire skills and knowledge to pursue advanced degree courses. • Comprehend and analyse problem-based questions on physiological aspects. • Recognize and explain how all physiological systems work in unison to maintain homeostasis in the body; and use feedback loops to control the same. • Learn an integrative approach to understanding the interactions of various organ systems resulting in the complex overall functioning of the body.

ZH Core X: Biochemistry of Metabolic Processes

Upon completion of the course, students should be able to: Gain knowledge and skill in the fundamentals of biochemical sciences, interactions, and interdependence of physiological and biochemical processes. • Get exposed to various processes used in industries and gain skills in techniques of chromatography and spectroscopy. • Demonstrate foundation knowledge in biochemistry; synthesis of proteins, lipids, nucleic acids, and carbohydrates; and their role in metabolic pathways along with their regulation. • Know about classical laboratory techniques, use modern instrumentation, design, and conduct scientific experiments, and analyse the resulting data. • Be knowledgeable in proper procedures and regulations in handling and disposal of chemicals

SEC (Skill enhancement course) paper: Research Methodology

After completing this course, the students should be able to: · Describe basic concepts of research and its methodologies · Identify appropriate research topics and set up hypothesis · Perform literature review using library (print) and internet (online) resources · Design experiments/surveys, collect data and represent data in tables/figures · Analyse data with appropriate software tools, interpret results and draw conclusion · Write scientific report/ review/ thesis and prepare seminar/ conference presentations - oral as well as poster · Understand the methods of citation and referencing styles, check plagiarism and get insight of intellectual property right

Life Sciences

LS core paper IV: Genetics and Evolutionary Biology

Students would be able to understand the fundamentals of Mendelian inheritance and its exceptions. They would be able to appreciate various other gene interactions like co-dominance, incomplete dominance, lethal alleles and pleiotropy. Further, students would be able to describe the concepts of linkage and crossing over and their usage in constructing gene maps. • Help students understand the basic principles of pedigree analysis and will be able to construct and analyse pedigree related problems for inherited traits. • Students would gain knowledge on chromosomal and genetic mutation. • Students would be able to describe the chromosomal sex-determination mechanisms and dosage compensation. • Students would be able to understand the major events in history of life and major theories of evolution. • Students would be able to appreciate the contribution of fossil studies in evolution and the phylogeny of horse. • Students would be able to calculate the gene and allele frequency using Hardy-Weinberg law and analyse population genetics problems. T • Students would understand the fundamental concepts of natural selection, speciation, mass extinction and macro-evolution.

SEC (Skill Enhancement Course) paper - AQUARIUM AND FISH KEEPING

Upon completion of the course, students should be able to: • Acquire knowledge about different kinds of fishes, their compatibility in aquarium. • Become aware of Aquarium as commercial,

decorative and of scientific studies. • Develop personal skills on maintenance of aquarium. • Know about the basic needs to set up an aquarium, i.e., dechlorinated water, reflector, filters, scavenger, aquatic plants etc. and the ways to make it cost-effective.

GE paper: Animal Cell Biotechnology

Upon completion of the course, students will be able to: • Get a clear concept of the basic principles and applications of biotechnology. • Know the basic techniques used in genetic manipulation helping them continue with higher studies in this field. • Acquire knowledge of the basic principles, preparations and handling required for animal cell culture. • Understand principles underlying the design of fermenter and fermentation process and its immense use in the industry. • Design small experiments for successful implementation of the ideas and develop solutions to solve problems related to biotechnology keeping in mind safety factor for environment and society. • Apply knowledge and skills gained in the course to develop new diagnostic kits and to innovate new technologies further in their career. • Enhance their understanding of the various aspects and applications of biotechnology as well as the importance of biosafety and ethical issues related to it.

Third year

Fifth semester

Honours

ZH Core XI: Molecular Biology

Upon completion of the course, students will be able to: • Describe the basic structure and chemistry of nucleic acids, DNA and RNA; • Compare and contrast DNA replication machinery and mechanisms in prokaryotes and eukaryotes. • Elucidate the molecular machinery and mechanism of information transfer processes– transcription and translation-in prokaryotes and eukaryotes; • Explain post-transcriptional modification mechanisms for the processing of eukaryotic RNAs; • Discuss general principles of transcription regulation in prokaryotes by exploring the structure and function of lactose and tryptophan metabolism operons; • Give an overview of gene expression regulation in eukaryotes; • Explain the significance of DNA repair mechanisms in controlling DNA damage; • Recognise role of RNAs (riboswitches, siRNA and miRNA) in gene expression regulation. • Demonstrate practical knowledge of raising, handling, maintenance, and special features such as antibiotic resistance of a simple prokaryotic model organism, Escherichia coli. • Quantitatively estimate concentration of DNA and RNA by colorimetric methods.

ZH Core XII: Principles of Genetics

Upon completion of the course, students will be able to: • Have a deeper understanding of the varied branches of the biological sciences like microbiology, evolutionary biology, genomics and metagenomics. • Gain knowledge of the basic principles of inheritance. • Analyse pedigree leading to development of analytical skills and critical thinking enabling the students to present the conclusion of their findings in a scientific manner. • Know the mechanisms of mutations, the causative agents and the harmful impact of various chemicals and drugs being used in day-to-day life. • Find out the effects of indiscriminate use of various chemicals, drugs, or insecticides in nature by studying their effect on various bacterial species in soil and water samples from different industrial or polluted areas.

ZH DSE Course-I: Animal Behaviour and Chronobiology

Upon completion of the course, students should be able to: • Understand types of animal behaviour and their importance to the organisms. • Enhance their observation, analysis, interpretation and documentation skills by taking short projects pertaining to Animal behaviour and chronobiology. • Relate animal behaviour with other subjects such as Animal biodiversity, Evolutionary biology, Ecology, Conservation biology and Genetic basis of the behaviour. • Understand various process of chronobiology in their daily life such as jet lag. • Learn about the biological rhythm and their application in pharmacology and modern medicine. • Realize, appreciate and develop passion to biodiversity; and will respect the nature and environment.

ZH DSE Course-II: Immunology

After completion of the course the students will be able to: • Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity • Define the cellular/molecular pathways of humoral/cell-mediated adaptive responses including the role of Major Histocompatibility Complex • Explain the cellular and molecular aspects of lymphocyte activation, homeostasis, differentiation, and memory • Understand the molecular basis of complex, humoral (Cytokines and Complement) and cellular processes involved in inflammation and immunity, in states of health and disease • Describe basic and state-of-the-art experimental methods and technologies • Integrate knowledge of each subsystem to see their contribution to the functioning of higher-level systems in health and disease including basis of vaccination, autoimmunity, immunodeficiency, hypersensitivity and tolerance

Life Sciences

LS DSE paper 3 - ANIMAL BIOTECHNOLOGY

Upon completion of the course, students will be able to: • Use or demonstrate the basic techniques of biotechnology; like DNA isolation, PCR, transformation, restriction, digestion etc. • Devise a strategy to manipulate genetic structure of an organism for the improvement in any trait or its well-being based on the techniques. • Understand the ethical and social issues raised regarding GMOs. • Apply the knowledge for designing a proposal for research project.

SEC (Skill Enhancement Course) paper: SERICULTURE

Upon completion of the course, students should be able to: • Learn about the history of sericulture and silk route. • Recognize various species of silk moths in India, and Exotic and indigenous races. • Be aware about the opportunities and employment in sericulture industry – in public, private and government sector. • Gain thorough knowledge about the techniques involved in silkworm rearing and silk reeling. • Develop entrepreneurial skills necessary for self-employment in mulberry and seed production and be apprised about practicing sericulture as a profit-making enterprise. • Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.

Sixth semester

Honours

Core paper: ZH Course XIII: DEVELOPMENTAL BIOLOGY

Upon completion of the course, students should be able to: • Understand the events that lead to formation of a multicellular organism from a single fertilized egg, the zygote. • Acquire basic knowledge of the cellular processes of development and the molecular mechanisms underlying these. • Describe the general patterns and sequential

developmental stages during embryogenesis; and understand how the developmental processes lead to establishment of body plan of multicellular organisms. • Discuss the general mechanisms involved in morphogenesis and to explain how different cells and tissues interact in a coordinated way to form various tissues and organs. • Understand about the evolutionary development of various animals. • Know the process of ageing leading to interventions that can improve the overall health and quality of life in aged people. • Learn the importance of latest techniques like stem cell therapy, in vitro fertilization and amniocentesis etc. to be applied for human welfare. • Develop the skill to raise and maintain culture of model system; *Drosophila* in the laboratory. Develop the skill to raise and maintain a culture of the model system; *Drosophila* in the laboratory.

Core paper: ZH Course XIV: Evolutionary Biology

Upon completion of the course, students should be able to: • Acquire problem solving and high order analytical skills by attempting numerical problems as well as performing simulation studies of various evolutionary forces in action. • Apply knowledge gained, on populations in real time, while studying speciation, behaviour and susceptibility to diseases. • Gain knowledge about the relationship of the evolution of various species and the environment they live in. • Get motivated to work towards mitigating climate change so that well adapted species do not face extinction as a result of sudden drastic changes in environment. • Use knowledge gained from study of variations, genetic drift to ensure that conservation efforts for small threatened populations are focused in right direction. • Predict the practical implication of various evolutionary forces acting on the human population in the field of human health, agriculture and wildlife conservation. • Use various software to generate interest towards the field of bioinformatics and coding used in programming language

ZH DSE Course-III: Animal Biotechnology

Upon completion of the course, students should be able to: • Use or demonstrate the basic techniques of biotechnology like DNA isolation, PCR, transformation, restriction digestion etc. • Make a strategy to manipulate genetic structure of an organism for the improvement in any trait or its well-being based on the techniques learned during this course. • Understand better the ethical and social issues regarding GMOs. • Use the knowledge for designing a project for research and execute it.

ZH DSE Course-IV: Wildlife Conservation and management

Upon completion of the course, students will be able to: • Become aware about the importance of wildlife in general, and its conservation and management in particular. • Comprehend the application of the principles of ecology and animal behaviour to formulate strategies for the management of wildlife populations and their habitats. • Understand the management practices required to achieve a healthy ecosystem for wildlife population along with emphasis on conservation and restoration. • Know the key factors for loss of wildlife and important strategies for their in situ and ex situ conservation. • Recognize the techniques for estimation, remote sensing and Global Position Tracking for wildlife. • Gain knowledge about the wildlife diseases and the quarantine policies. • Know about the Protected Area Networks in India, Ecotourism, Ecology of perturbation and Climax persistence. • Perform critical thinking, literature review; scientific writing as well as presentations; and participation in citizen science initiatives with reference to wildlife

Life Sciences

LS DSE 4: Immunology

Upon completion of the course, students will be able to:

- Study hematopoiesis to know the concepts of stem cells and their differentiation into progenitor stem cells and adult lineages.
- Learn the concepts of innate and acquired immunity.
- Understand adaptive immune responses and sequential phases-antigen recognition by lymphocytes, their proliferation, differentiation into effector and memory cells and elimination of pathogens.
- Learn about major histocompatibility complex and their role in transplantation immunity and autoimmunity
- Gain knowledge about the Complement system and how they interact and activate a catalytic cascade to remove immunogens.
- Study the role of various cytokines involved in cell to cell communication in the removal of pathogens.
- Understand the advent of hypersensitivities due to inappropriate innate and adaptive immune responses.
- Know the basic immunological aspects to comprehend the newer strategies in vaccine design, and efforts to treat autoimmunity, hypersensitivity and immunodeficiency.

Skill Enhancement Paper - Apiculture

Upon completion of the course, students should be able to:

- Learn about the various species of honeybees in India, their social organization and importance.
- Be aware about the opportunities and employment in apiculture – in public, private and government sector.
- Gain thorough knowledge about the techniques involved in bee keeping and honey production.
- Know about various products obtained from beekeeping sector and their importance.
- Develop entrepreneurial skills necessary for self-employment in beekeeping sector.
- Enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.