

## **DISCIPLINE SPECIFIC COURSES (DSC)**

### **INDEX**

#### **DEPARTMENT OF ZOOLOGY**

##### **B.SC. (HONS.) ZOOLOGY**

<b>Contents</b>	<b>Semester</b>	<b>Syllabus page #</b>
1. Nonchordata – Protists to Pseudocoelomates (Zoo-DSC-1) 2. Biology of Cell: Structure and Function (Zoo-DSC-2) 3. Concept of Ecology (Zoo-DSC-3)	<b>I</b>	<b>1-6</b>
1. Nonchordata – Coelomates (Zoo-DSC-4) 2. Fundamentals of Biomolecules (Zoo-DSC-5) 3. Human Physiology - Control and Coordination Systems (Zoo-DSC-6)	<b>II</b>	<b>7-12</b>
1. Diversity of Chordates (Zoo-DSC-7) 2. Biochemistry: Metabolic Processes (Zoo-DSC-8) 3. Human Physiology-Life Sustaining Systems (Zoo-DSC-9)	<b>III</b>	<b>13-20</b>
1. Comparative Anatomy of Vertebrates (Zoo-DSC-10) 2. Developmental Biology (Zoo-DSC-11) 3. Animal Behaviour (Zoo-DSC-12)	<b>IV</b>	<b>21-30</b>

##### **B.SC. LIFE SCIENCES**

<b>Contents</b>	<b>Semester</b>	<b>Syllabus page #</b>
1. Diversity of Animals (Zoo-LS-DSC-01)	<b>I</b>	<b>31-33</b>
2. Cell and Developmental Biology of Animals (Zoo-LS-DSC-06)	<b>II</b>	<b>34-36</b>
3. Biochemistry: Basic concepts of metabolism (Zoo-LS-DSC-09)	<b>III</b>	<b>37-38</b>
4. Fundamentals of Human Physiology	<b>IV</b>	<b>39-41</b>

**DISCIPLINE SPECIFIC CORE COURSE – 1 (DSC-1): Nonchordata – Protists to Pseudocoelomates**

**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		
<b>Nonchordata – Protists to Pseudocoelomates</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>Class XII pass with Biology as one of the papers in Class XII</b>	<b>-</b>

**Learning Objectives**

The course would provide an insight to the learner about the existence of different life forms on the earth and appreciate the diversity of animal life. It will help the students to understand the features of non-chordates and their systematic organization based on evolutionary relationships, structural and functional affinities. The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals; the economic, ecological, and medical significance of various animals in human life; and will create interest among them to explore the animal diversity in nature.

**Learning outcomes**

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

- Learn about the importance of systematics, taxonomy, and structural organization of non-chordates.
- Appreciate the diversity of non-chordates living in varied habits and habitats
- Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.
- Critically analyse the organization, complexity and characteristic features of nonchordates.
- Recognize the life functions and the ecological roles of the animals belonging to different phyla.
- Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.

**SYLLABUS OF DSC-1**

**Unit I: Introduction to Non-chordates**

**(2 Hours)**

General characteristics of non-chordates and basis of classification.

**Unit II: Protista**

**(07 Hours)**

General characteristics and classification; Life cycle of *Plasmodium vivax*; Locomotion and reproduction in Protista.

**Unit III: Porifera****(05 Hours)**

Introduction to Parazoa; General characteristics and classification; Canal system in sponges.

**Unit IV: Cnidaria and Ctenophora****(8 Hours)**

Introduction to Metazoa; General characteristics and classification; Polymorphism in Cnidaria; Corals and coral reefs.

**Unit V: Platyhelminthes and Nematelminthes****(8 Hours)**

General characteristics and classification; Parasitic adaptations of Helminthes; Life cycle of *Taenia solium* and *Ascaris lumbricoides*.

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 whole mount of Euglena, Amoeba, Noctiluca, Paramecium, Binary fission in Paramecium and Conjugation in Paramecium.
2. Examination of pond water collected from different places to observe diversity in Protista.
3. Study of Sycon, Hyalonema, Euplectella, Spongilla, T.S. of Sycon, L.S. of Sycon.
4. Study of *Obelia*, *Physalia*, *Millepora*, *Aurelia*, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium/Adamsia*, *Pennatula*, *Fungia*, *Meandrina*, *Madrepora*.
5. Specimen/slide of any one Ctenophore.
6. Study of adult *Fasciola hepatica*, *Taenia solium* and their life stages (Slides/microphotographs).
7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/microphotographs).
8. To submit a Project Report on the life cycle of any one parasite or pathogen/corals/coral reefs.
9. Examination of soil samples collected from different places to observe diversity in nematodes.

**Essential 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.

**DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC-2) Biology of Cell: Structure**

**Credit distribution, Eligibility and Prerequisites 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		
<b>Biology of Cell: Structure and Function</b>	4	2	--	2	Class X II pass with Biology as one of the papers in Class XII	-

**Learning Objectives**

The objective of the course is to help the students to learn and develop an understanding of a cell as a basic unit of life. This course is designed to enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.

**Learning outcomes**

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

- Understand the fundamental principles of cell biology.
- Explain the structure and functions of cell organelles involved in diverse cellular processes.
- Appreciate how cells grow, divide, survive, die, and regulate these important processes.
- Comprehend the process of cell signaling and its role in cellular functions.
- Have an insight into how defects in the functioning of cell organelles and regulation of cellular processes can develop into diseases. Learn the advances made in the field of cell biology and their applications

**SYLLABUS OF DSC- 2**

**Unit I: Overview of Cells and Plasma membrane**

**(05 Hours)**

Prokaryotic and Eukaryotic cells; Various models of plasma membrane structures, Transport across membranes: active and passive transport, facilitated transport; Cell-cell junctions, structures, and functions: Tight junctions, adherens junctions, gap junctions.

**Unit II: Endomembrane System**

**(10 Hours)**

Structure and Functions: Endoplasmic Reticulum (ER), Golgi apparatus, Signal hypothesis, Vesicular transport from ER to Golgi apparatus, Protein sorting and transport from Golgi apparatus, Coated Vesicles, Lysosomes, Peroxisomes. Structure of Mitochondria, Semiautonomous nature, Endosymbiotic hypothesis; Respiratory chain, Chemiosmotic hypothesis, ATP Synthase.

**Unit III: Cytoskeleton**

**(2 Hours)**

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments.

**Unit IV: Nucleus** (4 Hours)

Structure of Nucleus, Nuclear envelope, nuclear pore complex, Transport of molecules across nuclear membrane, nucleosome, nucleolus; Chromatin: euchromatin, heterochromatin.

**Unit V: Cell Division** (4 Hours)

Mitosis, Meiosis, Cell cycle and its regulation.

**Unit VI: Introduction to Cell Signaling** (05 Hours)

Cell Signaling through G-protein coupled receptor (GPCR) and role of secondary messenger: cAMP and protein kinase A.

**Practical component - 60 Hours**

1. Microscopy: Compound microscope: principle, components and handling; Phase contrast microscope; Electron microscope; Differential Interference Contrast (DIC) Microscope.
2. Principle and types of cell fixation and staining; Cell fractionation.
3. To study prokaryotic cells by Gram staining and eukaryotic cell (cheek cells) by hematoxylin/methylene blue.
4. To study the effect of hypotonic, isotonic, and hypertonic solutions on cell permeability.
5. Preparation of a temporary slide of squashed and stained onion root tip to study various stages of mitosis.
6. Study the effect of colchicine on mitosis at 24 hrs and 48 hrs.
7. Study of various stages of meiosis through permanent slides.
8. Preparation of stained mount to show the presence of Barr body in human female blood cells/cheek cells.
9. Cytochemical demonstration of:
  - a. DNA by Feulgen reaction
  - b. Mucopolysaccharides by PAS reaction
  - c. Proteins by Mercuric Bromophenol Blue/Acid Fast Green

**Essential readings**

1. Cooper, G.M., Hausman, R.E. (2019) The Cell: A Molecular Approach. VIII Edition, ASM Press and Sinauer Associates.
2. Becker, Kleinsmith, and Hardin (2018) The World of the Cell, IX Edition, Benjamin Cummings Publishing, San Francisco.
3. Karp, G. (2015). Cell and Molecular Biology: Concepts and Experiments, VIII Edition, John Wiley & Sons Inc.
4. Renu Gupta, Seema Makhija and Ravi Toteja (2018). Cell Biology Practical Manual, Prestige Publishers, New Delhi
5. VK Sharma (1991). Techniques in Microscopy and Cell Biology, Tata McGraw-Hill Publishing Company Limited, New Delhi

## DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC-3) Concepts of Ecology

### 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		
Concept of Ecology	4	2	0	2	Class X II pass with Biology as one of the papers in Class XII	NIL

#### Learning Objectives

The primary aim of this course is to develop a scientific understanding of the diverse aspects of the field of ecology. The students will be familiarized with the interactions between the organisms and their physical environment. Additionally, various attributes of populations and communities with help of theoretical concepts and field examples will be discussed. It provides a platform to understand the varied forces that lead to variations among populations of a species.

#### Learning outcomes

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

- Demonstrate an understanding of the basic concepts of the subject
- Explain the characteristics, dynamics, and growth of populations
- Understand the characteristics of the community, ecosystem development and climax theories
- Gain knowledge about the relationship of the evolution of various species and the environment they live in.
- Design basic field studies, collect data and interpret it
- Carry out population and community studies

### SYLLABUS OF DSC-3

#### Unit I: Introduction to Ecology (03 Hours)

Autecology and Synecology, Laws of limiting factors, Study of physical factors: Temperature and Light.

#### Unit II: Population (07 Hours)

Unitary and Modular populations; Unique and group attributes of population: density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion; Exponential and logistic growth, equations and patterns,  $r$  and  $k$  strategies; Intraspecific population regulation: density-dependent and independent factors.

#### Unit III: Species Interactions (06 Hours)

Types of species interactions, Interspecific competition: Lotka-Volterra model of

competition, Gause's Principle with laboratory and field examples, Niche concept; Predation: Lotka-Volterra equations, Functional and numerical responses, predator defence mechanisms, Resource partitioning.

**Unit IV: Community  
Hours)**

**(05**

Community characteristics: species richness, dominance, diversity, abundance, guilds, ecotone and edge effect; Ecological succession with examples and types.

**Unit V: Ecosystem**

**(6 Hours)**

Types of Ecosystems: Terrestrial ecosystem, vertical stratification in tropical forest; Food chain: detritus and grazing food chains, linear and Y-shaped food chains, food web; Energy flow through the ecosystem; Ecological pyramids and Ecological efficiencies; Biogeochemical cycle- nitrogen cycle.

**Unit VI: Applied Ecology  
Hours)**

**(03**

Ecology in wildlife conservation and management, Protected areas: National Parks, Biosphere reserves and Sanctuaries; Restoration ecology, Principles of Environmental impact assessment.

**Practical components - (60 Hours)**

1. Study of life tables and plotting of survivorship curves of different types from hypothetical/ real data
2. Determination of population density in a natural or a hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index.
3. Study of an aquatic ecosystem:
  - a) Phytoplankton and zooplankton
  - b) Measurement of temperature, turbidity/penetration of light, determination of pH
  - c) Dissolved oxygen content (Winkler's method), chemical oxygen demand
  - d) Free carbon dioxide and alkalinity
4. Study of ten endemic animals of India with slides/pictures/videos.
5. Report on a visit to a National Park/Biodiversity Park/Wildlife Sanctuary.

**Essential readings**

1. Odum, E.P. and Barrett G. W. (2008). Fundamentals of Ecology. Indian Edition(5th). Publisher: Brooks/Cole.
2. Smith T. M. and Smith R. L. (2015). Elements of Ecology. 9th International Edition. Publisher: Benjamin Cummings.
3. Saha G.K. and Mazumdar S. (2020) Wildlife Biology, An Indian Perspective. Publisher: PHI Learning Private Limited
4. Zimmer C. and Emlen D. J., (2013) 1st Edition. Evolution: Making Sense of Life, Roberts & Co.
5. Futuyma, Douglas and Mark, Kirkpatrick (2017) 3rd Edition. Evolutionary Biology, Oxford University Press

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

## 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		
<b>Non-Chordata: Coelomates</b>	<b>04</b>	<b>02</b>	<b>0</b>	<b>02</b>	<b>Class XII pass with Biology/ Biotechnology</b>	<b>NIL</b>

#### 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 Asterozoa.

**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		
<b>Fundamentals of Biomolecules</b>	<b>04</b>	<b>02</b>	<b>0</b>	<b>02</b>	<b>Class XII pass with Biology/ Biotechnology</b>	<b>NIL</b>

#### 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  $\alpha$ -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, TheMcGraw- 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 help 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.
- Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
  - Eroschenko, Victor P. (2012) Di Fiore's Atlas of Histology with Functional Correlations; 12th edition, CBS Publishers and Distributors Pvt. Ltd.

#### Suggestive readings

- Chatterjee, C.C. (2021) Human Physiology, 14th Edition, Volume 1 & Volume II, CBS Publishers and Distributors Pvt. Ltd.
- Kesar, S. and Vashisht, N. (2007) Experimental Physiology. Heritage Publishers.

**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	Class X II pass	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 (3 hrs)**

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; Swim bladder 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)**

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 branchiogenital 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*, Flat fish. Permanent slides of Placoid and Cycloid Scales.

**4. Amphibia:** *Ichthyophis*/*Ureotyphlus*, *Necturus*, *Bufo*, *Hyla*, *Alytes*, *Salamandra*.

**5. Reptilia:** *Chelone*, *Trionyx*, *Hemidactylus*, *Varanus*, *Uromastix*, *hamaeleon*, *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*, *Erinaceous*.

**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.



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

**Suggestive readings**

- Pough H. (2018). **Vertebrate Life**. X Edition, Pearson International.
- 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	Appeared in Sem II	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 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)**

$\beta$ -oxidation and omega-oxidation of saturated fatty acids with even number of carbonatoms; 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.

- To study the enzymatic activity of Lipase.
- Study of biological oxidation (SDH) [goat liver].
- To perform the Acid and Alkaline phosphatase assay from serum/ tissue.
- Dry Lab: To trace the labelled 'C' atoms of Acetyl-CoA till they evolve as CO<sub>2</sub> in the TCA cycle through models.

#### Essential/recommended readings

- Nelson, D.L., Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). New York, WH: Freeman Company.
- 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

- Stryer, L., Berg, J., Tymoczko, J., Gatto, G. (2019). Biochemistry (9th ed.), New York, WH: Freeman.
- 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	Appeared in Sem II	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- 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

# Department of Zoology

SEMESTER-IV  
BSc (Hons.) Zoology

## CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

### DISCIPLINE SPECIFIC CORE COURSE -10 – : Comparative Anatomy of Vertebrates Zoo-DSC-10

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Comparative Anatomy of Vertebrates Zoo-DSC-10	04	02	Nil	02	Passed Class XII with Biology/ Biotechnology	Basic knowledge of Vertebrates

### Learning Objectives

The learning objectives of this course are as follows:

- to impart in-depth knowledge about the structural patterns and a comparative account of the different organ systems of vertebrates.
- to understand the account of the functional and comparative morphology provides a deep understanding of animal diversity and the adaptive changes the vertebrates have gone through during evolution from common ancestors
- to help students identify the body plan types of complex chordates and their systematic organization based on evolutionary relationships, structural and functional affinities.
- to apprise the students about the correlation of comparative development to evolutionary biology and phylogeny, and how it helps in classifying animals.
- to enable students to establish the evolutionary links based on fossil records.

### Learning Outcomes

By studying this course, students will be able to

- have a better understanding of the evolutionary significance of comparative anatomy.
- understand the importance of morphology and anatomy of organisms in relation to evolution.
- appreciate the comparative anatomy among vertebrates that provides evolutionary evidences.
- enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.

## **SYLLABUS OF DSC-10**

<b>UNIT 1: Integumentary System</b>	<b>4 hrs</b>
Structure and derivatives of integument.	
<b>UNIT 2: Digestive System</b>	<b>4 hrs</b>
Alimentary canal and associated glands; Dentition.	
<b>UNIT 3: Circulatory System</b>	<b>4 hrs</b>
General plan of circulation; Evolution of heart and aortic arches.	
<b>UNIT 4: Respiratory System</b>	<b>4 hrs</b>
Skin, gills, lungs, accessory respiratory organs in fishes, air sacs.	
<b>UNIT 5: Skeletal System</b>	<b>5 hrs</b>
Outline of axial and appendicular skeleton; Concept of neurocranium, dermatocranium and splanchnocranium; Structure of a typical vertebra and its classification based on centrum; Jaw suspensorium; General plan of girdles and limbs.	
<b>UNIT 6: Nervous System</b>	<b>3 hrs</b>
Comparative account of brain; Cranial nerves in mammals.	
<b>UNIT 7: Sense Organs</b>	<b>3 hrs</b>
Classification of receptors; Structure and function of mammalian eye and ear.	
<b>UNIT 8: Urinogenital System</b>	<b>3 hrs</b>
Succession of kidney; Evolution of urinogenital ducts; Types of uteri in mammals.	
<b>Practical</b>	<b>(60 hrs)</b>
<b>(Laboratory periods: 15 classes of 4 hours each)</b>	
1. Study of different types of feathers of birds.	
2. Study of the disarticulated skeleton of Frog, Varanus, Fowl, Rabbit (Vertebral Column, Sternum, Girdles, Ribs, Limb bones).	
3. Study of the vertebrate Skull (i) one herbivorous and one carnivorous animal skull; (ii) one monocondylic and one dicondylic skull.	
4. Study of carapace and plastron of turtle/tortoise.	
5. Study of the digestive, circulatory and urinogenital system of frog/rat through videos on dissection or through virtual dissections.	
6. Project related to topics covered in theory.	
7. Field trips/Documentary film show on vertebrates/Visit to Zoological Park, Biodiversity Park or Sanctuary.	



8. Student Presentation: Power point presentation on any two animals from two different classes.

**Essential/recommended readings**

1. Kardong, K.V. (2005) Vertebrate's Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.

**Suggestive readings**

1. Leiem C.F., Bermis W.E, Walker, W.F, Grande, L. (2001) Functional anatomy of the vertebrates, An evolutionary perspective. III Edition, Brookes/Cole, Cengage Learning.

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

**DISCIPLINE SPECIFIC CORE COURSE -11 – :**  
**Developmental Biology**  
**Zoo-DSC-11**

**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		
Developmental Biology Zoo-DSC-11	04	02	Nil	02	Passed Class XII with Biology/ Biotechnology	Basic knowledge of Chordates

**Learning Objectives**

The learning objectives of this course are as follows:

- to provide an in-depth knowledge on the embryonic and post embryonic developmental processes.
- to apprise the students of the fascinating aspect of the development of a single fertilized egg to mature into a fully developed complex organism.
- to explain the basic principles and concepts the developmental processes from a single cell system to a multi-cellular system.
- to understand morphogenesis in Sea urchin, Drosophila, Frog and Chick.
- to provide the undergraduate students an in-depth knowledge on the embryonic and post embryonic developmental processes.
- by understanding the developmental processes, the students can relate to errors occurring during development leading to congenital disorders and human diseases.
- to familiarize the students with the technique of IVF and pre-diagnostic methods to identify any abnormality arising during development.
- To make the students aware of the areas of great interest including stem cell therapy, tissue engineering and regenerative medicine.

**Learning Outcomes**

By studying this course, students will be able to

- appreciate the events that lead to the formation of a multicellular organism from a single fertilized egg.
- better understand the general patterns and sequential developmental stages during embryogenesis.
- gain knowledge of the general mechanisms involved in morphogenesis.
- comprehend the processes of ageing to improve the overall health and quality of life in aged people.
- acquire basic knowledge and importance of latest techniques like stem cell therapy, *in vitro* fertilization and amniocentesis etc.
- develop the skill to raise and maintain culture of model system- *Drosophila* in the laboratory.

## Syllabus of DSC-11

### UNIT- 1: Introduction

2 hrs

Historical perspectives and basic concepts: Phases of development, Pattern formation, Differentiation and growth, Cytoplasmic determinants.

### UNIT- 2: Early Embryonic Development

12 hrs

Gametogenesis: oogenesis, spermatogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal), Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps; Gastrulation in frog and chick, Embryonic induction and organizers.

### UNIT- 3: Late Embryonic Development

6 hrs

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, structure, types, and functions of placenta.

### UNIT- 4: Post Embryonic Development

6 hrs

Metamorphosis and its hormonal regulation in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: concepts and theories.

### UNIT- 5: Implications of Developmental Biology

4 hrs

Teratogenesis: Teratogenic agents and their effects on embryonic development; *in-vitro* fertilization, Embryonic stem cell (ESC), Amniocentesis.

### Practical

(60 hrs)

#### (Laboratory periods: 15 classes of 4 hours each)

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula (Neural plate, Neural fold and Neural tube stages), tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides (Hamburger and Hamilton Stages): Stage 3 (Intermediate Streak)-13 hours, Stage 4 (Definitive Streak)-18 hours, Stage 5 (Head Process)-21 hours, Stage 7- 24 hours, Stage 8-28 hours, Stage 10-33 hours, Stage 11-40 hours, Stage 13-48 hours, Stage 19- 72 hours and Stage 24-96 hours of incubation
3. *in vivo* study of chick embryo development by windowing and candling methods. (Demonstration only)

4. Study of indirect development and metamorphosis by rearing any one insect.
5. Study of different sections of placenta (photomicrographs/ slides).
6. Project report on *Drosophila* or any insect culture/Visit to Poultry Farm/IVF Centre
7. Student Presentation: Power point presentation on any topic related to developmental biology.

#### **Essential/recommended readings**

1. Slack, J.M.W. (2013) Essential Developmental Biology. III Edition, Wiley- Blackwell.
2. Gilbert, S. F. (2010) Developmental Biology. IX Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA
3. Carlson, B.M. (2007) Foundations of Embryology. VI Edition, Tata McGraw-Hill Publishers.
4. Balinsky B. I. and Fabian B. C. (2006). An Introduction to Embryology. VIII Edition, International Thompson Computer Press.

#### **Suggestive readings**

1. Baweja, V. and Misra, M. (2021) E-book on Practical Manual of developmental Biology.
2. Arora, R. and Grover, A. (2018) Developmental Biology: Principles and Concepts. I Edition, R. Chand & Company.
3. Wolpert, L. (2002) Principles of Development. II Edition, Oxford University Press.
4. Kalthoff, K. (2001) Analysis of Biological Development. II Edition, McGraw Hill Publishers.

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

**DISCIPLINE SPECIFIC CORE COURSE– 12:  
Animal Behaviour Zoo-DSC-12**

**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		
<b>Animal Behaviour Zoo-DSC- 12</b>	<b>04</b>	<b>02</b>	<b>Nil</b>	<b>02</b>	<b>Passed Class XII with Biology/ Biotechnology</b>	<b>NIL</b>

**Learning Objectives**

The learning objectives of this course are as follows:

- To provide an overview of animal behaviour in a scientific study of the wild and the wonderful ways in which animals interact with each other, with other living beings, and with the environment.
- to understand and appreciate different types of animal behaviour, their adaptive and evolutionary significance.
- to equip the students with an ability to pursue career in behavioural ecology other related areas.
- to apprise the students of the versatility of Animal behaviour and its crosstalk among conservation biology, molecular biology, behavioural ecology and integrated pest management.

**Learning Outcomes**

By studying this course, students will be able to:

- comprehend various types of animal behaviour and their importance.
- observe, analyse, interpret and document the different types of behaviour.
- enhance their skills by taking short projects pertaining to Animal behaviour.
- appreciate and develop passion to biodiversity; and respect the nature and environment.
- better understand and relate the fundamentals and advanced concepts so as to develop a strong foundation that will enable them to acquire skills and knowledge.

**SYLLABUS OF DSC-12**

**UNIT- I Introduction to Animal Behaviour**

**4 hrs**

Origin and history of ethology; Pioneers of modern ethology: Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen; Proximate and ultimate causes of behavior.

- UNIT- 2 Mechanisms of Behaviour** **5 hrs**  
 Innate behaviour, Instinct, Stimulus filtering, Sign stimuli, Code breakers.
- UNIT- 3: Patterns of Behaviour** **5 hrs**  
**Orientation:** Primary and secondary orientation; Kinesis - orthokinesis, klinokinesis;  
**Taxis:** tropotaxis and klinotaxis, menotaxis (light compass orientation).  
**Learning:** Associative learning, Classical and operant conditioning, Habituation, Imprinting;  
**Reasoning:** Intelligence and artificial intelligence.
- UNIT- 4: Communication** **3 hrs**  
 Importance of communication; Role of Tactile, Chemical, Auditory, Visual stimuli in communication.
- UNIT- 5: Social Behaviour** **4 hrs**  
 Concept of Society; Insects' society; Honey bee: Society organization, polyphenism and polyethism; Foraging in honey bee, round dance, waggle dance; Experiments to prove distance and direction component of dance; Formation of new hive/queen.
- UNIT- 6: Altruism** **3 hrs**  
 Altruism, Inclusive fitness, Hamilton's rule
- UNIT 7: Sexual Behaviour** **6 hrs**  
 Asymmetry of sex; Sexual dimorphism, mate choice; Intra-sexual selection (male rivalry); Inter- sexual selection (female choice); Courtship behaviour, Courtship behavior in 3-spine stickleback; Infanticide; Parental care, sexual conflict in parental care.
- Practical** **(60 hrs)**  
**(Laboratory periods: 15 classes of 4 hours each)**
1. Tools, techniques and methods used in studying animal behavior.
  2. To study nests and nesting behaviour of the birds and social insects.
  3. To study the behavioural responses of wood lice to dry and humid conditions.
  4. To study geotaxis behaviour in earthworm.
  5. To study the phototaxis behaviour in insect larvae.
  6. To study different types of animal behaviour such as habituation, social life, courtship behaviour in insects and birds, and parental care from short videos/movies. At least two videos for each behaviour.
  7. Construction of ethogram using suitable data to study animal behaviour.
  8. Visit to Forest/Wild life Sanctuary/Biodiversity Park/Zoological Park to study and record the behavioural activities of animals and prepare a short report.

**Essential/recommended readings**

1. John Alcock, (2013) Animal Behaviour, Xth Edition, Sinauer Associates Inc., USA.
2. Manning, A. and Dawkins, M. S, (2012) An Introduction to Animal Behaviour, VI th Edition, Cambridge University Press, UK.
3. McFarland, D. (1985) Animal Behaviour, Pitman Publishing Limited, London, UK.

**Suggestive readings**

1. Rubenstein, D. (2022) Animal Behavior, XIIth Edition, Sinauer Associates, Oxford University Press, UK.
2. Gadagkar, R. (2021) Experiments in Animal Behaviour: Cutting-Edge Research at Trifling Cost, Indian Academy of Sciences. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.

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

UNIVERSITY OF DELHI

**SYLLABUS**

**DEPARTMENT OF ZOOLOGY**

**BSC LIFE SCIENCES**



**Course Code : ZOO-DSC-01**  
**Course Title: Diversity of Animals**  
**Total Credits: 04 (Credits: Theory-02, Practical-02)**  
**Total Lectures: Theory- 30 hrs., Practical- 15 classes of 4 hours each**

**Objectives:** The objective of this course is to teach the students concepts of morpho- taxonomy as well as understand the characteristics and physiological aspects of unicellular and metazoan animals. The course lays emphasis on creating awareness and concern towards significance of animal diversity for human survival and its socio- economic importance. In addition to this, the course is aimed at nurturing skills of conducting scientific inquiry and experimentation in the field of animal diversity to acquire knowledge of fundamental concepts and theories of animal diversity.

**Learning Outcomes:**

By the end of the course, the students will be able to:

- Acquire knowledge of diversity of non-chordate and chordates.
- Learn characteristics, morphotaxonomy, structural organization and physiological life system of diverse animal groups.
- Understand the economic importance of non-chordates and chordates and their importance in the ecosystem.
- Learn evolutionary relationships and phylogeny of invertebrates and vertebrates to structural as well as functional similarities.

**Unit I- Introduction (02 hrs.)**

Introduction to five kingdom classification system, General characters of kingdom Animalia and basis of its classification (with special reference to coelom), Concept of Taxonomic Hierarchy (up to species level), significance of binomial nomenclature.

**Unit II: Protista to Pseudocoelomates (09 hrs.)**

Characteristics of acoelomates and pseudocoelomates. Locomotory organelles and locomotion in Protozoa, Canal system in Porifera, Polymorphism in Cnidaria (Hydrozoa), Life cycle of *Taeniasolium* and its Parasitic adaptations, Life cycle of *Ascaris lumbricoides* and its Parasitic adaptations.

**Unit III: Coelomates (09 hrs.)**

General features of coelomates, Metamerism in Annelida, Vision in Arthropoda, Metamorphosis in Insects. Torsion and detorsion in Gastropoda. Pearl Formation, Water-vascular system in Asteroidea

#### Unit IV: Chordates

(10 hrs.)

Salient features of protochordates and chordates, Retrogressive metamorphosis in protochordates, Osmoregulation, Migration, and Parental care in fishes, Parental care in Amphibians, Flight adaptations and Migration in birds, Biting mechanism in snakes, Origin of mammals.

#### PRACTICAL

[15 classes of 4 hours each]

1. General Characteristics and Classification up to classes: Protista, Porifera, Cnidaria, Platyhelminthes, Nematelminthes. Study of museum specimens: *Amoeba*, *Euglena*, *Paramecium*, *Sycon*, *Euplectella*, *Obelia*, *Physalia*, *Aurelia*, *Metridium*, larval stage of *Taenia solium*, Male and female *Ascaris lumbricoides*.
2. General Characteristics and Classification up to classes: Annelida, Arthropoda, Mollusca, Echinodermata. Study of museum specimens: *Aphrodite*, *Nereis*, *Chaetopterus*, *Pheretima*, *Hirudinaria*, *Palaemon*, *Cancer*, *Limulus*, *Palamnaeus*, *Scolopendra*, *Chiton*, *Dentalium*, *Pila*, *Unio*, *Octopus*, *Pentaceros*, *Echinus*, *Cucumaria*, *Antedon*.
3. Study of following specimens, general characteristics and classification: *Balanoglossus*, *Amphioxus*, *Herdmania*.
4. Study of following specimens, general characteristics and classification up to order: *Petromyzon*, *Pristis*, *Exocoetus*, *Hippocampus*, *Hyla*, *Salamander* *Ichthyophis/Uraeotyphlus*, *Naja*, *Viper*, *Hydrophis*, *Chameleon*, *Uromastix*, *Milvus*, *Anas*, *Psittacula*, *Loris*, *Pteropus*, *Sorex*
5. Submission of report on an excursion to a Sanctuary/ Biodiversity Park.

**Note:** Classification to be followed from Ruppert, E.E., Fox, R.S., Barnes R.D. “*Invertebrate Zoology*” 7<sup>th</sup> Edition., Cengage Learning, India” & Young, J. Z. (2004) *The Life of Vertebrates*. III Edition. Oxford university press.

#### Recommended Books:

1. Ruppert, E.E., Fox, R.S., Barnes, R. D. *Invertebrate Zoology: A Functional Evolutionary Approach*. 7<sup>th</sup> Edition, Cengage Learning, India.
2. Young, J. Z. (2004) *The Life of Vertebrates*. III Edition. Oxford university press.
3. Barrington, E.J.W. (2012) *Invertebrate Structure and Functions*. II Edition, EWP Publishers.
- Pechenik, J. A. (2015) *Biology of the Invertebrates*. VII Edition, McGraw-Hill Education
4. Campbell & Reece (2005). *Biology*, Pearson Education, (Singapore) Pvt. Ltd.
5. Kardong, K. V. (2002). *Vertebrates Comparative Anatomy. Function and Evolution*. TataMcGraw Hill Publishing Company. New Delhi.
6. Pough H. *Vertebrate Life*, VIII Edition, Pearson International.

7. Lal, S.S. (2012), Practical Zoology Invertebrate.
8. Lal S.S. (2015-16), Practical Zoology Vertebrate.
9. P. S. Verma (2010), A Manual of Practical Zoology: Chordates.

**Teaching Learning Process:**

- Blend of conventional blackboard teaching, modern teaching learning tools and computational infrastructure- based instructions and Practical training.
- Problem solving and quizzes for enhanced understanding of the concepts.
- Explaining the handling and usage of the hardware and software required for solution to the given set of problems.

**Assessment Methods:**

- Presentations by Individual Student/ Group of Students
- Class Tests at Periodic Intervals.
- Written assignment(s)
- End semester University Theory Examination Presentations by Individual Student/ Group of Students

**DISCIPLINE SPECIFIC CORE COURSE -6 (Zoo-LS-DSC-06):– Cell and Developmental Biology of Animals**

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		
Cell and Developmental Biology of Animals Zoo-LS-DSC-06	04	02	0	02	Class XII pass	NIL

**Learning Objectives**

The learning objectives of this course are as follows:

- The course will help the students to learn and develop an understanding of a cell as a basic unit of life.
- The course will enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.
- The course will provide the students a complete comprehension about the essential vertebrate developmental biology
- The course will help the students to understand the conundrum of **the different levels of biological complexity** by tracing them back to events at the level of genes and genomes.

**Learning Outcomes**

By studying this course, students will be able to

- Explain the structure and functions of cell organelles involved in diverse cellular processes.
- Know the evolution of different concepts in developmental biology.
- Be able to understand the process of gamete formation from stem cell population to mature ova and sperm. The students will know the differences between Spermatogenesis and Oogenesis.
- Be able to comprehend the sequence of steps leading to the fusion of gametes and learn the contribution of sperm and ova to zygote formation
- Be able to understand how polyspermy is avoided in animal kingdom.
- Learn the mechanisms underpinning cellular diversity and specificity in animals.
- Learn the methods and tools related to developmental biology help to understand different processes of embryogenesis.

## **SYLLABUS OF Zoo-LS-DSC-06**

### **UNIT - I Cell Division and Differentiation (06 Hrs)**

Types of animal cells and tissues, Mitosis, meiosis, Cell cycle regulation, Cell-cell communication, Stem cells, Differential gene expression.

### **UNIT- II: Scope and History of Developmental Biology (03 Hrs)**

Historical perspective including contributions by eminent scientists and landmark experiments in the field of Developmental Biology, Concepts of Epigenesis, Preformation, Von Baer laws.

### **UNIT- III: Early Embryonic Development (15 Hrs)**

Gametogenesis: Spermatogenesis and Oogenesis in mammals; Types of Eggs and Egg membranes Fertilization: External (amphibians) and Internal (mammals), Fast and slow blocks to Polyspermy; Types and Patterns of cleavage; Types of morphogenetic movements; Early development of frog and chick up to gastrulation. Fate maps

### **UNIT- IV: Late Embryonic Development (04 Hrs)**

Fate of Germ Layers; Formation of neural tube, Extra-embryonic membranes in birds

### **UNIT- IV: Post Embryonic Development (02 Hrs)**

Metamorphic events and its hormonal regulation in amphibians.

### **Practical Component – 60 Hours**

1. Study of the various stages of meiosis through permanent slides.
2. Frog - Study of developmental stages - whole mounts and sections through permanent slides- cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Chick – Study of Whole Mounts of developmental stages of Chick through permanent slides (HH stages)- 13 hrs, 18hrs, 24hrs, 28hrs, 33hrs, 36hrs, 48hrs, 72hrs and 96hrs.
4. Study of the different types of placenta along with its function- through permanent slides / photomicrograph.
5. Study of various developmental stages in the life Cycle of Drosophila using stock culture/ permanent slides/ photomicrograph.
6. Visit to IVF centre/ Poultry Farm.
7. Project report on IVF Centre/ Poultry farm/ Drosophila culture/ Zebra fish culture.

### **Essential/recommended readings**

1. Cooper, G.M., Hausman, R.E. (2019) The Cell: A Molecular Approach. VIII Edition, ASM Press and Sinauer Associates.

2. Becker, Kleinsmith, and Hardin (2018) *The World of the Cell*, IX Edition, Benjamin Cummings Publishing, San Francisco.
3. Gilbert, SF (2014) *Developmental Biology* (10th edition). Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA. ISBN : 9780878939787
4. Balinsky, B.I. (2008). *An introduction to Embryology*, International Thomson Computer Press.
5. Freeman and Bracegirdle (1975, 2<sup>nd</sup> Edition) “*An Atlas of Embryology*”, Published by Heinmann.

**Suggestive readings**

1. De Robertis, E.D.P. and De Robertis, E.M.F. (2009) *The Cell and Molecular Biology*, Lippincott Williams & Wilkins, Philadelphia.
2. Karp, G. (2015). *Cell and Molecular Biology: Concepts and Experiments*, VIII Edition, John Wiley & Sons Inc
3. Kalthoff Klaus (2001) *Analysis of Biological Development*, 2<sup>nd</sup> ed. Boston, MA: McGraw-Hill, ISBN : 0071180788
4. Wolpert, L & Tickle, C (2011) *Principles of Developmental Biology* (4th edition). Oxford University Press, ISBN: 9780198792918
5. Carlson, Bruce M (1996). *Patten's Foundations of Embryology*, McGraw Hill, Inc. ISBN : 9780070634275

**DISCIPLINE SPECIFIC CORE COURSE-9:–  
Biochemistry: Basic concepts of metabolism  
(Zoo-LS-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		
<b>Biochemistry: Basic concepts of metabolism Zoo-LS-DSC-09</b>	<b>04</b>	<b>02</b>	<b>Nil</b>	<b>02</b>	<b>Appeared in Sem II</b>	<b>NIL</b>

**Learning Objectives**

The learning objectives of this course are as follows:

- The course will help the students to learn and develop an understanding of the various metabolic pathways in humans.
- The course will enable them to understand the tissue specific metabolism and its regulation.
- Gain knowledge of enzyme specificity for important metabolic pathways and how the body adjusts to variations in the demand for energy.

**Learning Outcomes**

By studying this course, students will be able to

- Correlate the properties of carbohydrates, proteins, lipids, and their importance in biological systems.
- explain biological mechanisms, such as the processes and control of bioenergetics and metabolism, as chemical reactions
- comprehend the concept of enzyme, its mechanism of action and regulation.
- Know the importance of high energy compounds, electron transport chain, synthesis of ATP under aerobic and anaerobic conditions.
- acquire knowledge related to the role of TCA cycle in carbon metabolism, importance of anaplerotic reactions and redox balance.

**SYLLABUS OF DSC- 09**

**UNIT-1: Metabolism of Carbohydrates (8 hrs)**

Basic structure and physiological significance of monosaccharides, disaccharides, homo and heteropolysaccharides. Glycolysis: Preparatory and Payoff phases, regulation, fates of pyruvate, Pentose phosphate pathway: oxidative and non-oxidative Phases; Gluconeogenesis: Bypass reactions, regulation and reciprocal coordination of glycolysis and gluconeogenesis; Glycogen

Metabolism: Glycogenolysis, Glycogenesis and its coordinated regulation, Krebs's Cycle (formation of Acetyl CoA, reactions of cycle, regulation).

**UNIT-2: Lipid Metabolism (6 hrs)**

Basic structure and physiological significance of fatty acids, structure and significance of storage and structural lipids; Biosynthesis: FAS and synthesis reactions, regulation;  $\beta$  oxidation of palmitic acid: activation of fatty acids and oxidation with bioenergetics, regulation.

**UNIT-3: Protein metabolism (6 hrs)**

Structure, classification and properties of amino acids, basics of protein structure; Transamination, Deamination, Glutamine formation, Glucose alanine cycle and Urea Cycle.

**UNIT-4: Enzyme (6 hrs)**

Enzymes and their classification, Introduction (basics of classification, properties and functions), Mechanism of action (understanding of basic concepts, Induced Fit Theory).

**UNIT- 5: Oxidative Phosphorylation (4 hrs)**

Review of Electron Transport Chain: Basics of electron transfer reactions, Universal Electron Acceptors without detailed structures, electron flow through complexes, Chemiosmotic theory, basics of ATP synthesis.

**Practical - 60 hrs**

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

1. Qualitative tests to identify functional groups of carbohydrates, amino acids and lipids.
2. Estimation of total protein in given solutions by Lowry's method.
3. Study effect of temperature, pH, and inhibitor on enzymatic activity of salivary amylase.
4. Biological oxidation of goat liver.
5. Identification of normal and abnormal constituents of urine.
6. Estimation of Acid and Alkaline phosphatases/ GOT and GPT.
7. To study the enzymatic activity of Lipase.
8. Dry Lab: To trace the labelled 'C' atoms of Acetyl-CoA till they evolve as CO<sub>2</sub> in the TCA cycle through models.

**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 (9<sup>th</sup> ed.). New York, WH: Freeman.
2. Voet, D., Voet. J. G. (2013). Biochemistry (4<sup>th</sup> ed.). New Jersey, John Wiley & Sons Asia Pvt. Ltd.



**DISCIPLINE SPECIFIC CORE COURSE-12 (Zoo-LS-DSC-12):–  
Fundamentals of Human Physiology**

**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		
<b>Fundamentals of Human Physiology Zoo-LS-DSC-12</b>	<b>04</b>	<b>02</b>	<b>Nil</b>	<b>02</b>	<b>Passed Class XII with Chemistry/ Biology/ Biotechnology</b>	<b>NIL</b>

**Learning Objectives**

The learning objectives of this course are as follows:

- to learn the fundamentals that underpins the health and well-being of living organisms.
- to study the internal working of organs and organ systems.
- to expand their knowledge with respect to functioning of various organ systems such as muscular, nervous, digestive, circulatory, respiratory, excretory, reproductive and endocrine in humans.

**Learning Outcomes**

By studying this course, students will be able to

- Have an enhanced knowledge and appreciation of human physiology
- Recognize and identify principal tissue structures and functions
- Better 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 mechanism.

## **SYLLABUS OF DSC- 12**

### **UNIT- 1: Nerve and Muscle** **7 hrs**

Structure of a neuron, Resting membrane potential, Graded potential, Origin of action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultrastructure of skeletal muscle, Molecular and chemical basis of muscle contraction.

### **UNIT- 2: Digestion** **4 hrs**

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids.

### **UNIT- 3: Respiration** **4 hrs**

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood.

### **UNIT- 4: Excretion** **4 hrs**

Structure of nephron, Mechanism of urine formation, Counter-current Mechanism.

### **UNIT- 5: Cardiovascular system** **5 hrs**

Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle.

### **UNIT- 6: Reproduction and Endocrine Glands** **6**

**hrs** Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal gland.

### **Practical:** **60 hrs**

#### **(Laboratory periods: 15 classes of 4 hours each)**

1. Preparation of haemin and haemochromogen crystals.
2. Estimation of WBC and RBC count of blood.
3. Estimation of haemoglobin using Sahli's haemoglobinometer.
4. Determination of Blood Pressure by Auscultatory method.
5. Lung function tests using Spirometry (Determination of Vital Capacity, Peak Expiratory Flow Rate. Lung Volumes and Capacities).
6. Measurement of oxygen saturation by pulse oximetry before and after exercise.
7. Experiments on superficial (plantar) and deep (knee jerk) reflex.
8. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, duodenum, liver, lung, kidney, bone, cartilage.
9. Project on Family planning devices.

**Essential/recommended readings**

1. Tortora, G.J. and Derrickson, B.H. (2009) Principles of Anatomy and Physiology, XIV<sup>th</sup> Edition, John Wiley & Sons, Inc.
2. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill.
3. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Victor P. Eroschenko. (2008). Di Fiore's Atlas of Histology with Functional correlations. XII Edition.

**Suggestive readings**

1. Kesar, S. and Vashisht, N. (2007) Experimental Physiology. Heritage Publishers.
- Prakash, G. (2012) Lab Manual on Blood Analysis and Medical Diagnostics. S. Chand and Company Ltd.