

DEPARTMENT OF ZOOLOGY

Category-I BSc. (H) Zoology

DISCIPLINE SPECIFIC CORE COURSE– 4 (DSC-4): Non-Chordata: Coelomates

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 | | |
| Non-Chordata: Coelomates | 04 | 02 | 0 | 02 | Class XII pass with Biology/ Biotechnology | 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 Annelida to Echinodermata.
- It will help the students to identify the body plan types of complex non-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

- learn about the importance of systematics, taxonomy, and structural organization of non-chordate coelomates.
- recognize the diversity of non-chordates living in varied ecological habitats.
- critically analyse the organization, complexity and characteristic features of non-chordates.
- comprehend the economic importance of non-chordates, their interaction with the environment and their role in the ecosystem.
- enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.

SYLLABUS OF DSC-4

UNIT – I Annelida

07 Hours

General characteristics and classification; Excretion in Annelida; Evolution of coelom and metamerism.

UNIT – II Arthropoda and Onychophora

12 Hours

General characteristics and classification (Special reference to Insecta up to orders); Vision and Respiration in Arthropoda; Metamorphosis in insects; Social life of bees and termite, Evolutionary significance of Onychophora.

UNIT – III Mollusca

06 Hours

General characteristics and classification; Respiration in Mollusca; Torsion and Detorsion in Gastropoda; Pearl formation in bivalves.

UNIT – IV Echinodermata

05 Hours

General characteristics and classification; Water-vascular System in Asteroidea.

Note: Outline classification up to classes to be followed from “Ruppert, Fox and Barnes (2004). Invertebrate Zoology: A Functional Evolutionary Approach”. VII Edition, Cengage Learning, India.

Practical component -60 Hours

1. Study of *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Serpula*, *Chaetopterus*, *Pheretima*, *Hirudinaria*, Trochophore larva.
2. Study of T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
3. Study of *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, *Bombyx*, *Periplaneta*, termite, *Apis*, *Musca*.
4. Study of *Peripatus*.
5. Study of *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Patella*, *Ostrea*, *Pinctada*, *Sepia*, *Octopus*, *Nautilus*.
6. Study of *Pentaceros/Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Cucumaria*, *Antedon*; Any two larval forms.
7. Study of mouth parts, digestive system and nervous system of *Periplaneta*. *
8. Study of the digestive system of *Pheretima*. *
9. Submit a Project Report on the larval forms in different phyla OR field study of the insect diversity.

*Subject to UGC approval and guidelines

Essential/recommended readings

1. Ruppert, Fox and Barnes (2004). Invertebrate Zoology. VII Edition, Cengage Learning, India.
2. Pechenik, J. A. (2015). Biology of the Invertebrates. VII Edition, McGraw-Hill Education.
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis. III Edition, Blackwell Science

Suggestive readings

1. Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003). Invertebrate Zoology: A Functional Evolutionary Approach. VII Edition, Cengage Learning, India
2. Barrington, E.J.W. (2012). Invertebrate Structure and Functions. II Edition, EWP Publishers

DISCIPLINE SPECIFIC CORE COURSE– 5 (DSC-5): Fundamentals of Biomolecules

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 | | |
| Fundamentals of Biomolecules | 04 | 02 | 0 | 02 | Class XII pass with Biology/ Biotechnology | NIL |

Learning Objectives

The learning objectives of this course are as follows:

- To provide fundamental and precise knowledge of biomolecules that play a crucial role in all processes of life and the development of diseases.
- To make the students understand the fundamental building blocks of living organisms that include carbohydrates, proteins, lipids, nucleic acids
- 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 the physiological importance of these biomolecules.
- 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 qualitative analysis of functional groups
- understand the properties of various biomolecules.
- appreciate the action of the enzyme and the various factors that affect their action detail.

SYLLABUS OF DSC-5

UNIT – I Carbohydrates

06 Hours

Structure and biological importance: with emphasis on aldose, ketose, chiral centre, polarised Light, Fischer nomenclature, Haworth projection formula, mutarotation of glucose, anomers, pyranose, furanose, glycosidic linkage; reducing and non-reducing sugars: monosaccharides, disaccharides, polysaccharides and glycoconjugates.

UNIT – II Lipids

04 Hours

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, tri-acylglycerols, phospholipids, glycolipids, steroids.

UNIT – III Proteins**08 Hours**

Amino acids: Structure, classification and general properties of α -amino acids; physiological importance of essential and non-essential amino acids; proteins: bonds stabilizing protein structure; Levels of organization in protein motifs, folds and domains; Denaturation.

UNIT – IV Nucleic Acids**04 Hours**

Structure: purines and pyrimidines, nucleosides, nucleotides, nucleic acids; Cot Curves: Base pairing, Denaturation and Renaturation of DNA; Types of DNA and RNA.

UNIT – V Enzymes**08 Hours**

Nomenclature and classification, cofactors; specificity of enzyme action, Isozymes, Mechanism of enzyme action; Enzyme kinetics; factors affecting rate of enzyme-catalysed reactions; derivation of Michaelis-Menten equation, concept of K_m and V_{max} , Lineweaver-Burk plot, multi-substrate reactions, enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme reaction.

Practical component – 60 Hours

1. Understanding the structures of biomolecules through ball and stick models.
2. To understand the preparation and roles of two important biological buffer systems: phosphate and bicarbonate; Preparation of buffers and determination of pH.
3. Identification of the functional groups by qualitative tests:
 - a. Carbohydrates
 - b. Lipids
 - c. Proteins
4. Separation of amino acids by paper chromatography.
5. Study the action of salivary amylase under optimum conditions.
6. Study the effect of pH, temperature and inhibitors on the action of salivary amylase.

Essential/recommended readings

1. Nelson, D.L., Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). New York, WH: Freeman Company.
2. 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– 6 (DSC-6): Human Physiology-Control and Coordination Systems

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- Control and Coordination Systems | 04 | 02 | 0 | 02 | Class XII pass with Biology/ Biotechnology | 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 tissue structures and functions
- understand the functions of important physiological systems including the nervous system, muscular system, endocrine and reproductive 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.
- synthesize 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-6

UNIT – I Nervous System and Sense Organs

08 Hours

Structure of neuron, resting membrane potential, origin and conduction of action potential across

the myelinated and unmyelinated nerve fibers; Types of synapses, synaptic transmission, Neuromuscular junction.

UNIT – II Muscle Physiology

07 Hours

Mechanism of muscle contraction; Characteristics of muscle twitch; Motor unit, summation, and tetanus.

UNIT – III Endocrine System

08 Hours

Hormones secreted by the glands, their physiological action and the disorders related to their secretion; Classification of hormones and their regulation; Mode of hormone action- Signal transduction pathways for peptide and steroid hormones.

UNIT – IV Reproductive System

07 Hours

Physiology of male and female reproduction– spermatogenesis, oogenesis, follicular development, steroidogenesis, implantation, pregnancy, and mammary gland development.

Practical component – 60 Hours

1. Classification, structure and functions of tissues: epithelial, connective, muscular and nervous tissue.
2. Structure, histology, types and function of bones and cartilage.
3. Classification and histological structure of muscle; ultrastructure of striated muscle.
4. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres, Nerve cells.
5. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
6. Recording of simple muscle twitch with electrical stimulation (Interpretation/ Virtual).
7. Study of permanent slides of Mammalian Skin, Spinal cord, Hypothalamus, Pineal, Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal, Testis and Ovary.
8. Permanent slide preparation from various tissues: Tissue fixation, block preparation, tissue sectioning, H&E staining, microscopy (Minimum three tissues; tissue can be procured from the slaughterhouse).

Essential/recommended readings

1. Tortora, G.J. and Derrickson, B.H. (2012). Principles of Anatomy and Physiology. XIII Edition, John Wiley and Sons, Inc.
2. Widmaier E, Raff H and Strang K. (2013) Vander's Human Physiology: The Mechanism of Body Functions. XIII Edition, McGraw-Hill Education.
3. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. 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. Kesar, S. and Vashisht, N. (2007) Experimental Physiology. Heritage Publishers.

3. D. B. Tembhare. (2017) Modern Entomology. Published by Himalaya Publishing House (ISO 9001: 2008 Certified).
4. Dawes, J. A. (1984) The Freshwater Aquarium, Roberts Royce Ltd. London.

Suggestive readings

1. S.S. Khanna and H.R. Singh. A Textbook of Fish Biology & Fisheries Published by Narendra Publishing House. 3rd Edition. (ISBN13: 9789384337124)
2. Dokuhon, Z.S. (1998). Illustrated Textbook on Sericulture. Oxford & IBH Publishing Co., Pvt. Ltd. Calcutta.

GENERIC ELECTIVES (GE-4): Lifestyle Disorders

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 | | | |
| Lifestyle Disorders | 04 | 02 | Nil | 02 | Class XII pass | NIL | Zoology |

Learning Objectives

The learning objectives of this course are as follows:

- The course aims to introduce the students to the concept of health, nutrition, and the factors affecting it.
- It will apprise students of the prevalence of emerging health issues affecting the quality of life.
- The course will facilitate the understanding of different physical and psychological associated disorders and their management for a healthy lifestyle.
- It highlights the important lifestyle-related disorders and describes the risks and remedies in relation to adopting a better life.

Learning Outcomes

By studying this course, students will be able to

- have a better understanding of lifestyle choices and the diseases associated with them.
- have an in-depth understanding of making better lifestyle decisions.
- learn about various techniques for preliminary diagnosis of lifestyle disorders

SYLLABUS OF GE-4

UNIT – I Introduction to Lifestyle (2.5 Weeks)

Traditional Indian lifestyle vs modern Indian lifestyle, lifestyle diseases – definition, risk factors-erratic sleep patterns, wrong food choices, smoking, alcohol abuse, stress, lack of optimum physical activity, illicit drug use, Obesity, respiratory diseases, diet and exercise.

UNIT – II Diabetes and Obesity (2.5 Weeks)

Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes- paediatric and adolescent obesity-weight control and BMI (Body Mass Index), Prediabetes, PCOS/PCOD.

UNIT – III Cardiovascular Diseases (3 Weeks)

Coronary atherosclerosis-Coronary artery disease, Causes-Fat and lipid, Alcohol Abuse-Diagnosis, Electrocardiograph, Echocardiograph, Treatment, Exercise and Cardiac rehabilitation.

UNIT – IV Cancer (2.5 Weeks)

Introduction to Cancer and general diagnostic methods to detect cancer; Lung Cancer, Mouth Cancer: associated lifestyle choices, symptoms and treatment.

UNIT – V Hypertension (2 Weeks)

Risk factors, complications (brain, heart, eye and kidney) and management of hypertension.

UNIT – VI WHO Global action plan and Monitoring (2.5 Weeks)

WHO Global action plan and Monitoring framework for prevention and control of non-communicable diseases, NPHCE (National Programme for the Health Care of Elderly), Fit India movement (Yoga and meditation).

Practical component -

1. Estimation of blood glucose (GOD/POD) by kit.
2. Calculation of BMI, waist to hip ratio, skin fold test.
3. Imaging techniques for cancer diagnosis. CT Scan, MRI, PET-CT scan. Confirmatory Biopsy.
4. Blood pressure measurement using a sphygmomanometer.
5. Study of cardiac rehabilitation- thrombolytic agents and balloon angioplasty.
6. Project Work based on Case studies related to risk factors of any ONE lifestyle disorder studied.

OR

7. To write a review of personal experience of using any of the available health or lifestyle-related applications over a period of time with some data to correlate.

Essential/recommended readings

1. James M.R, Lifestyle Medicine, 2nd Edition, CRC Press,2013,
2. Tortora, G.J. and Grabowski, S. (2006). Principles of Anatomy & Physiology. XI edition. John Wiley & Sons
3. Cooper, G.M., Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition, ASM Press and Sinauer Associates

Suggestive readings

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd/W.B. Saunders Company.
2. Widmaier E, Raff H and Strang K. (2013) Vander's Human Physiology: The Mechanism of Body Functions. McGraw-Hill Education 13th Edition.

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

Nomenclature of certificate/diploma/degrees:

- ✓ After securing 44 credits (from semesters I and II), by completing one year of study of the UG Programme with Zoology as a single core discipline, if a student exits after following due procedure, he or she shall be awarded an **Undergraduate Certificate in Zoology**.
- ✓ After securing 88 credits (from semesters I, II, III & IV), by completing two years of study of the UG Programme with Zoology as a single core discipline, if a student exits after following due procedure, he or she shall be awarded **Diploma in Zoology**.
- ✓ After securing 132 credits (from semester I to VI), by completing three years of study of the UG Programme with Zoology as a single core discipline, if a student exits after following due procedure, he or she shall be awarded **Bachelor of Arts (Honours) in Zoology**.
- ✓ After securing 176 credits (from semester I to VIII), by completing four years of study of the UG Programme with Zoology as a single core discipline and writes dissertation, the student shall be awarded **Bachelor of Arts (Honours with Research) in Zoology**.
- ✓ After securing 176 credits (from semester I to VIII), by completing four years of study of the UG Programme with Zoology as a single core discipline and engages in Academic Project/Entrepreneurship, the student shall be awarded **Bachelor of Arts (Honours with Academic Project/Entrepreneurship) in Zoology**.

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

GENERIC ELECTIVES (GE-8): Exploring Animal World Zoo-GE-8

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre-requisite of the course | Department offering the course |
|--|---------|-----------------------------------|----------|---------------------|--|-----------------------------|--------------------------------|
| | | Lecture | Tutorial | Practical/ Practice | | | |
| Exploring the Animal world Zoo-GE-8 | 04 | 02 | Nil | 02 | Passed Class XII with Biology/ Biotechnology | NIL | Zoology |

Learning Objectives

The learning objectives of this course are as follows:

- to overview the concepts of invertebrate and vertebrate animals, including sponges, cnidarians, comb jellies, flatworms, nematodes, annelids, molluscs, arthropods, echinoderms, invertebrate chordates, fishes, amphibians, reptiles, birds, and mammals.
- to enable students to understand the diversity within different groups, and interrelationship among different species and genera within each group of animals.
- to learn the hierarchy, body plan and their role in ecological development of animals.

Learning Outcomes

By studying this course, students will be able to

- Learn about the importance of systematics, taxonomy, and structural organization of non-chordates and chordata.
- Appreciate the diversity of animals living in varied habits and habitats.
- Understand evolutionary history and relationships of different animals through functional and structural affinities.
- better understand coelom formation, different levels of organization, role of macronutrients and micronutrients, their nutritional requirements for different age groups during various health conditions.

SYLLABUS OF GE-8

UNIT- 1: An Introduction to the Animal Kingdom **2 hrs**

Non-chordates vs. Chordates; Outline of Coelom, Body symmetry, Levels of organization

UNIT-2: Kingdom Protista **2 hrs**

General characters of Protozoa; Locomotory organelles

UNIT- 3: Porifera **2 hrs**

General characters of Phylum Porifera, Canal system in Porifera

UNIT- 4: Radiata **2 hrs**

General characters of Phylum Cnidaria & Ctenophora; Polymorphism

UNIT- 5: Helminthes **3 hrs**

General characters of helminths (Platyhelminthes and Nematelminths); Parasitic Adaptations

UNIT- 6: Coelomates (Non-chordates) **6 hrs**

General characters of Phylum Annelida; Metamerism

General characters of Phylum Arthropoda; Vision in insects

General characters of Phylum Mollusca; Pearl Formation

General characters of Phylum Echinodermata, water vascular system in starfish

UNIT- 7: Lower chordates (Protochordata) **1 hr**

Salient features of Protochordates (Hemichordates, Urochordates and Cephalochordates)

Unit 8: Higher chordates **12 hr**

General characters of Vertebrates:

- Cyclostomes; Cartilaginous and Bony fishes; Catadromous and Anadromous migration.
- Amphibians; Adaptations for Terrestrial Life
- Reptiles; Poisonous and Non-poisonous Snakes
- Aves; Flight Adaptations in birds
- Mammals - Prototheria, Metatheria and Eutheria.

Practical **(60 hrs)**

(Laboratory periods: 15 classes of 4 hours each)

1. Study of specimens- Non-chordates:

Euglena, Noctiluca, Paramecium; Sycon; Physalia, Tubipora, Meandrina; Taenia, Ascaris; Nereis, Heteronereis, Aphrodite, Hirudinaria, Peripatus; Limulus, Cancer, Daphnia, Julus, Scolopendra, Apis, Termite; Chiton, Dentalium, Octopus; Asterias and Antedon

2. Study of specimens- Chordates:

Balanoglossus, Herdmania, Amphioxus; Petromyzon; Sphyrna, Pristis, Hippocampus, Exocoetus, Diodon/ Tetrodon; Ichthyophis/ Uraeotyphlus, Bufo, Hyla, Salamandra; Rhacophorus, Draco, Uromastix, Naja, Viper;

Any three common birds (Crow, duck, Owl); Funambulus, Loris and Bat

3. Study through Permanent Slides:

- i) Cross Section of *Sycon*, and *Ascaris* (male and female).
- ii) T. S. of Earthworm passing through Pharynx, Gizzard, and Typhlosole region of intestine.
- iii) Septal and Pharyngeal Nephridia of Earthworm.
- iv) Placoid and Cycloid Scales in Fishes.

4. Study of Organ Systems (through videos/animations/photographs/dissections*:

- i) Digestive System of Cockroach;
- ii) Urinogenital System of Rat

* subject to UGC guidelines

Essential/recommended readings

1. Young, J.Z. (2004) The Life of Vertebrates. III Edition, Oxford University Press.
2. Ruppert, Fox and Barnes (2003) Invertebrate Zoology. A Functional Evolutionary Approach, VII Edition, Thomson Books/Cole.
3. Parker T.J. and Haswell W.A. (1972). Textbook of Zoology Vertebrates. VII Edition, Volume II. Blackwell, Hoboken

**Note: Refer Ruppert, Fox and Barnes (VII Ed.) for the classification of invertebrates;*

Suggestive reading

1. Saha, G.K. and Mazumdar, S. (2017). Wildlife Biology: An Indian Perspective. PHI learning Pvt. Ltd.
2. Campbell and Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
3. Mann Raven, P.H. and Johnson, G.B. (2004). Biology, VI Edition, Tata McGraw Hill Publications. New Delhi.

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