

SEMESTER -III
DEPARTMENT OF ZOOLOGY
Category I

(B.Sc. Honours in Zoology in three years)

DISCIPLINE SPECIFIC CORE COURSE -7 –:
Diversity of Chordates
Zoo-DSC-7

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Diversity of Chordates Zoo-DSC-7	04	02	Nil	02	Passed Class XII	NIL

Learning Objectives

The learning objectives of this course are as follows:

- The course aims to impart in-depth knowledge about the diverse life forms from the taxonomic positions of Protochordates and Agnatha to Mammalia.
- It will help the students to identify the body plan types of complex chordates and their systematic organization based on evolutionary relationships, structural and functional affinities.
- The course will help the students to understand the characteristic morphological, adaptive and anatomical features of diverse animals.
- The course will help students to understand the economic and ecological significance of various animals in human life.
- The course will create interest among them to explore and appreciate the animal diversity in nature.

Learning Outcomes

By studying this course, students will be able to

- Correlate the importance of systematics, taxonomy, and structural organization of chordates.
- Recognize the diversity of chordates living in varied ecological habitats.
- critically analyse the organization, complexity and characteristic features of chordates.
- comprehend the economic importance of 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.

SYLLABUS OF DSC-7

UNIT-I: Introduction to Chordates

2 hrs

General characteristics and outline classification.

UNIT-2: Protochordata

3hrs

General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of Tornaria and Ascidian larval forms in protochordates.

UNIT-3: Origin of Chordates

2 hrs

Theories of Origin of chordates with detailed concept of Dipleurula and the Echinoderm theory.

UNIT-4: Agnatha

2 hrs

General characteristics and classification of cyclostomes up to Class.

UNIT-

5:

Pisces

3 hrs

General characteristics of Chondrichthyes and Osteichthyes; Classification up to order; Osmoregulation; Swimbladder in fishes

UNIT- 6: Amphibia

4 hrs

General characteristics and classification up to order; Origin of Tetrapods (Evolution of terrestrial ectotherms); Parental care in Amphibians.

UNIT-7:

Reptilia

4 hrs

General characteristics and classification up to order; Affinities and evolutionary significance of *Sphenodon*; Poison apparatus and biting mechanism in snakes.

UNIT- 8: Aves

4 hrs

General characteristics and classification up to order; Flight adaptations; Migration in birds.

UNIT- 9: Mammalia

4 hrs

General characteristics and classification up to order; Adaptive radiation with reference to locomotory appendages.

UNIT- 10: Zoogeography

2 hrs

Zoogeographical realms, Plate tectonics and Continental drift theory.

Practical

60 hrs

(Laboratory periods: 15 classes of 4 hours each)

- 1. Protochordata:** *Balanoglossus*, *Herdmania*, *Branchiostoma*, Colonial Urochordata, Sections of *Balanoglossus* through proboscis and branchio-genital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions. Permanent slide of *Herdmania* spicules.
- 2. Agnatha:** *Petromyzon*, *Myxine*.
- 3. Pisces:** *Scoliodon*, *Sphyrna*, *Pristis*, *Torpedo*, *Chimaera*, *Mystus*, *Heteropneustes*, *Labeo*, *Exocoetus*, *Echeneis*, *Anguilla*, *Hippocampus*, *Tetrodon/Diodon*, *Anabas*, Flatfish. Permanent slides of Placoid and Cycloid Scales.
- 4. Amphibia:** *Ichthyophis/Ureotyphlus*, *Necturus*, *Bufo*, *Hyla*, *Alytes*, *Salamandra*.
- 5. Reptilia:** *Chelone*, *Trionyx*, *Hemidactylus*, *Varanus*, *Uromastix*, *Chamaeleon*, *Ophiosaurus*, *Draco*, *Bungarus*, *Vipera*, *Naja*, *Hydrophis*, *Zamenis*, *Crocodylus*; Key for Identification of poisonous and non-poisonous snakes.
- 6. Aves:** Study of six common birds from different orders. Types of beaks and claws.
- 7. Mammalia:** *Sorex*, Bat (Insectivorous and Frugivorous), *Funambulus*, *Loris*, *Herpestes*, *Erinaceus*.
- 8. Student Presentation:** Power point presentation on any two animals from two different classes.

***Note:** Refer Young, J.Z. (2004) for the classification of Protochordates and Tetrapods, and Parker T.J. and Haswell W.A. (1972) for the classification of Agnatha and Pisces.

Essential/recommended readings

1. Young, J.Z. (2004). **The Life of Vertebrates**. III Edition, Oxford University Press.

2. Parker T.J. and Haswell W.A. (1972). **Text book of Zoology Vertebrates**. VII Edition, Volume II.

Suggestive readings

1. Pough H. (2018). **Vertebrate Life**. X Edition, Pearson International.
2. Darlington P.J. (1966). **The Geographical Distribution of Animals**. R.E. Krieger Pub. Co.

NOTE: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE -8 – :
Biochemistry: Metabolic Processes
Zoo-DSC-8

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Biochemistry: Metabolic Processes Zoo-DSC-8	04	02	Nil	02	Passed 12 th Class	NIL

Learning Objectives

The learning objectives of this course are as follows:

- To provide fundamental and precise knowledge of the metabolic processes that play a crucial role in all processes of life and the development of diseases.
- To apprise the students of the various functions of the molecules like providing structural integrity to the tissue-engineered constructs.
- Through this course, the students would be able to understand myriads of health, potential treatments of diseases and solve several industrial problems
- The enzymatic study would enable them to understand the various metabolic pathways and physiological reactions.

Learning Outcomes

By studying this course, students will be able to

- Interpret the structure-functional relationships of carbohydrates, proteins, lipids and nucleic acids.
- Understand the clinical knowledge and importance of antioxidants.
- Understand the process of biological oxidation crucial to generation of energy for a living cell.
- Appreciate the action of various types of enzymes under variety of conditions.

Syllabus of DSC-8

UNIT- 1: Carbohydrate Metabolism

9 hrs

Glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis.

UNIT- 2: Lipid Metabolism

7 hrs

β -oxidation and omega-oxidation of saturated fatty acids with even number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis.

UNIT- 3: Protein Metabolism

4 hrs

Catabolism of amino acids: Transamination, Deamination, Urea cycle.

UNIT- 4: Oxidative Phosphorylation

7 hrs

Redox systems; review of mitochondrial respiratory chain: electron carriers, sites of ATP production, Oxidative phosphorylation; Chemiosmotic hypothesis, mitochondrial shuttle system.

UNIT- 5: Liver as a Major Metabolic Hub

3 hrs

Inter-connection of glucose-6-phosphate, pyruvate and acetyl-CoA; fates of amino acids, fatty acids and glucose in liver cells; cascade of metabolic events in fasting and starvation.

Practical

60 hrs

(Laboratory periods: 15 classes of 4 hours each)

1. Estimation of total protein in given solutions by Lowry's method.
2. Detection of SGOT and SGPT in serum/ tissue.
3. Estimation of GST and GSH in serum/ tissue.
4. To study the enzymatic activity of Lipase.
5. Study of biological oxidation (SDH) [goat liver].
6. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.
7. Dry Lab: To trace the labelled 'C' atoms of Acetyl-CoA till they evolve as CO₂ in the TCA cycle through models.

Essential/recommended readings

3. Nelson, D.L., Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). New York, WH: Freeman Company.
4. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry. XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.

Suggestive readings

1. Stryer, L., Berg, J., Tymoczko, J., Gatto, G. (2019). Biochemistry (9th ed.), New York, WH: Freeman.
2. Voet, D., Voet, J. G. (2013). Biochemistry (4th ed.). New Jersey, John Wiley & Sons Asia Pvt. Ltd.

**DISCIPLINE SPECIFIC CORE COURSE– 9:
Human Physiology- Life Sustaining Systems
Zoo-DSC-9**

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Human Physiology- Life Sustaining Systems Zoo-DSC-9	04	02	Nil	02	Passed 12 th Class	NIL

Learning Objectives

The learning objectives of this course are as follows:

- The course will provide a thorough understanding of the normal body function and helps to determine the cause of disease.
- It will enable the development of new and more effective treatments and guidelines for maintaining good health.
- It will equip the students with an ability to pursue career in medical and healthcare sector, pharmaceuticals and other related areas.
- It will help in understanding how these systems interact among themselves to maintain stability or homeostasis.

Learning Outcomes

By studying this course, students will be able to:

- Appreciate human physiology and have its enhanced knowledge.
- Recognize and identify principal and physiology of digestion.
- Understand the functions of important physiological systems including the digestive, circulatory, renal and respiratory system.
- Learn an integrative approach to understand how these separate systems interact to yield integrated physiological responses to maintain homeostasis in the body along with feedback mechanisms.
- Amalgamate ideas to make the connection between knowledge of physiology and real-world situations, including healthy lifestyle decisions and problems faced due to homeostatic imbalances.
- Perform, analyze and report on experiments and observations in physiology.
- Know the fundamentals and understand advanced concepts so as to develop a strong foundation that will help them to acquire skills and knowledge to pursue an advanced degree.

SYLLABUS OF DSC-9

UNIT- I Physiology of Digestion**7 hrs**

Overview of gastrointestinal tract and its associated glands; digestion; Absorption of carbohydrates, lipids, proteins; Hormonal control of secretion of enzymes in gastrointestinal tract.

UNIT- 2 Blood**4 hrs**

Structure and functions of haemoglobin; Blood clotting system, Fibrinolytic system.

UNIT- 3: Physiology of Heart**7 hrs**

Structure of heart; Coronary circulation; Origin and conduction of cardiac impulses; Cardiac cycle; Cardiac output and its regulation; nervous and chemical regulation of heart rate.

UNIT- 4: Physiology of Respiration**6 hrs**

Overview of respiratory system; Mechanism of respiration, Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Dissociation curves and the factors influencing it; regulation of respiration.

UNIT- 5: Renal Physiology**6 hrs**

Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance.

Practical**60 hrs****(Laboratory periods: 15 classes of 4 hours each)**

1. To understand the components of blood, their functions and Hematopoiesis.
2. To study whole blood hemolysis with ammonium chloride solution.
3. Preparation of haemin and haemochromogen crystals.
4. Measurement and statistical analysis of variations observed in the student population in the class for the following parameters:
 - a) White blood cells using haemocytometer
 - b) Red blood cells using haemocytometer
 - c) Hemoglobin
 - d) Blood pressure
5. Examination of histological sections of mammalian oesophagus, stomach, duodenum, ileum, rectum, liver, trachea, lung, kidney.
6. Study of Electrocardiogram; Analysis of ECG records and calculation of heart rate.
7. Detection of abnormal constituents in urine and their physiological significance.

Essential/recommended readings

1. Tortora, G.J. and Derrickson, B.H. (2017). Principles of Anatomy and Physiology. XV Edition, John Wiley and Sons, Inc.
2. Ganong W.F. (2019). Review of Medical Physiology 26th ed. Mc Graw-Hill.
3. Widmaier E, Raff H and Strang K. (2013) Vander's Human Physiology: The Mechanism of Body Functions. XIII Edition, McGraw-Hill Education.
4. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
5. Eroschenko, Victor P. (2012) Di Fiore's Atlas of Histology with Functional Correlations; 12th edition, CBS Publishers and Distributors Pvt. Ltd.

Suggestive readings

1. Chatterjee, C.C. (2021) Human Physiology, 14th Edition, Volume 1 & Volume II, CBS Publishers and Distributors Pvt. Ltd.
2. Vander A, Sherman J, and Luciano D (2014). Vander's Human Physiology

POOL OF DISCIPLINE SPECIFIC ELECTIVES (DSE) COURSES

DISCIPLINE SPECIFIC ELECTIVES (DSE-1): Aquatic Biology Zoo-DSE-1

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Aquatic Biology Zoo-DSE-1	04	03	00	01	Passed 12 th Class	NIL	Zoology

Learning Objectives

The learning objectives of this course are as follows:

- This course offers a comprehensive knowledge on life in freshwater and marine environments; lakes; stream and their characteristics, adaptations of organisms, water resource management; nutrient cycling; major threats to aquatic systems, pollution and eutrophication.
- To impart knowledge and understanding of basic laboratory equipment and practice of water quality analysis, to study of aquatic plants.
- To introduce various freshwater and marine ecosystems and its components.
- To understand the biodiversity and productivity of freshwater and marine environments.
- To impart knowledge on various threats and conservation strategies.

Learning Outcomes

By studying this course, students will be able to

- Be acquainted with the physico-chemical environment, and its role in aquatic ecosystem.
- Learn about adaptations unveiled by organisms to survive in these distinctive conditions.
- well-versed with the laws governing the use of freshwater systems, as well as the local, state, federal, and international agencies that enforce these laws to protect endangered and vulnerable species.
- Understand and apply relevant scientific principles in the area of aquatic biology and educate others or work to conserve our natural resources.
- Realize impact of human activities on aquatic organisms.

SYLLABUS OF DSE-1

UNIT-I: Aquatic Biomes

6 hrs

Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), Estuaries, Intertidal zones, Oceanic pelagic zone, Marine benthic zone and Coral reefs.

UNIT-2: Lakes

9 hrs

Lakes: Origin and classification (Glacial, Tectonic, Volcanic and Fluvial Lakes), Lake as an Ecosystem, Lake morphometry, Physico-Chemical Characteristics: Thermal stratification, Vertical distribution of oxygen in lakes, Dissolved Nitrates and Phosphates, Turbidity.

UNIT- 3: Streams and Rivers

9 hrs

Streams: Different stages of stream development, Physico-chemical environment, Stream flora and fauna. Adaptations of hill stream fishes. Rivers: Origin and characteristics of river. Functions. Concept of watershed management. Ramsar Convention.

UNIT-4: Marine Biology

12 hrs

Continental shelf, Salinity and density of sea water, Light attenuation in water: Photic, dysphotic and aphotic zones. Adaptations of deep-sea organisms. Marine mammals and their adaptations. Coral reefs: Formation, distribution, fauna and effect of climate change. Physico-chemical characteristics of estuaries, estuarine ecosystem.

UNIT-5: Management of Aquatic Resources

9 hrs

Major threats to freshwater systems, including pollution and sand mining. Impact of large dams and fragmentation on river ecology and fishery. Thermal pollution and oil spills; Sewage treatment, Water quality assessment- BOD and COD.

Practical

30 hrs

(Laboratory periods: 15 classes of 2 hours each)

1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identification of following present in a lake ecosystem (3-5 each):
 - a) Macrophytes
 - b) Phytoplankton
 - c) Zooplankton
3. Estimation of pH, dissolved oxygen, alkalinity, free carbondioxide, carbonates and bicarbonates in water collected from a nearby lake/ water body.

4. Estimation of Biochemical oxygen demand of water sample.
5. To demonstrate the following instruments used in limnology and discuss its significance:
 - a) Secchi disc
 - b) Van Dorn Bottle
 - c) Conductivity meter
 - d) Turbidity meter
 - e) PONAR grab sampler
6. Project Report on a visit to a Sewage treatment plant/Freshwater ecosystem (wetland, lake, river side etc.)/Marine bio-reserve/Fisheries Institutes.

Essential/recommended readings

1. Sullivan O.P. and Reynolds C.S. (2004) The lakes hand book, Limnology and limnetic ecology. Wiley Blackwell.
2. Brian R. Moss (2018) Ecology of Freshwaters: Earth's Blood stream (5th edition). Wiley.
3. Dodds W.K. and Whiles M.R. (2019). Freshwater Ecology: Concepts and Environmental Applications of Limnology (3rd edition). Academic Press.
4. Barrick, M., Odum, E.P., Barrett, G.W., (2005). Fundamentals of Ecology. 5th Edition. Cengage Learning.

Suggested readings:

1. Robert G. Wetzel. (2001) Limnology: Lake and River Ecosystems. 3rd edition.
2. Castro and Huber. Marine Biology. 11th Edition, Mc Graw and Hill.

DISCIPLINE SPECIFIC ELECTIVES (DSE-2): Agrochemicals & Pest Management Zoo-DSE-2

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Agrochemicals & Pest Management Zoo-DSE-2	04	03	00	01	Passed 12 th Class	NIL

Learning Objectives

The learning objectives of this course are as follows:

- This course offers an insight about the role of insects as powerful competitors of man as they cause enormous injury to crops and animals and also act as vectors of many diseases.
- To impart knowledge about various types of pests, their distinguishing features, life cycle, symptoms of infestation and/or damage to crops and human health.
- This course will help the students to understand the concept of insect pests and their population dynamics in relation to changing environmental conditions.
- The students will learn about the various methods used in pest management with *pros* and *cons* of each, and how they could be integrated for effective, economical and eco-friendly pest management programs (IPM).
- To enthuse the students to become entomologists.

Learning Outcomes

By studying this course, students will be able to:

- create awareness about adverse effects of insecticides on the environment and the need for an environment-friendly approach to the management of insect pests.
- gain knowledge about the concepts and tools of pest management.
- Understand the planning of agricultural ecosystem, tolerance of pest damage, and timing of different pest control tactics to effectively manage the pest population.
- learn about the use of different pest control techniques in a harmonious manner.
- understand the role of IPM in sustainable agriculture as the future of modern plant protection and pest control strategy.

SYLLABUS OF DSE-2

UNIT- I: Diversity of insects

6 hrs

Salient features of insects and reasons for their diversity; Outlines of insect classification up to orders. Significance of insects in the ecosystem.

UNIT-2: Insect morphology and development

9 hrs

Overview of insect morphology: Distinction between prognathous, hypognathous and opisthognathous head, types of antennae, mouth parts and legs. Insect development and types of metamorphosis.

UNIT-3: Insect crop pests and their management

12 hrs

Introduction to different types of pests and their status, Factors responsible for emergence of pest, Pest population dynamics.

Bionomics and Control of Crop pests: *Leptocorisa acuta*, *Sesamia inferens*, *Helicoverpa armigera*, *Pyrilla perpusilla*, *Earias vitella*, *Raphidopalpa faveicollis*, *Papilio demoleus*.

Bionomics and strategies for the management of stored grain pests: *Sitophilus oryzae*, *Callosobruchus chinensis*, *Trogoderma granarium* and *Corcyra cephalonica*.

UNIT-4: Medically Important and Household Pests

6 hrs

Bionomics and management of cockroach, rat flea, mosquitoes, house fly, sand fly, human louse and termites.

UNIT-5: Insect Pest Management

12 hrs

Overview of pest management tactics: physical, mechanical, cultural, biological, microbial, botanical and genetic control (SIT/SIRM).

Chemical control: Chlorinated hydrocarbons (BHC, Aldrin) organophosphates (Malathion Parathion), carbamates (Carbaryl, Propoxur) and synthetic pyrethroids (Allethrin and Cypermethrin).

Integrated pest management (IPM): Definition, principle, components of IPM and advantages.

Practical

30 hrs

(Laboratory periods: 15 classes of 2 hours each)

1. Study of the morphology of insects with the help of museum specimens/ slides/ photographs: types of antennae, mouthparts, and legs of insects.
2. Study of two economically important insects representing different orders: Dictyoptera, Hemiptera, Orthoptera, Isoptera, Anoplura (Siphunculata), Diptera, Coleoptera, Hymenoptera and Lepidoptera.
3. Elementary knowledge of collection, preservation and rearing techniques of

insects: Submission of life cycle stages of any two insect pests.

4. Determination of LD₅₀/ LC₅₀ of insecticides based on the data provided.
5. Study of Instruments used for chemical control through specimens/videos/photographs.
6. Submission of report based on field trips to entomological institutes, museums, laboratories.

Essential/recommended readings

1. Borror, D.J., Triplehorn, C.A., and Johnson, N.F. (2005) Introduction to the Study of Insects. M Saunders College Publication, USA.
2. Chapman, R.F. (1998) The Insects: Structure and Function. Cambridge University Press, UK.
3. Imms, A. D. (1923) A General Text Book of Entomology. Chapman &Hall, UK.
4. Snodgrass, R. E. (1935) Principles of Insect Morphology. Cornell Univ. Press, USA.
5. Dennis, S. Hill. (2005) Agricultural Insect Pests of the Tropics and Their Management. Cambridge University Press.
6. David, B. V. and Ananthkrishnan, T.N. (2004) General and Applied Entomology. Tata-McGraw Hill, New Delhi.

Suggested readings

1. Duntson, P.A. (2004) The Insects: Structure, Function and Biodiversity. Kalyani Publishers, New Delhi.
2. Atwal, A.S. (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, New Delhi.
3. Wigglesworth, V.B. (1984) Insect Physiology. VIII Edition, Chapman & Hall, New York.

DISCIPLINE SPECIFIC ELECTIVES (DSE-3): Medical Zoology Zoo-DSE-3

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Medical Zoology Zoo-DSE-3	04	03	00	01	Passed 12 th Class	NIL

Learning Objectives

The learning objectives of this course are as follows:

- This course offers an insight about the various types of human diseases.
- The students will understand the concepts of pathogenic and pathological basis of diseases including infectious diseases caused by viruses, prokaryotes, protozoans, helminthes, vector borne and zoonotic diseases.
- Learn about nutritional deficiencies and lifestyle diseases, endocrine diseases and cancer.

Learning Outcomes

By studying this course, students will be able to:

- understand various types of human diseases.
- clarify the concepts of pathogenic and pathological basis of diseases.
- Recognize deficiencies and lifestyle diseases, endocrine diseases and cancer.
- broaden the understanding of medical importance of studying Zoology.

SYLLABUS OF DSE-3

UNIT-1: Introduction to Infectious diseases 6 hrs

Concept of Epidemiology, Incidence, Prevalence, Virulence, Pathogenicity, Transmission, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis.

UNIT- 2: Transmission, prevention and control of Viral infection 6 hrs

Dengue, Polio, Measles, Mumps, influenza, SARS, HIV.

UNIT-3: Bacterial infections 6 hrs

Tetanus, Diphtheria, Tuberculosis, Typhoid, Cholera; brief account of *Rickettsia*, *Borellia*, *Treponema* and *Leptospira*.

UNIT- 4 Protozoan and Helminthic infection 6 hrs

Life history and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax*, *Trypanosoma gambiense*; *Wuchereria bancrofti*, *Faciolopsis buski*, *Ancylostoma duodenale*.

UNIT-5: Nutritional deficiency and lifestyle-based diseases. 6 hrs

Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindness, Rickets, Osteoporosis, Obesity, Cardiovascular diseases (CVD), Atherosclerosis, Diabetes mellitus, Inflammatory Bowel Disease (IBD).

UNIT-6: Endocrine Diseases 9 hrs

Hormonal imbalances leading to diseases: Diabetes insipidus, Acromegaly, Gigantism, Dwarfism, Goitre, Cretinism, Cushing and Crohn's syndrome, Addison's disease.

UNIT-7: Cancer 6 hrs

Definitions, Nomenclature, characteristics of benign and malignant neoplasms, grading and staging of cancer, biology of tumor growth, invasion and metastasis, carcinogens and cancer.

Practical 30 hrs

(Laboratory periods: 15 classes of 2 hours each)

1. Study of Disease specific bacteria and viruses through pictures/micrographs/Videos.
2. Performing of gram staining and study of Acid Fast staining through permanent slides.
3. Urine analysis for abnormal constituents: protein, blood, bile salts and glucose.
4. Study of arthropod vectors associated with human diseases: *Anopheles*, *Aedes*, *Culex*, *Phlebotomus*, *Xenopsylla*.
5. Study of permanent slides and specimens of *Plasmodium sp*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Schistosoma haematobium* and *Wuchereria bancrofti*.
6. Study of endocrine diseases through case studies (any 2).
7. Identification and study of cancer cells- Slides/Photomicrographs/Videos.
8. Project work/report: field visit to a research institute/laboratory to study some of the pathological and diagnostic techniques.

Essential/recommended readings

1. Park, K. (2017) Textbook of Preventive and social medicine. 23rdEdition. B.B Publisher.
2. Robbins, Basic Pathology, 9th edition (2012), Kumar, Abbas, Fausto and Mitchell; Saunders Publication, ISBN-13: 978-1437717815
3. Ramnik. Sood (2009) Medical Laboratory Technology Methods and Interpretations, 6th edition; Jaypee Brothers Medical Publishers, ISBN-13: 978-8184484496.

Suggested readings

1. Robbins and Cotran. Pathologic Basis of Disease, 8th edition (2009), Vinay Kumar, Abul. K. Abbas, Jon C. Aster, Nelson Fausto; Saunders Publishers, ISBN-13: 978-1416031215
2. Arora, D.R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications

DISCIPLINE SPECIFIC ELECTIVES (DSE-4): Wildlife Conservation & Management Zoo-DSE-4

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Wildlife Conservation & Management Zoo-DSE-4	04	03	00	01	Passed Class 12 th	NIL

Learning Objectives

The learning objectives of this course are as follows:

- To acquaint the students with varied aspects of wildlife conservation, including its importance, major threats, and management of their habitats and populations.
- The emphasis will be on developing interest and invoking a sense of responsibility among students towards wildlife conservation.
- The course also explores different techniques, perspectives, and approaches to both identify and achieve wildlife management goals.
- To motivate students to pursue a career in the field of wildlife conservation and management.

Learning Outcomes

By studying this course, students will be able to:

- Appreciate wildlife in general and realize its conservation and management in particular.
- Better understand 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.
- comprehend 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 and Ecotourism in India.
- Perform critical thinking, literature review; scientific writing as well as presentations; and participation in citizen science initiatives with reference to wildlife.

SYLLABUS OF DSE-4

UNIT-1: Introduction to Wildlife

3 hrs

Values of wildlife - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion.

UNIT-2: Evaluation and Management of Wildlife **9 hrs**

Habitat analysis: a) Physical parameters: Topography, Geology, Soil and water; b) Biological Parameters: food, cover, forage; Standard evaluation procedures: Bio-telemetry, Remotesensing and GIS.

UNIT- 3: Management of Habitats **9 hrs**

Setting back succession: Grazing, prescribed fire, mechanical treatment and selective herbicide application; Advancing the successional process and cover construction; Preservation of genetic diversity; Restoration of degraded habitats.

UNIT- 4: Population Estimation **6 hrs**

Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation and hair identification; Pug marks and census methods.

UNIT- 5: Wildlife Health and Rehabilitation **9 hrs**

Care of injured and diseased animal; Quarantine; Common diseases of wild animals: Zoonosis (*Ebola* and *Salmonella*), Rabies, Foot and Mouth Disease, *Mycobacterium* TB, Bovine and Avian Flu (Any 3 in detail).

UNIT- 6: Protected Areas and their management **9 hrs**

National parks and Sanctuaries; Biosphere reserves; Conservation and Community reserve; Important features of Protected Areas in India; Project Tiger- conservation and management challenges in Tiger reserves; Human-wildlife conflict; Eco-tourism.

Practical **30 hrs**

(Laboratory periods: 15 classes of 2 hours each)

1. Demonstration of basic equipment needed in wildlife studies- use, care and maintenance (Compass, Binoculars, Spottings cope, Range Finders, Global Positioning System, Various types of Cameras and lenses).
2. Familiarization and study of animal evidences in the field: Identification of animals through pugmarks, hoof marks and scats.
3. Trail/ transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences).
4. Identification of Big cats: Lion, Tiger, Cheetah, Leopard and Jaguar.
5. Project Report: Identification of mammalian fauna, avian fauna, herpeto-fauna through direct and indirect evidences seen on a field trip to a National Park/Wildlife

Sanctuary/Biodiversity Park or any other wildlife conservation site.

Essential/recommended readings:

1. Hudson, P.J., Rizzoli, A., Grenfell, B.T. Heestrbeek, H. and Dobson, A.P. (2002) *The Ecology of Wildlife Diseases*. Oxford University Press, Oxford.
2. Banerjee, K. (2002) *Biodiversity Conservation in Managed and Protected Areas*. Agrobios, India.
3. Kenneth Anderson (2000) *The Kenneth Anderson Omnibus Vol I*. Rupa Publications.
4. Jim Corbett. (2017) *Man Eaters of Kumaon*. Om Books International.
5. Saha, G.K. and Mazumdar, S. (2017) *Wildlife Biology: An Indian Perspective*. PH Ilearning Pvt. Ltd. ISBN: 8120353137, 978-812035313.
6. Sinclair, A.R.E., Fryxell, J.M. and Caughley, G. (2006) *Wildlife Ecology, Conservation and Management*. Wiley-Blackwell, Oxford, UK.
7. Singh, S.K. (2005) *Text Book of Wildlife Management*. IBDC, Lucknow.

Suggested readings:

1. Primack, R.B. (1998). *Essentials of Conservation Biology*. Sinauer Associates, Inc. Sunderland, MA.
2. Hossetti, B.B. (1997). *Concepts in Wildlife Management*. Daya Publishing House, Delhi.
3. Sharma, B.D. (1999) *Indian Wildlife Resources Ecology and Development*. Daya Publishing House, Delhi.

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

GENERIC ELECTIVES (GE-5): Food, Nutrition & Health Zoo-GE-5

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Food Nutrition & Health Zoo-GE-5	04	02	00	02	Passed 12 th Class	NIL

Learning Objectives

The learning objectives of this course are as follows:

- This course offers an overview of the concepts of normal food and nutrition required by the human body to maintain good health.
- To understand physiology, biochemistry, pathology, immunology, medicine, food science, and other fields with context to nutrition.
- Learn the concept of malnutrition, lifestyle-related disorders, addiction-related social health problems and eating disorders will be introduced.
- Appreciate knowledge that can be applied in everyday life.
- Learn the role of macronutrients and micronutrients, their nutritional requirements for different age groups during various health conditions.
- The students will be encouraged to pursue further studies in nutrition and health.

Learning Outcomes

By studying this course, students will be able to

- have an in-depth understanding of the dietary sources and role of nutrients in forming a balanced diet.
- appreciate the concept of nutritional requirements for different age groups and in pregnancy and lactation.
- know about the various food allergens and the body's hypersensitivity towards it.
- understand the concept of health and role of various nutrients in mitigating several deficiency disorders.
- identify and analyse the causes of malnutrition, lifestyle-related disorders, addiction-related social health problems and eating disorders.

- appreciate the various techniques from identification of adulterants, estimation of essential nutrients in food products, to measurement of vital anthropometric indicators of health, as widely used by practitioners.

SYLLABUS OF GE-5

UNIT-1: Basic concept of food and nutrition

2 hrs

Components of nutrients (Macronutrients and Micronutrients).

UNIT-2: Dietary sources and physiological functions

6 hrs

Carbohydrates, Proteins, Lipids Vitamins and Minerals (Iron, Iodine, Calcium, Selenium, Zinc); beneficial effects of dietary fibres; elementary idea of Probiotics, Prebiotics, Organic Food.

UNIT-3: Nutritional requirements

4 hrs

Study of different age groups (infants, preschool children, school children, adolescents, adults, elderly) and in pregnant women and lactating mother.

UNIT-4: Concept of a balanced diet

4 hrs

Food groups, Food Pyramid, Food and Culture; Food Hypersensitivity: Food allergy (nuts and seafood) and Food intolerance (lactose and gluten).

UNIT-5: Health

2 hrs

Definition and concept of health. Indicators of metabolic health.

UNIT-6: Nutritional deficiencies and disorders

9 hrs

Symptoms and prevention of the following: Protein Energy Malnutrition (Kwashiorkor and Marasmus), Vitamin deficiency (A, D, B1, B3 B12, C) Mineral deficiency (Iron, Iodine, Calcium, Selenium, Zinc).

Lifestyle-related diseases: Causes, Symptoms and Complications of Hypertension, Diabetes mellitus and Obesity. Role of dietary and lifestyle modifications for the prevention of these diseases.

Eating Disorders: Complications and Management of Anorexia nervosa and Bulimia nervosa.

UNIT-7: Social health problems

3 hrs

Deleterious effects of addiction-related social health problems: Smoking, alcoholism, and drug dependence.

Practical

60 hrs

(Laboratory periods: 15 classes of 4 hours each)

1. To detect adulteration in (a) Ghee (b) Sugar (c) Tea Leaves (d) Turmeric.
2. Study of nutrition labelling of any 5 popular packaged foods.
3. Study and comparison of food pyramids of any 3 popular diet trends with focus on their pros and cons.
4. Ascorbic acid estimation in food by titrimetry.
5. Estimation of calcium in food by titrimetry.
6. Measurement of anthropometric indicators of health (BMI, Waist to hip ratio, Skin fold test).
7. Plan the diet chart of any three different age groups using RDA values (infants, preschool children, school children, adolescents, adults and elderly).
8. An exercise based on 24-hour food recall of students for quantification and analysis of the macronutrients' and micronutrients' uptake based on the current RDA values (with focus on nutritional status and risk factors).
9. Project Work on the Indian government initiatives focused on nourishment of school children/ expectant mothers.

OR

A small-scale questionnaire-based survey on the knowledge and usage of available resources for quitting smoking and its success/relapse rates.

Essential/recommended readings

1. Gibney MJ et al (2009) Introduction to Human Nutrition, 2nd edition, Wiley-Blackwell, Hoboken
2. ICMR-NIN (2020) Expert Group on Nutrient Requirement for Indians, Recommended Dietary Allowances (RDA) and Estimated Average Requirement (EAR)
3. Elia M et al (2013) Clinical Nutrition, 2nd edition, Wiley-Blackwell, Hoboken

Suggested readings:

1. Mann J and Truswell AS (2017) Essentials of Human Nutrition, 5th edition, Oxford University Press. Oxford
2. Kaveri Chakrabarty and A.S. Chakrabarty (2020) Textbook of Nutrition in Health and Disease, 1st edition, Springer Nature Singapore Pte Ltd

GENERIC ELECTIVES (GE-6): Introduction to Biology Zoo-GE-6

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Introduction to Biology Zoo-GE-6	04	02	00	02	Passed 12 th Class	NIL

Learning Objectives

The learning objectives of this course are as follows:

- The course is designed to acquaint students with the basic concepts of modern biology including processes in cell biology, genetics and variation, process of evolution and also the physico-chemical aspects of life.
- It emphasizes on exploring different techniques, perspectives in the fields of biology from microscopy to computational biology.
- The course has been designed keeping in mind the fact that biology helps to understand ourselves and our place and role in the living world.
- It will motivate the students to pursue careers in the field of technology.

Learning Outcomes

By studying this course, students will be able to

- learn the importance of Biology in everyday life, understand the conditions and processes that led to biochemical origin of life on earth.
- compare and contrast evolutionary theory and their application to populations.
- appreciate the different cell types and cellular processes.
- know the basic structure and functioning of cell such as division, processes of information transfer from DNA to proteins.
- have an in-depth understanding of the role and importance various biomolecules like nucleic acids, proteins, lipids and carbohydrates.
- demonstrate practical knowledge of using basic laboratory instrumentation such as microscopes, micropipettes and their applications.
- learn the diverse techniques taught in practical like chromatography, biochemical test, spectrophotometric analysis and also computational biology will hone their analytical skills.

SYLLABUS OF GE-6

UNIT-1: Introduction to concepts of biology

2 hrs

Themes in the study of biology; a closer look at ecosystem; a closer look at cell; process of science, biology and everyday life.

UNIT-2: Evolutionary history of biological diversity

4 hrs

Early earth and the origin of life; major events in the history of life; classifying the diversity of various Kingdoms of Life.

UNIT-3: Darwinian view of life and origin of species

9 hrs

Darwin's theory of evolution; evolution of populations (Hardy-Weinberg principle); Concepts of species; mechanism of speciation.

UNIT-4: Genetic approach to Biology

7 hrs

Cell and organelles; cell cycle: Mitosis and meiosis; Mendel's laws and variations; model organisms for the genetic analysis.

UNIT-5: Chemical context of living systems

8 hrs

Structure and function of biomolecules: carbohydrate, protein, lipid, and nucleic acid.

Practical

60 hrs

(Laboratory periods: 15 classes of 4 hours each)

1. To learn use of microscope and other common instruments used in laboratory.
2. Preparation of normal, molar, and standard solutions, phosphate buffers.
3. Separation of amino acids (*any three*) by paper chromatography.
4. To perform gram staining of bacteria.
5. To prepare temporary mount of human cheek epithelial cells and to study its characteristics.
6. To perform quantitative estimation of protein using the Lowry's method.
7. To perform biochemical test and identify two functional groups of carbohydrates.
8. To retrieve sequence from database and perform Multiple Sequence Alignment.
9. Visit to a cell culture and tissue culture facility and submission of project report.

Essential/recommended readings

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P. Hetal (2006) Biology 7th edition Tata McGraw Hill Publications, New Delhi

3. Karp, G. (2010). Cell & Molecular Biology: Concepts & Experiments. VI edition, John Wiley & Sons Inc.
4. De Robertis, E.D.P. & De Robertis. E.M.F. (2009). The cell & Molecular Biology, Lippincott Williams, Wilkins, Philadelphia.
5. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley & Sons Inc.

Suggestive readings

1. Sheeler, P and Bianchi, D.E. (2006). Cell and Molecular Biology, 3rd edition, John Wiley & sons NY.
2. Rideley, M. (2004). Evolution. III Edition, Blackwell publishing.

GENERIC ELECTIVES (GE-7): Water-borne Diseases: Understanding and Management
Zoo-GE-7

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Water-borne Diseases: Understanding and Management Zoo-GE-7	04	02	00	02	Passed 12 th Class	NIL

Learning Objectives

The learning objectives of this course are as follows:

- It deals with interactions between microbial water quality and human health.
- It includes appreciating how the quality of water can be affected by natural, seasonal, accidental, intentional, and man-made activities,
- It will help the students learn how the contaminated water increases the burden of human diseases with particular emphasis on infectious diseases,
- It will help understand the environmental pressures caused by contaminated water and how it drives the emergence and re-emergence of infectious diseases with increased/altered virulence, antibiotic resistance.
- It will motivate students to pursue a career in Health Management

Learning Outcomes

By studying this course, students will be able to

- know the sources of microbial water contamination and its impact on human health.
- understand the relationship between human behaviour and water quality.
- learn remediation strategies for several types of microbial water quality contamination.
- understand epidemiological studies related to water quality and public health.
- be able to grasp the concepts of various water sources and transmission mechanisms of infectious agents from those sources to humans.
- organize and present well-synthesized scientific discussions on topics relevant to waterborne disease and public health.
- develop a critical understanding of the contribution of organisms to the welfare of society.

- examine the multiple water-borne pathogens, their modes of transport and transmission, their public health effects, and existing methods for disease prevention and remediation.

SYLLABUS OF GE-7

UNIT-1: Introduction to Public Health

4 hrs

Definition, scope, concept, and importance of public health microbiology; Roles of microbiologists in public health; Concept of health and disease; Indicators of health; Basic concept of water pollution and public health hazard in the community.

UNIT- 2: Introduction to Water Quality

8 hrs

Common terms and definitions in water quality, aquatic resources of the world and sources of drinking water; Water, sanitation, and hygiene (WASH) – fact sheets, WHO guidelines and resolutions; common contaminants of drinking water and linkages to disease; Water pollution (water quality properties, types of water pollution, point and non-point sources of water pollution); Types of contaminants influencing water quality; Water Treatment, Control of Water Borne Diseases.

UNIT- 3: Microbiology of Water

3 hrs

Microbiological quality of drinking; water as a causing factor of infectious diseases; water-borne pathogens (types, sources, and transmission); microbial testing of Water; monitoring and surveillance of water quality.

UNIT- 4: Water-Borne Diseases

10 hrs

Source of infection, transmission, symptoms, mitigation, prevention and treatment (with reference to the role of agencies/NGO).

-Bacterial infections- Cholera, Typhoid fever, Botulism, *E. coli* infection, Campylobacteriosis, Dysentery, Typhoid fever.

-Viral infections: Rotavirus, Hepatitis A and E, Poliomyelitis, Polyomavirus infection.

-Protozoal infections: Acanthamoeba keratitis, Amoebiasis, Cryptosporidiosis, Cyclosporiasis, Giardiasis.

- Parasitic worms: Schistosomiasis, Fascioliasis, Strongyloidiasis, Hookworm infections, Giardiasis.

-Vector-borne infections: Malaria, Dengue, Chikungunya, Onchocerciasis, Leishmaniasis, Japanese encephalitis, Dracunculiasis, Lymphatic filariasis,

UNIT- 5: Waterborne Pathogens: Detection Methods

5 hrs

Polymerase chain reaction (PCR) -Multiplex PCR; Quantitative PCR (qPCR), Real-time PCR; Microarrays; Pyro-sequencing; Biosensors; Fluorescence *in situ* hybridization

(FISH); Immunology-based methods.

Practical

(60 hrs)

(Laboratory periods: 15 classes of 4 hours each)

1. To determine dissolved oxygen in water samples collected from different water bodies by Winkler's Method.
2. To determine temperature, pH, conductivity, total solids, and total dissolved solids in water samples from different locations.
3. To measure the COD of water samples from various sources.
4. Isolation and identification of microorganisms from different water samples.
5. Project report on water quality monitoring system.
6. Visit to WASH Institute (Water Sanitation and Hygiene Institute)/ Shri Ram Institute for Industrial Research.

Essential/recommended readings

1. Aquatic Pollution: An Introductory Text, 3rd Edition, Edward A. Laws, ISBN 9780471348757.
2. Waterborne Disease, 1st edition (January 15, 1997), Paul Hunter, ISBN 0125515707.

Suggestive readings

1. Microbiology of Waterborne Diseases, Steven Percival, Rachel Chalmers, Martha Embrey, Paul Hunter, Jane Sellwood and Peter Wyn-Jones, ISBN 978012551570-2.