Graduate Attributes in Zoology

1. **Disciplinary knowledge and skills:** Capable of demonstrating (i) comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in Zoology and its different subfields (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases), and other related fields of study, including broader interdisciplinary subfields such as chemistry, physics and mathematics; (ii) ability to use modern instrumentation for advanced genomic and proteomic technology.

2. Skilled communicator: Ability to impart complex technical knowledge relating to Zoology in a clear and concise manner in writing and oral skills.

3. Critical thinker and problem solver: Ability to have critical thinking and efficient problem solving skills in the basic areas of Zoology (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, insect, vectors and diseases etc.).

4. Sense of inquiry: Capability for asking relevant/appropriate questions relating to issues and problems in the field of Zoology, and planning, executing and reporting the results of an experiment or investigation.

5. Team player/worker: Capable of working effectively in diverse teams in both classroom, laboratory and in industry and field-based situations.

6. Skilled project manager: Capable of identifying/mobilizing appropriate resources required for a project, and manage a project to completion, while observing responsible and ethical scientific conduct; and safety and chemical hygiene regulations and practices.

7. Digitally literate: Capable of using computers for Bioinformatics and computation and appropriate software for analysis of genomics and proteomics data, and employing

modern bioinformatics search tools to locate, retrieve, and evaluate location and biological annotation genes of different species.

8. Ethical awareness/reasoning: Capable of conducting their work with honesty and precision thus avoiding unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, and appreciating environmental and sustainability issues. Research ethics committee expects them to declare any type of conflict of interest that may affect the research. Any plan to withhold information from researchers should be properly explained with justification in the application for ethical approval.

9. Lifelong learners: Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling.

Programme Learning Outcomes (PO) in B.Sc. (Hons.) Zoology

A. Knowledge and Understanding

1. Demonstrate (i) in-depth knowledge and understanding about the fundamental concepts, principles and processes underlying the academic field of Zoology and its different subfields (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases, apiculture, aquarium fish keeping, medical diagnostics, and sericulture) (ii) procedural knowledge that creates different types of professionals in the field of Zoology and related fields such as, apiculture, aquarium fish keeping, medical diagnostics, and sericulture, etc.(iii) skills related to specialization areas within Zoology as well as within subfields of Zoology, including broader interdisciplinary subfields (Chemistry, Physics and Mathematics).

2. Over the years, Zoologists were able to find many differences within the same breed of an animal species. As a Zoology professional one can study extinct animals by specializing in Paleozoology, on the different types of birds in Ornitholog; opt for studying Herpetology and Arachnology, the branches dealing with the study of snakes and spiders, respectively or

3. Appreciate the complexity of life processes, their molecular, cellular and physiological processes, their genetics, evolution and behaviour and their interrelationships with the environment.

4. Study concepts, principles and theories related with animal behaviour and welfare.

5. Understand and interpret data to reach a conclusion

6. Design and conduct experiments to test a hypothesis.

7. Understand scientific principles underlying animal health, management and welfare.

8. Accept the legal restrictions & ethical considerations placed for animal welfare.

9. Understand fundamental aspects of animal science relating to management of animals.

10. Assess problems and identify constraints in management of livestock.

B. Subject Specific Intellectual and Practical Skills

The students will be able to

1. Understand how organisms are classified and full and identified
2. Demonstrate knowledge of basic zoological principles
3. Use appropriate information with a critical understanding
4. Learn basic laboratory and analytical skills
5. Use effective methods for modifying animal behaviour
6. Participate in animal management programmes in an effective manner
7. Work safely and effectively in the field, in laboratories and in animal facilities
8. Demonstrate competence in handling and statistical analysis of data gained from practical
9. Learn communication and IT skills, including the collation and statistical analysis of data, citing & referencing work appropriately, communicating using a range of formats

In course learning outcomes, the student will attain subject knowledge in terms of individual course as well as holistically. The example related to core courses and their linkage with each other is stated below:

Programme Learning Outcomes (PO) of different courses in B.Sc. (Hons.) Zoology

Programme Outcome	**CC1**	**CC2**	**CC3**	**CC4**	**CC5**	**CC6**	**CC7**	**CC8**	**CC9**	**CC 10**	**CC 11**	**CC 12**	**CC 13**	**CC 14**
Core Competency	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Critical Thinking	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Analytical Reasoning	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Research Skills	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Teamwork	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Programme Outcome	DSE A5-1	DSE A5-2	DSE B5-1	DSE B5-2	DSE A6-1	DSE A6-2	DSE B6-1	DSE B6-2
Additional Academic Knowledge	Y	Y	Y	Y	Y	Y	Y	Y
Problem solving	Y	Y	Y	Y	Y	Y	Y	Y
Additional Analytical Skills	Y	Y	Y	Y	Y	Y	Y	Y
Additional Research Skills	Y	Y	Y	Y	Y	Y	Y	Y

Programme Outcome	SEC A-3-1	SEC A-3-2	SEC A-4-1	SEC A-4-2
Additional Knowledge Enhancement	Y	Y	Y	Y
Exposure Beyond Discipline	Y	Y	Y	Y
Analytical Reasoning	Y	Y	Y	Y
Moral and Ethical Awareness	Y	Y	Y	Y

Course Learning Outcomes (CO) in B.Sc. (Hons.) Zoology

CC 1 Non- Chordates I (Protista to Pseudocoelomate)

After successfully completing this course, the students will be able to:

1. Develop understanding on the diversity of life with regard to protists, non chordates and chordates.
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. Understand how morphological change due to change in environment helps drive evolution over a long period of time.

Cc2 Molecular Biology

After successfully completing this course, the students will be able to:

1. Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario.
2. Get well versed in recombinant DNA technology which holds application in biomedical & genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields.
3. Apply their knowledge in problem solving and future course of their career development in higher education and research.
4. Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry.

CC 3 Non-Chordate II (Coelomate Phyla)

After successfully completing this course, the students will be able to:

1.Develop understanding on the diversity of life with regard to non chordates
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. Examine the diversity and evolutionary history of a taxon
5. Understand how morphological change due to change in environment helps drive evolution over a long period of time.

CC 4 Cell Biology

After successfully completing this course, the students will be able to

1. Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.
2. Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.
3. Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.
4. Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.

CC 5 Chordata

After successfully completing this course, the students will be able to:

1. Develop an understanding of the evolution of vertebrates thus integrating structure, function and development.
2. Have an overview of the evolutionary concepts including homology and homoplasy, and detailed discussions of major organ systems.

CC 6 Animal Physiology: Controlling & Co-ordinating system

After successfully completing this course, the students will be able to:

1. Have an overview of the evolutionary concepts including homology and homoplasy, and detailed discussions of major organ systems.
2. Understand how cells, tissues, and organisms function at different levels. The course content also provides the basis of understanding their abnormal function in animal and human diseases and new methods for treating those diseases.
3. Develop an understanding of the related disciplines, such as cell biology, neurophysiology, pharmacology, biochemistry etc.

CC 7 Fundamental of Biochemistry

After successfully completing this course, the students will be able to:

1. Understand about the importance and scope of biochemistry.
2. Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.
3. Understand the structure and function of immunoglobulins.
4. Understand the concept of enzyme, its mechanism of action and regulation.

5. Understand the process of DNA replication, transcription and translation.
6. Learn the preparation of models of peptides and nucleotides.
7. Learn biochemical tests for amino acids, carbohydrates, proteins and nucleic acids.
8. Learn measurement of enzyme activity and its kinetics.

CC 8 Comparative Anatomy of Vertebrates

After successfully completing this course, the students will be able to:

1. Comparative anatomy of different organs like stomach, respiratory organs, heart and aortic arches, kidney and urinogenital ducts, brain; axial and appendicular systems.
2. Idea about the different scales and bones, study of disarticulated skeleton of toad, pigeon and guineapig.

CC 9 Animal Physiology: Life Sustaining System

After successfully completing this course, the students will be able to:

1. Physiological aspects of the important systems like digestive,respiratory, circulatory, osmoregulatory and excretory.
2. Hands-on training on ABO Blood group determination, haemoglobin estimation and blood cell identification of human and cockroach.

CC 10 Immunology

After successfully completing this course, the students will be able to:

1. Know how resistance development and resistance transfer occur.
2. Identify the major cellular and tissue components which comprise the innate and adaptive immune system.
3. Understand how are immune responses by CD4 and CD8 T cells, and B cells, initiated and regulated.
4. Understand how does the immune system distinguish self from non-self .

CC 11 Ecology

After successfully completing this course, the students will be able to:

1. Know the evolutionary and functional basis of animal ecology.
2. Understand what makes the scientific study of animal ecology a crucial and exciting endeavour.
3. Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field.

4. Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice.
5. Solve the environmental problems involving interaction of humans and natural systems at local or global level.

CC 12 Principle of Genetics

After successfully completing this course, the students will be able to:
1. Understand how DNA encodes genetic information and the function of mRNA and tRNA
2. Apply the principles of Mendelian inheritance.
3. Understand the cause and effect of alterations in chromosome number and structure.
4. Relate the conventional and molecular methods for gene manipulation in other biological systems.
5. Discuss and analyse the epigenetic modifications and imprinting and its role in diseases.
6. Get new avenues of joining research in related areas such as genetic engineering of cells, cloning, genetic disorders, human fertility programme, genotoxicity, etc

CC 13 Developmental Biology

After successfully completing the course, the students will be able to
1. Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.
2. Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.
3. Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.
4. Understand how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.
5. Examine the evolutionary history of the taxa based on developmental affinities.
6. Understand the relevance of developmental biology in medicine or its role in development of diseases.

CC 14 Evolutionary Biology

After successfully completing this course, the students will be able to:

1. Acquire an in-depth knowledge on the diversity and relationships in animal world.
2. Develop a holistic appreciation on the phylogeny and adaptations in animals.
3. Enable the students to understand the evolution of universe and life.
4. Understanding on the process and theories in evolutionary biology.
5. Develop an interest in the debates and discussion taking place in the field of evolutionary biology.

SEC A-3-1 Apiculture

Upon successful completion of this course, the student should be able to:

1. Explain what are the prerequisite to get started in beekeeping
2. Describe the laws around beekeeping in Vancouver
3. Discuss the responsibilities of urban beekeepers
4. Identify where to purchase equipment and demonstrate how to assemble it
5. Name and identify major parts of the honeybee such as the stinger or mandibular parts
6. Describe bee biology and anatomy from the perspective of managing bees
7. Describe the importance of wax and identify what to look for in comb during hive inspections

SEC A-4-1 Aquarium Fisheries

After completing this course the learners will be able to

1. To learn the scientific method of setting an aquarium
2. To learn the culture breeding and marketing techniques of common indigenous ornamental fishes
3. To make the students aware of the vast potentials involved in ornamental fish farming and trading besides making them learn the diseases in fishes and other constraints in their culturing.

DSE -A -5-1 Parasitology

1. Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-organisms.
2. Diagnose the causative agents, describe pathogenesis and treatment for important diseases like malaria, leishmaniasis, trypanosomiasis, toxoplasmosis, schistosomiasis, cysticercosis, filariasis etc.

3. Assess the importance of incidence, prevalence and epidemiology in microbiological diagnostic activities.
4. Develop awareness about the causative agents and control measures of many commonly occurring disease

DSE -B-5-1 Endocrinology

1. Understand neurohormones and neurosecretions.
2. Learn about hypothalamo and hypapophysial axis.
3. Understand about different endocrine glands and their disorders.
4. Understand the mechanism of hormone action.

DSE A-6-1 Animal biotechnology

After successfully completing this course, the students will be able to:
1. Develop an understanding of the fundamental molecular tools and their applications of DNA modification and cloning.
2. Appreciate shifting their orientation of learning from a descriptive explanation of biology to a unique style of learning through graphic designs and quantitative parameters to realize how such research and innovations have made science interdisciplinary and applied.
3. Develop future course of their career development in higher education and research with a sound base.
4. Apply their knowledge with problem solving approach to recommend strategies of genetic engineering for possible applications in Biotechnology and allied industry.

DSE B-6-1 Animal Behaviour and Chronology

After successfully completing this course, the students will be able to:
1. Learn a wide range of theoretical and practical techniques used to study animal behaviour.
2. Develop skills, concepts and experience to understand all aspects of animal behaviour.
3. Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives.
4. Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild.
5. Consider and evaluate behaviour of all animals, including humans, in the complex ecological world, including the urban environment