VIDYANAGAR COLLEGE

Department of Zoology

B.Sc. Honours and General in Zoology

Programe Specific Outcome, Course Outcome, Programe Outcome

Programme Outcome:

B.Sc. General

a) Students graduating through B.Sc. General Programme from this college are expected to develop analytical skills which will enable them to solve problem-based issues that they face in the next level of their career.

b) Students graduating from this college in this programme are expected to be able to relate the real-life aspects of environment, specifically the animal world and associated issues surrounding them, with what they have learnt in their books and in the classrooms.

c) Students completing the programme are expected to be confident and self-reliant in the sense that they feel they are employable.

d) The programme will impart among the students the advanced knowledge in biological science in specific regard to Zoology along with instilling greater values of life to become worthy citizen of the country.

Programme specific Outcome:

B.Sc. General with Zoology Programme

- Zoology is not only about studying animal diversity for the sake of pursuing graduate level education; rather it gives an enormous opportunity to appreciate the variety and variability of life forms surrounding us along with an in-depth idea about the persistent human-animal relation/interaction in the backdrop of environment which is quintessential for survival. The B.Sc. General program with Zoology as one of the subjects in Vidyanagar College under the University of Calcutta is an attempt to both introduce and, at the same time, provide an in depth look into one of the most interesting as well as challenging subjects of biology that one can study.
- The core idea of the course is to make the student aware of the foundational aspects related to the animal world around us, appreciate the diversity in life forms, how organisms interact with one another and how they hold relevance to the human life by interacting/affecting/benefitting in various ways.
- The program covers multiple aspects of animal biology and spans from classical zoology to cellular, biochemical and molecular aspects of physiology and pathology. The course also provides exposure to economic zoology, medical entomology as well as clinical diagnostics to help students acquire a comprehensive knowledge while providing them options to explore different aspects of the subject from which they can choose to continue further higher levels of education and/or select appropriate career options.
- The courses included in the program offer multiple avenues which can be used in the future for selecting suitable career including academia, research, independent entrepreneurship and or employment in public/private sectors in the fields of aquaculture, sericulture, apiculture animal husbandry, agricultural and medical entomology, public health etc.

- The program will help students to think creatively and independently, develop analytical skills and explore possibilities beyond those entrenched in prevailing opinion/s and practice/s.

Format of the Semesters

Core Courses [Syllabus for Students from other Hons [GE (H)], Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)) and Students for Zoology as third subject in Pure General (GE-1)]
Semester 1: CC1/GE1- Animal Diversity
Semester 2: CC2/GE2- Comparative Anatomy & Developmental Biology

Core Courses [Syllabus for Students from other Hons [GE (H)], Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-))]
Semester 3: CC 3/GE3- Physiology and Biochemistry
Semester 4: CC 4/GE4- Genetics and Evolutionary Biology

SKILL ENHANCEMENT COURSE SEC (G)
Semester 3 [Syllabus for Students from Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)]
SEC- A (1): Apiculture

Semester 4 [Syllabus for Students from Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)]
SEC- B (1): Aquarium Fish Keeping

DISCIPLINE SPECIFIC ELECTIVE COURSE DSE (G)

Semester 5: [Syllabus for Students from Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)]
DSE-A (1): Applied Zoology

Semester 6: [Syllabus for Students from Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)]
DSE B2 – Ecology and Wildlife Biology

Semester wise Course Outcomes in B.Sc. General in Zoology:

Semester 1: [Syllabus for Students from other Hons [GE (H)], Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)) and Students for Zoology as third subject in Pure General (GE-1)]

Core Course- CC1/GE1- Animal Diversity

1. The course will help to gain a comprehensive insight about various aspects of non-chordate and chordate biology (including basis of animal classification and taxonomy), be able to identify and differentiate animals based on their morphological characters and systemic organization, learn about evolution of animals from protozoa to higher life forms, formation of body plans and development of complex organ systems from unicellular origin.
2. The course will help the students to learn about the evolution, development and functioning of typical processes like locomotion in protozoa, circulatory and excretory strategies in porifera, invertebrate respiratory system, development of segmentation and water vascular system. These will help students to appreciate the development of complex tissue grade organ systems in the higher life forms.
3. The course will help to develop interest in the broad concepts in invertebrate and vertebrate biology along with keen interest in pursuing advanced studies in the field of classical zoology, animal taxonomy and biodiversity.

Semester 2: [Syllabus for Students from other Hons [GE (H)], Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-))

Core Course- CC2/GE2- Comparative Anatomy & Developmental Biology

1. The course is designed such that students will gain insight into the processes leading to early embryonic development including production of gametes, fertilization, cleavage and gastrulation using echinoderm and amphibia as model examples of developmental biology. The course will help to learn about the development of germ layers and body plan along with the regulatory processes involved therein.
2. The course will help to learn about the developmental diversity involved in the evolution of major organ systems in the vertebrates including digestive, respiratory, circulatory, urinogenital and integumentary systems along with understanding the functional similarities and dissimilarities of the various organ systems which in turn will help to establish deeper perception of the basis of evolution of organ systems in response to changing demands as life evolved from aquatic to terrestrial forms.
3. The course will help to gain logical and consistent understanding of animal evolution from the perspective of organ system development which will thereby help to develop keen interest in pursuing advanced studies in the field of animal development, molecular taxonomy and evolution.

Semester 3: [Syllabus for Students from other Hons [GE (H)], Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)) and Students for Zoology as third subject in Pure General (GE-1)]

Core Course- CC 3/GE3- Physiology and Biochemistry

1. Knowledge about physiology and biochemistry is fundamental for understanding and appreciating the basis of existence and functionality of life forms. The course has been designed such that the students will gain deeper understanding of the different complex physiological systems in the animals and their coordinated functioning to maintain systemic homeostasis.
2. The course will help to learn about vital processes like origin of impulse and its propagation across different nerve fibers, synaptic transmission, muscle contraction and associated responses as well as to understand the vital physiological processes like respiration, digestion, excretion and reproduction in relation to the concerned anatomical structures.
3. The course will also help to learn about the regulatory systems including endocrine and nervous systems along with functioning of the feedback loops to control the physiological processes. Further the students will gain knowledge about the basic pathways of cellular metabolism from the perspective of biological molecules including protein, carbohydrate and lipid metabolism and learn about the basics of enzyme function, derive and quantify the rates of enzyme action, learn about the modes of enzyme action and enzyme inhibitors.
4. The course envisages to motivate the students relate the theoretical knowledge on enzyme biochemistry and conceptualize the same in real life situations like understanding the basis for action of medicines which often modulate enzyme activities within the system. This in turn will help to develop ideas and analytical aptitude among students for pursuing higher studies on glycobiology, protein chemistry and even structural biology which have immense relevance on human health and diseases.

SKILL ENHANCEMENT COURSE SEC(G)

SEC- A (1): Apiculture

This course aims to help the students

- To understand the significance of beekeeping as an economically viable industry and
- To learn about the bee diversity and be able to identify bees based on morphological characters, understand the biology and behavior of bees and gain insight into the social structure and organization of bee colonies, acquire knowledge about parasites affecting the bees along with concerned strategies for efficient rearing of disease-free bees and maintaining productive apiaries..
- To learn techniques of bee rearing, apiary management, strategies of honey collection along with commercializing the products obtained from apiculture including honey, bee wax, propolis, pollen, etc. as well as learn about optimization techniques based on changing climate and geographical regions for augmentation of productions associated with apiculture.
- To be aware of the opportunities and employment in apiculture industry in public and private as well as to invest upon as independent entrepreneur.

Semester 4: [Syllabus for Students from other Hons [GE (H)], Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)) and Students for Zoology as third subject in Pure General (GE-1)]

Core Course- CC 4/GE4- Genetics and Evolutionary Biology

1. The course will help to generate understanding and ideas to apply the Mendelian principles in experimental studies while learning the basis of genetic disorders along with understanding the causes and their effects of alteration in structure and number of chromosomes by various kinds of mutations.
2. The course will further help to learn about the basis of genetic material exchange at the molecular level by linkage and crossing over through DNA recombination and gain insight into the basis of sex differentiation and dosage compensation in animals using fruit fly as an example.
3. The students will learn about the origin and evolution of life forms which will help them develop interest in theories, hypothesis and debates related to evolution along with harnessing in-depth knowledge on the diversity and relationships in animal world as well as an understanding of the phylogeny, basis of speciation and the evolutionary processes leading to selection of highly evolved life forms.

SKILL ENHANCEMENT COURSE SEC(G)

SEC- B (1): Aquarium Fish Keeping

This course aims to help the students

- To understand the significance of aquarium fish keeping as an economically viable industry, specifically fish-based cottage industry.
- To learn about the fish diversity, be able to identify exotic and endemic aquarium fishes based on morphological characters and understand the biology and behavior of commercially relevant aquarium fishes for enhanced rearing.
- To develop skills and learn techniques of fish rearing, management of aquarium and ornamental fisheries, strategies for commercialization including fish handling, packaging and transportation as well as formulation of fish feeds with high nutrition value and most importantly be aware about the prospect and employment opportunities in aquarium fish-based small-scale industry in public and private as well as to invest upon as independent entrepreneur.

Semester 5: [Syllabus for Students from Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)]

DISCIPLINE SPECIFIC ELECTIVE COURSE DSE (G)

DSE-A (1): Applied Zoology

This course aims to help the students

- To understand and generate the concept of different species interaction in the environment and generate ideas about the diseases, transmission, prevention and control of diseases with emphasis on the pathogenicity of Protozoan and the Helminthic parasites.
- To study about the epidemiology of diseases: their transmission, prevention, prophylaxis and control along with learning about the different pests and their strains.
- To understand the difference between various types of pests and extent of damage caused to the crops, fruits, vegetables, stored grains as well as gain knowledge about insects of medical and economic importance.

- To understand the significance of animal husbandry, poultry farming and fish technology as economically viable animal-based cottage industries.
- To learn about maintenance of cattle and poultry, techniques for synchronization of estrus cycle and artificial insemination in cattle, management of poultry breeding stocks and broilers, as well as processing and preservation of eggs.
- To learn about the techniques used for genetic improvements in aquaculture industry, strategies for induced breeding in fishes and transportation of fish seed.
- To generate awareness about the various opportunities and employable skills in animal husbandry, poultry farming and fish technology both in the public as well as private sectors and most importantly to learn how to develop entrepreneurial skills needed for self-employment as well as practicing animal husbandry, poultry farming or fish technology as a profit-making enterprise.

Semester 6: [Syllabus for Students from Core Course for Pure General Course Students (Zoology as 1st or 2nd subject (CC-G-)]

Discipline Specific Course
Elective Course: SEM 6
DSE B2 – Ecology and Wildlife Biology
ZOOG – DSE- B- 6- 2 –TH
Unit 1: Introduction to Ecology
Unit 2: Population
Unit 3: Community
Unit 4: Ecosystem
Unit 5: Wild Life
Aims:
Ecology and Wildlife Biology is a very good option to have knowledge about nature and its association with the ecosystem. The concept of ecology gives a glimpse of the ecosystem and nature and its association with human ,within the ecosystem. The concept of ecosystem and wildlife will give an insight into biodiversity and conservation of ecosystem around urban-nature interface. The course will give an opportunity to know about the basic concept of ecology and the association of human beings and nature.

Ecology& Wild life Biology; ZOOG-DSE-B-6-2-P

- Identification of flora, mammalian fauna, avian fauna:

- Students will be able to accurately identify various species of plants, mammals, and birds in the field.
- Students will develop skills in using field guides, keys, and other resources to identify flora and fauna.
- Students will gain knowledge about the ecological roles and significance of different species in their respective habitats
- Demonstration of basic equipment needed in wildlife studies use, care, and maintenance:

- Students will be proficient in handling and using basic equipment such as compasses, binoculars, spotting scopes, range finders, GPS devices, and cameras.
- Students will understand the importance of proper care and maintenance of equipment to ensure accurate data collection and longevity.
- Students will demonstrate competence in using equipment for wildlife observation, tracking, and data recording.
- Familiarization and study of animal evidences in the field:

- Students will be able to recognize and interpret various animal signs and evidences such as pug marks, hoof marks, scats, pellet groups, nests, antlers, etc.
- Students will understand how to use animal evidences for species identification, habitat assessment, and tracking animal movements.
- Students will develop skills in documenting and recording animal evidences for further analysis and research.
- Study of an aquatic ecosystem:

- Students will gain an understanding of the components and dynamics of aquatic ecosystems, focusing on phytoplankton and zooplankton.
- Students will learn methods for measuring physical and chemical parameters of aquatic environments, including area, temperature, salinity, pH, dissolved oxygen content, chemical oxygen demand, and free CO_2.
- Students will be able to conduct field measurements using appropriate techniques and equipment, such as Winkler's method for determining dissolved oxygen content.

- Students will analyze and interpret data collected from aquatic ecosystems to assess water quality, ecosystem health, and potential impacts on aquatic organisms.

Programme Outcome:

B.Sc. Honours

a) Students graduating through B.Sc. Hons. Programme from this college affiliated to the University of Calcutta are expected to develop analytical skills which will enable them to solve problem-based issues which they will face in next level of career.

b) Students, although at the initial stage after getting admitted to the course often face difficulty in language and communication skills, but when they pass out, they are expected to develop good communication skills and overcome the vernacular issues so as to be pretty adept in expressing their understanding of the subject.

c) Students of this programme will become capable to ask questions, critically appreciate a scholarly presentation of any form and debate upon the issues inviting cross discussions.

d) Students graduating from this college in this programme are expected to be able to relate the real-life aspects of environment, specifically the animal world and associated issues surrounding them, with what they have learnt in their books and in the classrooms.

e) Students completing the programme are expected to be confident and self-reliant in the sense that they feel they are employable.

f) The programme will impart among the students the advanced knowledge in biological science in specific regard to Zoology along with instilling greater values of life to become worthy citizen of the country.

Programme Specific Outcome:

B.Sc. Honours in Zoology Programme

- Zoology is not only about studying animal diversity for the sake of pursuing graduate level education; rather it gives an enormous opportunity to appreciate the variety and variability of life forms surrounding us along with an in-depth idea about the persistent human-animal relation/interaction in the backdrop of environment which is quintessential for survival. The B.Sc. Honours program in Zoology in Vidyanagar College under the University of Calcutta is anattempt to both introduce and, at the same time, provide an in depth look into one of the most interesting as well as challenging subjects of biology that one can study.
- The core idea of the course is to make the students aware of the foundational aspects related to the animal world around us, appreciate the diversity in life forms, how organisms interact with one another and how they hold relevance to the human life by interacting/affecting/benefitting us in various ways.
- The program covers multiple aspects of animal biology and spans from classical zoology to cellular, biochemical and molecular aspects of physiology and pathology. The course also provides exposure to economic zoology, medical entomology as well as clinical diagnostics to help students acquire a comprehensive knowledge while providing them options to explore different aspects of the subject from which they can choose to continue further higher levels of education and/or select appropriate career options.

- The courses included in the program offer multiple avenues which can be used in the future for selecting suitable career including academia, research, independent entrepreneurship and or employment in public/private sectors in the fields of aquaculture, sericulture, apiculture animal husbandry, agricultural and medical entomology, public health etc.
- The program will help students to become self-reliant, mature and think creatively as well as independently while developing analytical skills and exploring possibilities beyond those entrenched in prevailing opinion/s and practice/s.
- Students successfully completing the course are expected to develop a keen interest in pursuing higher studies in either the mother subject or any one of the specialized subjects, taught in the course, to ultimately choose a dynamic career in academia and research thereby contributing to the benefit of themselves as well as the nation.
- Apart from academia and research, a student successfully completing the course is equally trained to choose a career in business in the private sector (as an independent entrepreneur) or in the public sector (cottage industry-initiatives of the Govt.) primarily based on agricultural zoology, animal husbandry, sericulture, pisciculture, apiculture, ornamental fisheries and many other relevant fields. In short, studying Zoology provides ample career options to a student to independently move forward in life and earn a respectable living.

Semester-wise Course for B.Sc. (Honours) in Zoology

	Sem-1	**Sem-2**	**Sem-3**	**Sem-4**	**Sem-5**	**Sem-6**
Core Course (CC)	2TH+2TU CC-1&2	2TH+2TU CC-3&4	3TH+3TU CC-5,6 &7	3TH+3TU CC-8,9 &10	2TH+2TU CC-11&12	2TH+2TU CC-13&14
Discipline Specific Elective (DSE)					2TH+2TU DSE–A(1) +B(1)	2TH+2TU DSE–A(2) +B(2)
Skill Enhancement Course (SEC)			1TH+0TU SEC-A(1)	1TH+0TU SEC-B(2)		
Generic Elective (GE)	1TH+1TU GE-1	1TH+1TU GE-2	1TH+1TU GE-3	1TH+1TU GE-4		
Ability Enhancement Compulsory Course (AECC)	1TH+0TU AECC-1	1TH+0TU AECC-2				
Total No. of Courses and Marks	**4 x 100 = 400**	**4 x 100 = 400**	**5 x 100 = 500**	**5 x 100 = 500**	**4 x 100 = 400**	**4 x 100 = 400**
Total Credits	**20**	**20**	**26**	**26**	**24**	**24**

TH = Theory T = Tutorial

□ CC/GE/DSE : Each theory and Tutorial Course have 5 and 1 Credit(s) respectively
□ GE : Covering two subjects with two courses each; any subject in any semester; CC of a different subject in general course is to be treated as GE for Honours Course
□ DSE/SEC : Group (A&B) for specified semesters
□ AECC/SEC : Each Course has 2 Credits
□ AECC-1 : Communicative English / MIL; AECC-2 : Environmental Studies

Format of the Semesters

Semester 1

CC1- Non Chordata – I (Protists to Pseudocoelomates)
CC2- Molecular Biology

Semester 2

CC3- Non Chordata – II (All Coelomate Phyla)
CC4- Cell Biology

Semester 3

CC5- Chordata
CC6- Animal Physiology: Controlling & Co-ordinating System
CC7- Fundamentals of Biochemistry

Semester 4

CC8- Comparative Anatomy of Vertebrate
CC9- Animal Physiology: Life sustaining system
CC10- Immunology

Semester 5

CC11- Ecology
CC12- Principle of Genetics

Semester 6

CC13- Developmental Biology
CC14- Evolutionary Biology

Discipline Specific Elective Course –
DSE- A-(1) AND DSE- B-(1) in Semester 5 and DSE- A-(1) AND DSE- B-(1) in Semester 6

- **DSE- A-1- Parasitology**
- **DSE- B-1- Endocrinology**
- **DSE- A-1- Animal Biotechnology**
- **DSE – B-1- Animal Behaviour & Chronology**

Skill Enhancement Course

- **SEC- A-(1) in Semester 3 and SEC-B-(1) in Semester 4**
- **SEC- A-(1)- Apiculture**
- **SEC- B-(1)- Aquarium Fisheries**

Semester wise Course Outcomes in B.Sc. Honours in Zoology:

Semester 1

CC1- Non Chordata – I (Protists to Pseudocoelomates)

1. The course will help to gain a comprehensive insight about various aspects of non-chordate biology (including basis of animal classification and taxonomy), be able to identify and differentiate non-chordates based on their morphological characters and systemic organization, learn about evolution of animals from protozoa to higher life forms, formation of body plans and development of complex organ systems from unicellular origin.
2. The course will help the students to learn about the evolution, development and functioning of typical processes like locomotion in protozoa, circulatory and excretory strategies in porifera along with the basis of intra-specific and interspecific animal interactions that impact biodiversity. These will help students to appreciate the development of complex tissue grade organ systems in the higher life forms
3. The students will further learn about coral reefs and aquatic biodiversity which are crucial components of marine ecosystem and thereafter be able to describe economic, ecological and conservational significance/relevance of various animals in human life.
4. It will also help to gather comprehensive knowledge about the biology of worms which carry immense agricultural and medical relevance due to their multiple roles as parasites, symbionts, etc.
5. The course will help to develop interest in the broad concepts in invertebrate biology along with keen interest in pursuing advanced studies in the field of classical zoology, animal taxonomy and biodiversity. After completion of the course one can find out some relative and thoughtful answer regarding the evolution of life forms, how lower non-chordates survive in nature and interact with other animals. This course will help the students to prepare themselves for higher studies and NET/SET/other examination for entry into services.

CC2- Molecular Biology

1. The course is designed to gain a comprehensive knowledge about the molecular basis of life, appreciate how a cell functions in order to survive and propagate.
2. The students will learn about the biomolecules, their structure, function and interactions. How gene expression occurs, the basis of gene expression regulation, cellular quality control strategies for repairing DNA damage and cope up with stress are quintessential factors to understand.
3. They will understand the basis of Central Dogma of life, how it operates differentially in the prokaryotes and eukaryotes and also develop idea about epigenetic factors regulating gene expression.
4. This paper seeks to enable the students gain knowledge about the basic tools of molecular biology for performing basic experiments and thereupon developing a basic sense/ orientation for pursuing career in biomedical research. This will help them to learn how to frame questions in molecular biology for pursuing advanced studies.

Semester 2

CC3- Non Chordata – II (All Coelomate Phyla)

1. The course is designed such that students will gain insight into non-chordate developmental processes including insect metamorphosis, evolution of body plan in higher non-chordates like coelom development, metameric segmentation.

2. The course will teach the students to appreciate the development and functioning of invertebrate organ systems which is essential for gaining comprehensive idea on the evolutionary pathways leading to development of complex organs in the chordates.
3. The course will help to gain information about the connecting links and affinities between non-chordates and chordates to trace the evolutionary trajectories in the animal kingdom as well as to know about the highly developed biological caste system, social structure and functional organization prevalent within the arthropods. This will help to appreciate the evolutionary history of complex interactions within the animals.
4. After completion of the said course a student will gain logical and consistent understanding of the broad concepts in Zoology along with deeper understanding of the non-chordate biodiversity which will help to develop keen interest in pursuing advanced studies in the field of classical zoology, animal taxonomy and biodiversity and prepare themselves for NET/SET/other examination for entry into services.

CC4- Cell Biology

1. The paper is designed to provide a comprehensive knowledge about the structure and function of cells, major sub-cellular compartments including cytoplasm, nucleoplasm and mitochondrial matrix.
2. The students will learn and appreciate inter-organellar crosstalk in maintaining cellular metabolic homeostasis along with getting acquainted with major signaling pathways, the sub-cellular events of molecular signaling leading to cell division and death, anterograde and retrograde signaling within cells, etc.
3. The course will further help the students to learn the vital metabolic events including the operation of mitochondrial respiratory chain and ATP production to maintain cellular bioenergetic homeostasis.
4. This course will enable the students to develop ideas and analytical aptitude for conducting experimental studies required for basic and translational work in the fields of cancer, metabolic diseases, stem cell biology, cloning and developmental biology, etc.

Semester 3

CC5- Chordata

1. The paper has been designed such that the students will gain deeper understanding of the different classes of chordates, level of organization and evolutionary relationship between different sub-phyla classes and sub-classes within and across the phyla.
2. The students will learn about the basis of chordate evolution from the protochordates to higher vertebrates while understanding the development of vital organ systems in the chordates including pharynx, respiratory organs, feeding apparatus, exoskeletal derivatives as well as types of metamorphosis involved in developmental process.
3. The course will further help the students to learn about the physical basis of specialized adaptations and movements including echolocation and flight in mammals and birds respectively.
4. The main essence of the paper design is to instill among the students a sense of appreciation about the diversity of chordates so as to develop interest in the broad concepts in vertebrate biology which will further help them to grow keen interest in pursuing advanced studies in the field of classical zoology, animal taxonomy and biodiversity.

CC6- Animal Physiology: Controlling & Co-ordinating System

1. This course aims at providing deeper understanding of the different complex physiological systems in the animals and their coordinated functioning to maintain systemic homeostasis.

2. The students will learn about the regulatory systems including endocrine and nervous systems along with functioning of the feedback loops to control the physiological processes while being able to identify different types of animal tissues and develop basic idea about the vital processes like synaptic transmission, hormonal secretion and associated responses.
3. The course will help the students to comprehend and analyze problems in physiology and biochemistry which is fundamental to the understanding of animal biology while relating to the theoretical knowledge and translating them in real life situations like designing strategies for healthy life style.
4. The objective of this course is to help students conceptualize about homeostatic imbalances i.e. how physiological processes adapt changing external and internal stimuli in order to maintain health and integrity.
5. At the end of this course the students are expected to develop ideas and analytical aptitude for pursuing higher studies, conducting experiments pertaining to research on physiology including the fields of cancer, metabolic diseases, stem cell biology, cloning and developmental biology, etc.

CC7- Fundamentals of Biochemistry

1. The paper is designed such that the students gain knowledge about cellular metabolism from the perspective of biological molecules, learn about the structure of major biomolecules including proteins, carbohydrates, lipids, and nucleic acids along with pathways leading to their synthesis and regulation.
2. The course aims at providing a comprehensive understanding of the basics of cellular bioenergetics, anabolic and catabolic processes operating for maintaining cellular physiological homeostasis.
3. The students will further learn about the basics of enzyme function, derive and quantify the rates of enzyme action, learn about the modes of enzyme action and enzyme inhibitors.
4. After completing this course, the students are expected to be able to relate to the theoretical knowledge on enzyme biochemistry and translate them in real life situations like understanding the basis for action of medicines which often modulate enzyme activities within the system.
5. The course design keeps in mind that the students pursuing the program develop ideas and analytical aptitude for pursuing higher studies on glycobiology, protein chemistry and even structural biology which have immense relevance on human health and diseases.

Skill Enhancement Course

SEC-A-(1) in Semester 3 - Apiculture

This course aims to help the students

- To understand the significance of beekeeping as an economically viable industry and
- To learn about the bee diversity and be able to identify bees based on morphological characters, understand the biology and behavior of bees and gain insight into the social structure and organization of bee colonies, acquire knowledge about parasites affecting the bees along with concerned strategies for efficient rearing of disease-free bees and maintaining productive apiaries..
- To learn techniques of bee rearing, apiary management, strategies of honey collection along with commercializing the products obtained from apiculture including honey, bee wax, propolis, pollen, etc. as well as learn about optimization techniques based on changing climate and geographical regions for augmentation of productions associated with apiculture.
- To be aware of the opportunities and employment in apiculture industry in public and private as well as to invest upon as independent entrepreneur.

Semester 4

CC8- Comparative Anatomy of Vertebrate

1. The paper is designed such that the students can learn about the developmental diversity involved in the evolution of major organ systems in the vertebrates including digestive, respiratory, circulatory, urinogenital, integumentary, skeletal and nervous systems.
2. The students will understand and appreciate the functional similarities and dissimilarities of the various organ systems which will help to establish deeper understanding of the basis of evolution of organ systems in response to changing demands as life evolved from aquatic to terrestrial forms.
3. The course aims at providing a comprehensive understanding of the basis of evolution of complex nervous system and brain development which underlies the evolution of behavior and cognitive abilities in the higher mammals.
4. After completing this course, the students will gain logical and consistent understanding of the vertebrate evolution from the perspective of organ system development which will help to develop keen interest in pursuing advanced studies in the field of animal development, molecular taxonomy and evolution.

CC9- Animal Physiology: Life sustaining system

This course aims to help the students

- To learn about molecular and functional basis of vital physiological processes in vertebrates like hematopoiesis, blood clotting along with the basis of blood grouping in humans.
- To be able to correlate the vertebrate anatomy with the concerned physiological processes involved therein including appreciation of structure function relation to meet the physiological requirements.
- To understand the basis of thermoregulation and osmoregulation along with correlating the environmental factors determining/modulating the functional diversity of these processes across different animals residing in various ecosystems.
- To be able to relate to the theoretical knowledge with the real-life situations including biodiversity, habitat-specific distribution of animals and conservational strategies guided by animal physiological requirements.
- To develop ideas and analytical aptitude for pursuing higher studies in the fields of animal physiology, human clinical complications and conservation.

CC10- Immunology

1. The objective of the course is to provide comprehensive insight of the immune system along with knowledge about immune cell diversity and organs contributing to systemic production of immune cells and molecules.
2. This course will enable the students to understand the basis of different types of immune responses including allergy and auto-immune responses along with learning about antigenic diversity and basis of inflammation as the major immunological response.
3. The course will further help the students to gain insight into the basis of acquired immunity mainly through active & passive immunization along with strategies for vaccine development.
4. The students will learn about the diverse factors involved in immunological signaling, associated regulatory factors and complex interplay of diverse immune cells and biological macromolecules modulating immunogenic responses.
5. The course amins at providing a comprehensive knowledge about the basic tools of molecular immunology for performing basic experiments and thereupon developing a basic sense/ orientation for pursuing career in biomedical research. It will help students to learn how to frame questions in molecular immunology for pursuing advanced studies while preparing themselves for higher studies and NET/SET/other examination for entry into services.

Skill Enhancement Course

SEC-B-(1) in Semester 4- Aquarium Fisheries

This course aims to help the students

- To understand the significance of aquarium fish keeping as an economically viable industry, specifically fish-based cottage industry.
- To learn about the fish diversity, be able to identify exotic and endemic aquarium fishes based on morphological characters and understand the biology and behavior of commercially relevant aquarium fishes for enhanced rearing.
- To develop skills and learn techniques of fish rearing, management of aquarium and ornamental fisheries, strategies for commercialization including fish handling, packaging and transportation as well as formulation of fish feeds with high nutrition value and most importantly be aware about the prospect and employment opportunities in aquarium fish-based small-scale industry in public and private as well as to invest upon as independent entrepreneur.

Semester 5

CC11- Ecology

1. The objective of this course is to provide the students a comprehensive idea about the biotic and abiotic interactions between organisms and the environment in which they live, function and expand by giving birth to their progenies.
2. The course is designed such that the students will get a deeper insight into the community structure, population dynamics of various species while at the same time learning about various types of intra- and inter-specific interactions that underlie the community interactions, kinds of food chains operating in the different types of ecosystem as well as the chemico-biological and nutrient cycles operating as a source for supply of raw materials for production and consumption.
3. The students will also learns about the status of animals and plants in the ecosystem from the point of view of abundance, exploitation and conservation so that they can contribute in the future to prevent species extinction due to over-exploitation They will learn about the various agencies like The International Union for Conservation of Nature and World Wide Fund; how they operate for conducting species monitoring and conservation, what is meant by Red Data book, how species are enlisted in different IUCN categories based on their abundance and what will be the impact of species extinction from the ecosystem.
4. After completion of this course, students are expected
    - To have a clear idea about the functional and evolutionary biology of ecology.
    - To present ecology as a scientific study and an exciting field while being able to analyze a biological problem, derive a testable hypothesis and design experiments and put them into practice.
    - To solve environmental problems involving human-animal interactions and solve ecological problems pertaining to local and global level.

CC12- Principle of Genetics

1. The outcome of this course is to help the students generate understanding and ideas to apply the Mendelian principles in experimental studies while gaining deeper insight into the causes and their effects of alteration in structure and number of chromosomes.
2. The students will learn about the basic principles of mutation and the diseases caused by the different kinds of mutation while knowing about the molecular methods and conventional techniques for gene manipulation in biological systems.

3. Successful completion of this course will lead to generation of aptitude and analytical skills among students in the fields of biomedical research including genetic engineering, cell culture, cloning, genetic disorders, etc.

Discipline Specific Elective Course in Semester 5

DSE A-1- Parasitology

1. This course enables students to understand and develop concepts about species interaction in the environment in regards to host-parasite relation/interactions while learning about diseases, modes of transmission, prevention and strategies for control of diseases.
2. The students will develop a deep understanding of the pathogenicity of Protozoan and the Helminthic parasites, study about the epidemiology of the diseases: their transmission, virulence and pathogenicity of pathogenic micro-organisms, their prevention, prophylaxis and control of the diseases.
3. The course provides an opportunity to study the causative agents, pathogenesis and treatment strategies for important diseases like malaria, leishmaniasis, trypanosomiasis, toxoplasmosis, schistosomiasis, cysticercosis, filariasis etc. while evaluating the significance of incidence, prevalence and epidemiology in microbiological diagnostic activities.
4. The course amins at providing a comprehensive knowledge about the basic tools of molecular parasitology for performing basic experiments and thereupon developing a basic sense/ orientation for pursuing career in biomedical research. It will help students to learn how to frame questions in molecular immunology for pursuing advanced studies while preparing themselves for higher studies and NET/SET/other examination for entry into services.

Semester 6

CC13- Developmental Biology

1. The objective of this course is to develop among the students a generalized understanding of how a multicellular organism is evolved from a single celled fertilized zygote, and appreciate the molecular intricacies underlying the processes.
2. The students will learn and understand the different changes in opinion and knowledge that has taken place over the course of time in the field of developmental biology from the beginning of 19^{th} century.
3. The course will help to learn about the developmental diversity involved in the evolution of major organ systems in the vertebrates along with understanding the functional similarities and dissimilarities of the various organ systems which in turn will help to establish deeper perception of the basis of evolution of organ systems in response to changing demands as life evolved from aquatic to terrestrial forms.

4. The course also provides a good opportunity to develop knowledge about tissue-specific developmental gene expressions, determination of cell lineages along with critically appreciating the concept of potency and commitment of cells during the course of development.
5. The course will help to gain logical and consistent understanding about the evolutionary history of the taxa based on overall developmental affinities as well as from the perspective of organ systems which will thereby help to develop keen interest in pursuing advanced studies in the field of animal development, molecular taxonomy and evolution.
6. The students will also learn about the relevance of developmental biology in medicine or its role in development of diseases as well as develop concepts on *in vitro* fertilization, stem cell transplantation and basics of regenerative medicine.

CC14- Evolutionary Biology

This course is designed for the students

- To understand the evolution of universe and the generation of life forms.
- To encourage them develop interest in theories, hypothesis and debates related to evolution of mankind while harnessing in-depth knowledge on the diversity and relationships in animal world.
- To develop a complete understanding of the phylogeny and adaptations of life forms in animal world while gaining a precise understanding of the processes and theories of evolutionary biology.
- To help the student gain firm base of construction of phylogenetic trees using taxonomic tools along with harnessing in-depth knowledge on the diversity and relationships in animal world as well as develop an understanding of the phylogeny, basis of speciation and the evolutionary processes leading to selection of highly evolved life forms.

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Discipline Specific Elective Course in Semester 6

DSE- A- 1- Animal Biotechnology

1. The course is developed such that the students gain an understanding of the techniques of biotechnology; like DNA isolation, PCR, transformation, restriction, digestion etc.
2. The students will learn how to formulate strategies 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.
3. The course will ensure that students develop a strong foundation of the ethical and social issues raised regarding the generation of genetically modified organisms (GMOs).
4. The students are expected to pursue higher studies in the field, while preparing themselves for higher studies and NET/SET/other examination for entry into services. It is also expected that students utilize this knowledge and learn to frame questions in molecular biology and recombinant DNA technology for pursuing advanced studies and therein design scientific projects for experimental research.