



**Assam University  
Silchar**

**Curriculum**  
*for*  
**Four Year Under Graduate Programme**  
*in*  
**ZOOLOGY**  
*under*  
**National Education Policy – 2020**  
**w.e.f.**  
**Academic Session 2023-24**



**Assam University, Silchar**  
**NEP 2020 FYUGP Course Curriculum (Zoology)**  
**Course Structure**

Sem	DSC	DSM - 1	DSM – 2	IDC	SEC
I	<b>ZOO:DSC-101 (3)</b> Diversity of Non-chordates	<b>ZOO:DSM-101 (3)</b> Animal Diversity	-	<b>ZOO:IDC-101 (3)</b> Understanding Life Processes	<b>ZOO:SEC-101 (3)</b> Apiculture
	<b>ZOO:DSC-102 (3)</b> Diversity of Chordates				
II	<b>ZOO:DSC-151 (3)</b> Cell Biology	-	<b>ZOO:DSM-151 (3)</b> Cell Biology & Histology	<b>ZOO:IDC-151 (3)</b> Economic Zoology	<b>ZOO:SEC-151 (3)</b> Medical Diagnostics
	<b>ZOO:DSC-152 (3)</b> Practical – I				
III	<b>ZOO:DSC-201 (4)</b> Principles of Genetics	<b>ZOO:DSM-201 (4)</b> Physiology & Biochemistry	-	<b>ZOO:IDC-201 (3)</b> Public Health & Hygiene	<b>ZOO:SSEC-201 (3)</b> Sericulture
	<b>ZOO:DSC-202 (4)</b> Principles of Ecology				



IV	<b>ZOO:DSC-251 (4)</b> Histology	<b>ZOO:DSM-251 (3)</b> Practical	<b>ZOO:DSM-252 (3)</b> Genetics & Molecular Biology	-	-
	<b>ZOO:DSC-252 (4)</b> Fundamentals of Biochemistry				
	<b>DSC-253 (4)</b> Practical - II				
V	<b>ZOO:DSC-301 (4)</b> Animal Physiology	<b>ZOO:DSM-301 (3)</b> Genetics & Molecular Biology	<b>ZOO:DSM-302 (3)</b> Evolution & Adaptation	-	-
	<b>ZOO:DSC-302 (4)</b> Biochemistry of Metabolic Processes				
	<b>ZOO:DSC-303 (4)</b> Practical - III				
VI	<b>ZOO:DSC-351 (4)</b> Molecular Biology	-	<b>ZOO:DSM-351 (4)</b> Practical		
	<b>ZOO:DSC-352 (4)</b> Evolutionary Biology				
	<b>ZOO:DSC-353 (4)</b> Reproductive & Developmental Biology				
	<b>ZOO:DSC-354 (4)</b> Practical – IV				



VII	<b>ZOO:DSC-401 (4)</b> Immunology & Bio-technology	<b>ZOO:DSM-401 (4)</b>  Evolution & Adaptation			
	<b>ZOO:DSC-402 (4)</b> Toxicology & Environmental Monitoring				
	<b>ZOO:DSC-403 (4)</b> Animal Behaviour & Chronobiology				
	<b>ZOO:DSC-404 (4)</b> Practical – V				
VIII	<b>ZOO:DSC-451 (4)</b> Research Methodology/Bio-techniques & Biostatistics	-	<b>ZOO:DSM-451 (4)</b>  Biological Techniques		
	<b>ZOO:DSC-452 (4)</b> Fish & Fisheries				
	<b>ZOO:DSC-453 (4)</b> Applied Zoology				
	<b>ZOO:DSC-454 (4)</b> Comparative Anatomy & Sense Organs of Vertebrates				

Note- Figures in the parenthesis represent credits assigned to the paper.



## Marks Distribution

<b>DSC, DSM and IDC Papers:</b> All theory papers will have 70% External evaluation and 30% internal evaluation. In practical papers, the marks distribution will be as follows:			<b>SEC Papers</b>	
Description	Marks		Marks	
	External Assessment (A)	Internal Assessment (B)	Theory	50
Major experiment	28	15	Practical*	30
Minor experiment	21	6	Internal	20
Viva-voce	14	6	Total	100
Record and submission	7	3	* Marks distribution is as given in the previous column marked (B)	
Total	70	30		



## SEMESTER - I

### ZOO: DSC-101

Course Title: **Diversity of Non-chordates**

Credits: 3

Contact hours: 45  
(All units are of equal credits)

Marks: 100

**Learning Objective:** *To know the general characters and classification of Non-chordates and understand the increasing complexity of body forms*

#### **Unit 1: Protozoa and Porifera**

1. General characters and classification of Protozoa up to classes; Nutrition, Locomotion and Reproduction in Protozoa
2. General characters and classification of Porifera up to classes; Canal system in sponges
3. Body symmetry and segmentation of Metazoa

#### **Unit 2: Cnidaria and Ctenophora**

1. General characteristics and Classification of Cnidaria up to classes
2. Life cycle of Obelia
4. Polymorphism in Siphonophora
5. Corals and coral reefs formation
6. General characteristics and affinities of Ctenophora

#### **Unit 3: Helminthes and Annelids**

1. General characters and classification of Platyhelminthes up to classes; Life cycle and pathogenicity of *Taenia solium*
2. General characters and classification of Nematelminthes up to classes, Life cycle and pathogenicity of *Ascaris lumbricoides*, Concept of pseudocoelom
3. General characteristics and classification of Annelids up to classes; Evolution of coelom and metamerism, Digestion in Annelida with special reference to Leech

#### **Unit 4: Arthropoda**

1. General characters and classification of Arthropoda up to classes
2. Digestion, Vision and Respiration in Arthropoda with special reference to prawn
3. Characteristics and phylogenetic significance of Onychophora
4. Characteristics and phylogenetic significance of Limulus

#### **Unit 5: Mollusca and Echinodermata**

1. General characters and classification of Mollusca up to classes
2. Respiration in Mollusca with reference to Pila, Torsion and detorsion in gastropods
3. General characters and classification of Echinodermata up to classes
4. Water-vascular system in Asteroidea

**Course Outcome:** *Students will be able to classify and describe the diverse groups of non-chordate animals.*

#### **Suggested Readings:**

- Ruppert EE, Fox RS, and Barnes RD. (2006). Invertebrate Zoology: A functional evolutionary approach. Cengage. 7<sup>th</sup> Edition



- 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
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- Ganguly, Sinha and Adhikari – Biology of Animals Vol. I, New Central
- Kotpal RL. Modern text book of Zoology: Invertebrates. 12<sup>th</sup> Edition. Rastogi Publications.
- Jordan EL, Verma PS. Invertebrate Zoology. S. Chand
- Parker and Haswell. Textbook of Zoology Invertebrates. Vol I. 8<sup>TH</sup> Edition

## **ZOO: DSC–102**

Course Title: **Diversity of Chordates**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To know the general characters and classification of Chordata and their diversity*

### **Unit 1: Taxonomy**

1. Systematics and taxonomy, Taxonomic terms, Concept of Classification, Taxonomic Hierarchy, Taxonomic key, Taxonomic types
2. International Code of Zoological Nomenclature (ICZN), Binomial nomenclature
3. Principle of priority, Newer trend in systematics
4. Basic concept of Molecular Taxonomy and DNA Barcoding

### **Unit 2: Introduction to Chordates and Protochordates**

1. General characteristics and outline classification of chordates
2. General characteristics of Hemichordata, Urochordata and Cephalochordata
3. Retrogressive metamorphosis in Urochordata
4. Advanced features of vertebrates over Protochordata

### **Unit 3: Agnatha and Fishes**

1. General characteristics and classification of Cyclostomes up to class
2. Classification of fishes upto order
3. General characteristics of Chondrichthyes and Osteichthyes
4. Migration, Osmoregulation and Parental care in fishes

### **Unit 4: Amphibia and Reptilia**

1. General characteristics and classification up to order; Parental care in Amphibians
2. General characteristics, distribution and affinities of *Sphenodon*
3. Difference between poisonous and non-poisonous snakes
4. Poison apparatus and Biting mechanism in snakes



## Unit 5: Aves and Mammals

1. General characteristics and classification of Aves up to order
2. *Archaeopteryx*: general characteristics and phylogenetic importance
3. Migration in birds; Flying and perching mechanism in birds
4. General characters and classification of mammals up to order; Echolocation of Bats

**Course Outcome:** Students will be able to classify and describe the diverse groups of chordate animals.

### Suggested Readings:

- Mayr E (2015). *Principles of Systematic Zoology*. Scientific Publishers-Jodhpur
- Kapoor VC (2019). *Theory and Practice of Animal Taxonomy and Biodiversity*. Oxford & IBH Publishing; 8<sup>th</sup> Edition
- Narendran TC (2009). An introduction to taxonomy. Zoological Survey of India.
- Paul DN, Hebert T, Gregory R (2005). *The Promise of DNA Barcoding for Taxonomy*. *Systematic Biology*. 54(5):852–859.
- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford University press.
- Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- Ganguly, Sinha and Adhikari – *Biology of Animals*, Vol II
- Parker and Haswell. *Textbook of Zoology Vertebrates*. Vol II. 8<sup>TH</sup> Edition
- Kotpal RL. *Modern text book of Zoology: Vertebrates*. 12<sup>th</sup> Edition. Rastogi Publications.
- Jordan EL, Verma PS. *Chordate Zoology*. S. Chand

## ZOO: DSM–101

Course Title: **Animal Diversity**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning Objective:** To know the general characters and classification of Non-chordates and Chordata as well as their diversity

### Unit 1: Protozoa, Porifera and Cnidaria

1. General characters and classification of Protozoa up to classes; locomotion in Protozoa
2. General characters and classification of Porifera up to classes; Canal System in *Sycon*
3. General characters and classification up of Cnidaria to classes; Coral and Coral reef formation

### Unit 2: Platyhelminthes, Nematelminthes and Annelida

1. General characters and classification of Platyhelminthes up to classes; Life history of *Taenia solium*
2. General characters and classification of Nematelminthes up to classes; Life history of *Ascaris lumbricoides*
3. General characters and classification of Annelida up to classes; Digestive System of Leech





### **Unit 3: Arthropoda, Mollusca and Echinodermata**

1. General characters and classification of Arthropoda up to classes; Vision in Arthropoda
2. General characters and classification of Mollusca up to classes; Torsion in gastropods
3. General characters and classification of Echinodermata up to classes; Water- vascular system in Star Fish

### **Unit 4: Protochordates, Agnatha, Fishes and Amphibia**

1. General features of Protochordates, Agnatha and Cyclostomes
2. General features and Classification of fishes up to orders; Osmoregulation in Fishes
3. General features and Classification of Amphibia up to orders; Parental care

### **Unit 5: Reptiles, Aves and Mammals**

1. General features and Classification of Reptilia up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes
2. General features and Classification of Aves up to orders; Flight adaptations in birds
3. Classification of Mammals up to orders; Monotremata, Marsupials and Placentals – their characteristic features

**Course Outcome:** *Students will be able to classify and describe the diverse groups of non-chordate and chordate animals.*

### **Suggested Readings:**

- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
- Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
- Pough H. Vertebrate life, VIII Edition, Pearson International.
- Ganguly, Sinha and Adhikari – Biology of Animals Vol. I, New Central
- Ganguly, Sinha and Adhikari – Biology of Animals, Vol II
- Kotpal RL. Modern text book of Zoology: Vertebrates. 12<sup>th</sup> Edition. Rastogi Publications.
- Jordan EL, Verma PS. Invertebrate Zoology. S. Chand
- Jordan EL, Verma PS. Chordate Zoology. S. Chand

## **ZOO: IDC-101**

Course Title: **Understanding Life Processes**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning Objectives:** *To know the fundamental biological processes that occur in living organisms*

### **Unit 1: The Living World**

1. Characteristics of Living Beings
2. Diversity in the Living World
3. Levels of organization for Living Beings



4. Binomial Nomenclature- rules of nomenclature
5. Zoological parks and Botanical gardens

### **Unit 2: Digestion and Absorption**

1. Digestive system of Human
2. Process of digestion- digestion in mouth, stomach and small intestine
3. Absorption of digested products
4. Food and its types
5. Diseases due to nutritional deficiency

### **Unit 3: Respiration**

1. Respiratory system of Human
2. Mechanism of breathing in human
3. Transport of gases- transport of Oxygen and Carbon dioxide
4. Respiratory volumes and capacities
5. Some respiratory disorders

### **Unit 4: Circulation**

1. Circulatory system of human
2. Body fluids- blood and lymph
3. Blood Groups
4. Blood Pressure
5. Some disorders of circulatory system

### **Unit 5: Reproduction**

1. Male reproductive system of human
2. Female reproductive system of human
3. Gametogenesis, Human sperm and human ovum
4. Menstrual cycle
5. Fertilisation

**Course Outcome:** *Students will be able to demonstrate a comprehensive understanding of the diverse life processes, their interconnections to sustain life.*

### **Suggested Readings:**

- Taylor DJ, Green NPO, Stout GW (2005). Biological Science. Cambridge University Press; 3<sup>rd</sup> Edition.
- Enger E, Ross FC, Bailey D (2004). Concepts in Biology. McGraw-Hill Higher Education; 11<sup>th</sup> Edition
- Campbell, N.A. and Reece J.B (2011). Biology. Pearson, Benjamin; 9<sup>th</sup> Edition
- Biology – XI and XII, NCERT, New Delhi



## **ZOO: SEC-101**

Course Title: **Apiculture**

Credits: 3

Contact hours: 60

Marks: 100

### **THEORY**

Credits: 2

Contact hours: 30

Marks: 50

(All units are of equal credits)

**Learning Objective:** *To inculcate skills in apiary management*

#### **Unit 1: Biology of Bees**

1. History, Classification and Biology of Honey Bees
2. Social Organization of Bee Colony

#### **Unit 2: Rearing of Bees**

1. Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth
2. Bee Pasturage, Selection of Bee Species for Apiculture
3. Bee Keeping Equipment
4. Methods of Extraction of Honey (Indigenous and Modern)

#### **Unit 3: Diseases and Enemies**

1. Bee Diseases and Enemies
2. Control and Preventive measures

#### **Unit 4: Bee Economy**

1. Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen

#### **Unit 5: Entrepreneurship in Apiculture**

1. Bee Keeping Industry – Govt initiatives and recent efforts
2. Modern methods in employing artificial Beehives for cross pollination in horticultural gardens

**Course Outcome:** *Students will be able to apply their knowledge and skills in apiculture to establish and manage their own beekeeping operations successfully.*

#### **Suggested Readings:**

- Selby C. Beekeeping: *A Beginner's Guide To Backyard Beekeeping*. 2<sup>nd</sup> Edition
- Prost, P. J. *Apiculture*. Oxford and IBH, New Delhi.
- Bisht D.S., *Apiculture*, ICAR Publication.
- Singh S., *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.



## **SEC-101: PRACTICAL**

Credit: 1

Contact Hours: 30

Marks: 30

1. Identification of different casts in honeybees-Queen, drones and workers
2. Structure of honey comb-different type of cells for queen, drones and workers
3. Morphological peculiarities of worker bees-Honey and pollen storage structures
4. Identification of bee keeping instruments and bee hives
5. Visit to an Apiculture Farm and Preparation of a Field Report/Project Report/PowerPoint presentation



## SEMESTER - II

### ZOO: DSC-151

Course Title: **Cell Biology**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To understand structure and functions of cell and cell organelles*

#### **Unit 1: Overview of the Cells**

1. History of discovery of cell, diversity of cell size and shape
2. Cell theory
3. General characters of Prokaryotic and Eukaryotic cells
4. Structure of Virus, Viroids, Mycoplasma and Prions

#### **Unit 2: Membrane and Endomembrane Systems**

1. Various models of plasma membrane structure
2. Transport across membranes: Active and Passive transport, Facilitated transport
3. Cell junctions: Tight junctions, Desmosomes, Gap junctions
4. Structure and functions of Endoplasmic reticulum, Golgi apparatus and Lysosomes

#### **Unit 3: Mitochondria, Ribosomes and Peroxisomes**

1. Mitochondria: Structure and function, Semi-autonomous nature
2. Endosymbiotic hypothesis
3. Ribosomes: types, structure and functions
4. Peroxisomes: Structure and function

#### **Unit 4: Nucleus and Cytoskeleton**

1. Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus
2. Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)
3. Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

#### **Unit 5: Cell Division and Cell Signalling**

1. Mitosis and Meiosis
2. Cell cycle and its regulation
3. GPCR and Role of second messenger (cAMP)

**Course Outcome:** *Students will be able to apply their knowledge of cell biology to explain cellular processes and their implications in the broader context of biological systems.*

#### **Suggested Readings**

- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.
- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.



- Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Lodish H, Berk A, Kaiser CA, et al (2007). *Molecular Cell Biology*. VI Edition. W. H. Freeman
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

## **ZOO: DSC-152**

Course Title: **Practical – I (Non-chordates, Chordates and Cell Biology)**

Credits: 3

Contact hours: 60

Marks: 100

**Learning objectives:** *To understand the classification, diversity, and characteristics of non-chordates and chordates and to develop knowledge of cell biology*

### **Non-chordates:**

1. Study of whole mount of *Euglena*, *Amoeba* and *Paramecium*, Binary fission and Conjugation in *Paramecium*
2. Examination of pond water collected from different places for diversity in Protista
3. Study of museum specimen for identification from each non-chordate phyla (Slides/micro-photographs)
4. One specimen/slide of any ctenophore
5. Mount of mouth parts and digestive system and nervous system of *Periplaneta*

### **Chordates:**

1. Study of museum specimen from Protochordates, hemichordate and Cephalochordata
2. Sections of *Balanoglossus* through, proboscis and branchiogenital regions
3. Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions.
4. Study of museum specimens from Agnatha, Fishes, Amphibia, Reptilia and Mammalia.
5. Key for Identification of poisonous and non-poisonous snakes
6. Study of six common birds from different orders. Types of beaks and claws
7. Mount of Weberian ossicles, pecten from Fowl head

### **Cell Biology:**

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female exfoliated cells from the cheek.

**Course outcome:** *Students will have a comprehensive understanding of non-chordates, chordates, and cell biology, enabling them to analyze and interpret the biological aspects of animals at the cellular and organismal levels.*



## **ZOO: DSM-151**

Course Title: **Cell Biology & Histology**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To know structure, functions and organisation of cells and tissues.*

### **Unit 1: Overview of Cell and plasma membrane**

1. Prokaryotic and Eukaryotic cells, Cell theory
2. Various models of plasma membrane structure
3. Transport across membranes: Active and Passive transport, Facilitated transport
4. Cell junctions: Tight junctions, Desmosomes, Gap junctions

### **Unit 2: Cell Organelles**

1. Structure and functions of Endoplasmic reticulum, Golgi apparatus and Lysosomes
2. Mitochondria: Structure and function, Semi-autonomous nature
3. Peroxisomes: Structure and function
4. Structure and function of Nucleus, Nucleolus

### **Unit 3: Cytoskeleton, Chromatin and Cell Cycle**

1. Structure and Functions: Microtubules, Microfilaments and Intermediate filaments
2. Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)
3. Cell cycle and its regulation

### **Unit 4: Epithelial Tissue and Connective Tissue**

1. Types, structure, location, and functions of epithelial tissue.
2. Types, structure, location, and functions of connective tissue proper (Loose and Dense).
3. Types, structure, location, and functions of specialised connective tissue

### **Unit 5: Muscular and Nervous Tissues**

1. Types and functions of muscles, Ultra structure of skeletal muscle
2. Neurons: Structure, types and functions
3. Glia Cells: Structure, types and functions
4. Synapse: Structure and types

**Course Outcome:** *Students will be able to apply their knowledge of cell biology and histology to explain cellular processes and their implications in the broader context of biological systems.*

### **Suggested Readings**

- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
- Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.



- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.
- Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Pushpalatha K and Bhat D (2022). *Inderbir Singh's Textbook of Human Histology*. X Edition. Jaypee Brothers Medical Publishers

## **ZOO: IDC-151**

Course Title: **Economic Zoology**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning objectives:** *To know the economic importance of animals and their applications in various human activities.*

### **Unit 1: Medical Zoology**

1. Basic concept of pandemic, epidemic, endemic, and outbreak
2. Basic concept of parasite, zoonotic diseases with examples
3. Basic concept of communicable and non-communicable diseases with examples

### **Unit 2: Economically Important Insects**

1. Basic concept of artificial harvesting of honey
2. Culture of Silkworm for various types of silk production
3. Culture of lac insect for lac production

### **Unit 3: Fish and Fishery**

1. Types of commercial fishes, Construction and management of ponds for fish culture
2. Composite fish culture
3. Ornamental fishes

### **Unit 4: Livestock Farming I**

1. Importance of animal husbandry in food production
2. Overview of different livestock organisms used in Assam and their characteristics.
3. Common diseases affecting livestock and their prevention; Vaccination schedules

### **Unit 5: Livestock Farming II**

1. Poultry farming, common diseases and preventive measures
2. Selection criteria for dairy animals, milking techniques, Managing reproductive cycles and lactation in dairy cows
3. Ethical considerations in using animals for animal husbandry practices

**Course Outcome:** *Students will be able to apply economic zoology concepts and techniques to address practical challenges in areas such as animal husbandry, and sustainable resource management.*





### **Suggested Readings:**

- Shukla GS and Upadhyay VB (2016). Economic Zoology. Rastogi Publications. 5<sup>th</sup> Edition
- Islam A (2020). A Textbook of Economic Zoology. Dreamtech Press
- Chatterjee KD (2019). Parasitology (Protozoology and Helminthology). CBS, 13<sup>th</sup> Edition
- Mathialagan P (2020). Textbook of Animal Husbandry: Extension Education. CBS Publishers & Distributors; 4<sup>th</sup> Edition

## **ZOO: SEC-151**

Course Title: **Medical Diagnostics**

Credits: 3

Contact hours: 60

Marks: 100

### **THEORY**

Credits: 2

Contact hours: 30

Marks: 50

(All units are of equal credits)

**Learning objectives:** *To understand the principles and techniques used in medical diagnostics*

### **Unit 1: Introduction and Haematology**

1. Importance of medical diagnostics
2. Blood composition, Preparation of blood smear and Differential Leucocyte Count (DLC) using Leishman's stain
3. Platelet count using haemocytometer
4. Erythrocyte Sedimentary Rate (ESR), Packed Cell Volume (PCV)

### **Unit 2: Diagnostic Methods used for Sputum, Urine and Stool Analysis**

1. Sputum analysis: Physical characteristics and abnormal constituents
2. Urine Analysis: Physical characteristics and abnormal constituents
3. Stool Analysis: Physical characteristics and abnormal constituents

### **Unit 3: Non-infectious Diseases**

1. Diabetes (Type I and Type II): Causes, types, symptoms, complications, diagnosis and prevention
2. Hypertension (Primary and secondary): Causes, types, symptoms, complications, diagnosis and prevention
3. Cancer: Basics, benign and malignant tumour, metastasis, Detection

### **Unit 4: Infectious Diseases**

1. Tuberculosis: Causes, types, symptoms, diagnosis and prevention
2. Hepatitis: Causes, types, symptoms, diagnosis and prevention



## Unit 5: Medical Imaging Techniques

1. X-Ray: Basic principle and applications
2. CT Scan: Basic principle, types and applications
3. MRI: Basic principle, types and applications
4. Sonography: Basic principle and applications

**Course Outcome:** *Students will be able to apply knowledge of medical diagnostic techniques for disease identification and management.*

### Suggested Readings:

- Kumar V, Abul K. Abbas AK, Jon C. Aster JC, Singh MK (2020). Robbins and Cortan, *Pathologic Basis of Disease*, X Edition, Elsevier Health Science; South ASIA edition.
- Park, K. (2007), *Preventive and Social Medicine*, B.B. Publishers
- Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House
- Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
- Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
- Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd.

## SEC – 151: PRACTICAL

Credit: 1

Contact Hours: 30

Marks: 30

1. Identifications of different cellular components of blood.
2. Identifications of different types of vials used in medical diagnosis.
3. Determination of Rh factor of blood.
4. Differential Leucocyte Count (DLC) using Leishman's stain.
5. Detection of pH, sugar and protein in a sample of human urine.



## SEMESTER - III

### ZOO: DSC-201

Course Title: **Principles of Genetics**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To understand basic principles in heredity and inheritance*

#### **Unit 1: Mendelian Genetics and its Extension**

1. Principles of inheritance
2. Incomplete dominance and co-dominance
3. Allele concept: Multiple alleles, pseudo allele and lethal allele
4. Epistasis, Additivity, Pleiotropy

#### **Unit 2: Linkage, Crossing Over and Chromosomal Mapping**

1. Linkage: Concept and significance
2. Crossing over: Concept and mechanism
3. Models of recombination
4. Linkage map – coincidence, interference

#### **Unit 3: Sex Determination and Extranuclear Inheritance**

1. Chromosomal, environmental and hormonal mechanisms of sex determination
2. Sex-linked, sex-influenced and sex-limited characters inheritance
3. Maternal effects and cytoplasmic inheritance
4. Mitochondrial mutations

#### **Unit 4: Important Concepts in Genetics I**

1. Concept of Polygenic inheritance with suitable examples
2. Complementation test in Bacteriophage
3. Gene transfer mechanism: Conjugation, Transformation and Transduction

#### **Unit 5: Important Concepts in Genetics II**

1. Types of chromosomal aberrations
2. Giant chromosome (Polytene and Lampbrush): Structure and functions
3. Genetic disorders and Pedigree analysis

**Course Outcome:** *Students will be able to apply principles of genetics to explain inheritance patterns and analyze various genetic disorders*

#### **Suggested Readings:**

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co



- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings
- Strickberger MW (2015). *Genetics*. III Edition. Pearson Education India
- Russel PJ (2016). *iGenetics A molecular Approach*. III Edition. Pearson Education India

## **ZOO: DSC-202**

Course Title: **Principles of Ecology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To understand Principles and the concepts in ecology and wildlife management*

### **Unit 1: Introduction to Ecology**

1. Definition of ecology, Autecology and synecology
2. Levels of organization, Laws of limiting factors
3. Biotic and abiotic factors; Animal adaptations to physical environment
4. Ecological habitat and niche

### **Unit 2: Ecosystem**

1. Components of ecosystem, Types of ecosystems with examples
2. Food chain, Food web, Energy flow through the ecosystem
3. Ecological pyramids, Ecological efficiencies, Productivity
4. Biogeochemical cycle: Nitrogen cycle, Carbon cycle, Phosphorous cycle

### **Unit 3: Population**

1. Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves
2. Exponential and logistic growth
3. Population regulation: density-dependent and independent factors
4. Population interactions: negative and positive interactions; Gause's Principle; Lotka-Volterra equation for competition and Predation

### **Unit 4: Community**

1. Community structure and characteristics: species richness, dominance, diversity, abundance, vertical stratification
2. Ecotone and edge effect; Ecological succession with example
3. Theories pertaining to climax community

### **Unit 5: Applied Ecology**

1. Concept of sanctuary, national park, biosphere reserve
2. Ecology in Wildlife Conservation and Management
3. Causes of depletion of wildlife
4. Project Tiger, Project Rhino
5. Application of GIS and remote sensing in wildlife biology



**Course Outcome:** Students will be able to explain ecological concepts and apply them to real-world scenarios, contributing to sustainable practices and ecosystem conservation.

### **Suggested Readings:**

- Colinviaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
- Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
- Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
- Robert Leo Smith Ecology and field biology Harper and Row publisher
- Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
- Curningham and Curningham – Environmental Science, Mc Graw Hill
- Verma and Agarwal – Environmental Biology, S Chand
- Sharma PD (204). Ecology and Environment. XIII Edition. Rastogi Publications

## **ZOO: DSM–201**

Course Title: **Physiology and Biochemistry**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning objectives:** To know the fundamental principles underlying animal physiology and biochemical processes.

### **Unit 1: Digestion and Respiration**

1. Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins & lipids
2. Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

### **Unit 2: Excretion and Cardiovascular System**

1. Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism
2. Composition of blood, Haemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

### **Unit 3: Reproduction and Endocrine Glands**

1. Physiology of male reproduction: spermatogenesis; Physiology of female reproduction: oogenesis, menstrual cycle and its hormonal control
2. Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal gland

### **Unit 1: Nerve and Muscle**

1. Resting membrane potential; Graded potential, Action potential: Properties, its origin and conduction across the myelinated and non-myelinated nerve fibres
2. Mechanism of Synaptic transmission
3. Mechanism of skeletal muscle contraction



## Unit 5: Enzymes and Metabolism

1. Classification and nomenclature of enzymes, Mechanism of action, Enzyme Kinetics
2. Glycolysis, Krebs Cycle, Pentose phosphate pathway, Electron transport chain
3.  $\beta$ -oxidation of fatty acid, Transamination, Deamination and Urea Cycle

**Course Outcome:** Students will be able to explain the physiological and biochemical basis of animal functions and demonstrate the application of this knowledge in the field of zoology.

### Suggested Readings:

- Kim E. Barrett KE, Barman SM, Yuan J X.-J., Brooks H (2019). Ganong's Review of Medical Physiology, McGraw-Hill Education / Medical; 26<sup>th</sup> Edition.
- Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H. Freeman & Co.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw Hill.

## ZOO: IDC-201

Course Title: **Public Health & Hygiene**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning objectives:** To know essentials of public health and sanitation thereby warding off diseases and uplifting the living standards of the community

### Unit 1: Nutrition & Dietetics

1. Nutrition – definition, importance of Carbohydrate, Protein, Lipids and Minerals
2. Balanced diet - Basics of meal planning, Concept of energy, calories,
3. Food adulteration and food fortification

### Unit 2: Reproductive Health & Family Welfare

1. Maternal health, Population control and family welfare
2. Sexually transmitted diseases – HIV/AIDS, syphilis, gonorrhea
3. Management of diseases like Obesity, Diabetes mellitus, Cardiovascular disorders,

### Unit 3: Health & Diseases

1. Health-Education: Health dynamicity – definition, factors influencing health, health and socio-economic development.
2. Communicable diseases and prevention: Malaria, Typhoid, Hepatitis (Jaundice) and, Diarrhea
3. Other vector borne diseases: Dengue, chikunguniya: causes and prevention methods.



#### **Unit 4: Environmental & Mental Health**

1. Environmental health - Determinants of environmental health; Occupational environment and health concerns
2. Environment and Health hazards: Environmental Pollution – Air, Water, Land and Noise and associated health hazards
3. Psychological stresses, depressive disorders
4. Stress reduction and management-importance of yoga

#### **Unit 5: Lifestyle & Hygiene**

1. Ill effects of smoking, alcoholism, substance abuse and drug abuse
2. Hygiene: Definition, personal hygiene- body odour, oral hygiene, grooming, feminine hygiene, hand washing, toiletry.
3. Community Hygiene, Environmental Sanitation and Sanitation in Public places occupational hygiene

**Course outcome:** *Students will gain a comprehensive understanding of public health and hygiene, enabling them to contribute to disease prevention and promote healthier communities.*

#### **Suggested Readings:**

- Jatin V. Modi and Renjith S. Chawan. Essentials of Public Health and Sanitation–Part I-IV
- Murray, C. J. L. and A.D. Lopez. (1996). The Global Burden of Disease. World Health Organization.
- Park, J.E. and Park, K. Textbook of Community Health for Nurses.
- Swaminathan S. Principles of Nutrition and Dietetics.

### **ZOO: SEC-201**

Course Title: **Sericulture**

Credits: 3

Contact hours: 60

Marks: 100

#### **THEORY**

Credits: 2

Contact hours: 30

Marks: 50

(All units are of equal credits)

**Learning objectives:** *To inculcate knowledge on cultivation and commercial production of silkworms for the sustainable production of silk fibers.*

#### **Unit 1: Introduction**

1. Sericulture: Definition, history and present status; Silk route
2. Types of silkworms, Distribution and Races
3. Exotic and indigenous races; Mulberry and non-mulberry Sericulture



## Unit 2: Biology of Silkworm

1. Life cycle of *Bombyx mori*
2. Structure of silk gland and secretion of silk

## Unit 3: Rearing of Silkworms

1. Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances
2. Disinfectants: Formalin, bleaching powder, RKO
3. Silkworm rearing technology: Early age and Late age rearing Types of mountages; Spinning, harvesting and storage of cocoons

## Unit 4: Pests and Diseases

1. Pests of silkworm: Uzi fly, dermestid beetles and vertebrates
2. Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases

## Unit 5: Entrepreneurship in Sericulture

1. Prospectus of Sericulture in India: Sericulture industry in different states, employment
2. Potential in mulberry and non-mulberry sericulture

**Course Outcome:** *Students will be able to demonstrate competence in sericulture practices, understand the silk production cycle, and effectively manage silk worm rearing and silk processing operations.*

## Suggested Readings

- Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
- Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan 1972.
- Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
- Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

## SEC-201: PRACTICAL

Credit: 1

Contact Hours: 30

Marks: 30

1. Identification of Mulberry and non-mulberry silk worms, exotic and Indigenous species
2. Study of Life Cycle of *Bombyx mori*: a) Morphology of egg, larva, pupa and adult of silkworm
3. Sex separation in larva, pupa and adult of silkworm *Bombyx mori*
4. Identification of silkworm rearing appliances
5. Identification of various food plants of silk worm
6. Identification of Pests & Predators of silkworms
6. Visit to a Sericulture Farm and Preparation of a Field Report/Project Report/ PowerPoint presentation





## SEMESTER - IV

**Course Code: DSC-251**

**Course Title: Histology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning objectives:** *To know the microscopic structure and organization of animal tissues, organs and their functions.*

### **Unit 1: Epithelial Tissue and Connective Tissue Proper**

1. Types, structure, location, and functions of epithelial tissue.
2. Types, structure, location, and functions of connective tissue proper (Loose and Dense).

### **Unit 2: Specialised Connective Tissue**

1. Blood: Components and their functions.
2. Structure and functions of haemoglobin.
3. Blood as a buffer system; Blood groups: ABO, Rh factor, MN, Golden blood
4. Structure types and functions of bones and cartilages

### **Unit 3: Muscular Tissues**

1. Types and functions of muscles;
2. Ultrastructure of skeletal muscle
3. Molecular and chemical basis of skeletal muscle contraction; isotonic and isometric contraction
4. Characteristics of muscle twitch; treppe, summation and tetanus; Electromyography

### **Unit 4: Nervous Tissues**

1. Neurons: Structure, types and functions; Neuron doctrine
2. Classification and properties of nerve fibres
3. Glia Cells: Structure, types and functions
4. Synapse: Structure and types; Neuromuscular junction

### **Unit 5: Histology of Organs**

1. Structural organization of gastrointestinal tract and functions of associated glands
2. Structure of salivary glands, liver, pancreas and lungs
3. Structural organisation of mammalian heart, histology of blood vessels
4. Structure of kidney and its functional unit

**Course Outcome:** *Students will be able to analyze and classify animal tissues, comprehend their functions, and apply histological techniques for research and diagnostic purposes.*

### **Suggested Readings:**

- Pushpalatha K and Bhat D (2022). Inderbir Singh's Textbook of Human Histology. X Edition. Jaypee Brothers Medical Publishers



- Kim E. Barrett KE, Barman SM, Yuan J X.-J., Brooks H (2019). Ganong's Review of Medical Physiology, McGraw-Hill Education / Medical; 26<sup>th</sup> Edition.
- Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Eric R. Kandel ER, Koester JD, Mack SH (2021). Principles of Neural Science. VI Edition, McGraw Hill Medical

## **ZOO: DSC–252**

Course Title: **Fundamentals of Biochemistry**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To understand structure and functions of bio-molecules*

### **Unit 1: Carbohydrates**

1. Structure and Biological importance of Monosaccharides
2. Structure and Biological importance of Oligosaccharides
3. Structure and Biological importance of Polysaccharides
4. Glycosylation and Glycoconjugates

### **Unit 2: Lipids**

1. Classification of lipids
2. Structure and Significance of physiologically important saturated and unsaturated fatty acids
3. Triacylglycerols, Phospholipids, Glycolipids, Steroids

### **Unit 3: Proteins**

1. Amino acids: Structure, Classification and General properties of  $\alpha$ -amino acids; Physiological importance of essential and non-essential  $\alpha$ -amino acids
2. Classification of proteins, Levels of organization in proteins, bonds stabilizing protein structure

### **Unit 4: Enzymes and Vitamins**

1. Nomenclature, classification and properties of enzymes; Mechanism of enzyme action
2. Enzyme kinetics, Concept of  $K_m$  and  $V_{max}$ , Lineweaver and Burk plot, Factors affecting rate of enzyme-catalysed reactions
3. Vitamins: Classification, properties and functions

### **Unit 5: Nucleic Acids**

1. Structure of Purines and Pyrimidines, Nucleosides, Nucleotides, Base pairing, Hoogsteen base pair
2. Watson and Crick model of B-DNA, types of DNA
3. Basic structure and functions of different types RNA
4. Denaturation and Renaturation of DNA, Cot curves, Hypochromicity and Hyperchromicity of DNA



**Course Outcome:** Students will be able to comprehend the fundamental principles of biochemistry and apply them to analyze the biochemical processes and functions in living organisms.

### Suggested Readings:

- Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
- 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.
- Metzler DE (2021). *Biochemistry: The Chemical Reactions of Living Cells*. II Edition, Academic Press
- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). *Molecular Biology of the Gene*, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.
- Rastogi VB (2020). *Zubay's Principles of Biochemistry*. Medtech, Revised & Enlarged Edition

## ZOO: DSC-253

Course Title: **Practical – II (Genetics, Ecology, Histology, Biochemistry)**

Credits: 4

Contact hours: 60

Marks: 100

**Learning objectives:** To know the principles and mechanisms of genetics, ecology, histology, and biochemistry in relation to living organisms.

### Genetics:

1. To study the Mendelian laws and gene interactions through power-point presentation
2. Study of human karyotype (normal and abnormal).
3. Pedigree analysis of some human inherited traits.

### Ecology:

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method),
4. Biological Oxygen Demand (BOD)
5. Report on a visit to places of zoological importance

### Histology:

1. Recording of simple muscle twitch with electrical stimulation through PowerPoint presentation



2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Study of permanent slides/micro-photographs of Mammalian skin, Cartilage, Bone, Spinal cord and brain tissue.
4. Study of permanent slide/micro-photographs of mammalian Pituitary, Testis, Ovary, Adrenal, Thyroid and Parathyroid
5. Microtomy: Preparation of permanent slides of Goat/Fish tissues

### **Biochemistry:**

1. Qualitative tests of functional groups in carbohydrates and proteins
2. Paper chromatography of amino acids
3. Action of salivary amylase under optimum conditions
4. Effect of pH and temperature on the action of salivary amylase

**Course outcome:** *Students will have a comprehensive understanding of the genetic, ecological, histological, and biochemical aspects of organisms and their interactions with the environment.*

## **ZOO: DSM-251**

Course Title: **Practical (Animal Diversity, Physiology and Biochemistry, Genetics, Molecular Biology, Evolution)**

Credits: 3

Contact hours: 60

Marks: 100

**Learning Objectives:** *Understand the diversity of animals through practical exploration, explore the physiological and biochemical processes that occur in different animal species.*

### **Animal Diversity**

1. Study of museum specimens from each phylum (at least 3 specimen each) and sub-phyla as well as specimens of evolutionary significance.
2. Key for Identification of poisonous and non-poisonous snakes. An —animal album containing photographs, cut outs, with appropriate write up about the above-mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

### **Physiology and Biochemistry**

1. Preparation of hemin crystals
2. Study of permanent histological sections (slide/micro-photographs) of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides/micro-photographs of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Study of activity of salivary amylase under optimum conditions

### **Genetics and Evolutionary Biology**

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of fossil evidences from plaster cast models or pictures



3. Study of homology and analogy from suitable specimens/ pictures

### **Molecular Biology:**

1. Study of Polytene chromosomes from Chironomous / Drosophila larvae
2. Quantitative estimation of DNA using colorimeter or spectrophotometer

**Course Outcome:** *Students will be able to demonstrate practical skills in animal identification, physiological and biochemical experimentation, genetic and molecular analysis, and understand the role of evolution in shaping animal diversity.*

## **ZOO: DSM-252**

Course Title: **Genetics and Molecular Biology**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning objectives:** *To understand the fundamental principles of genetics and molecular biology*

### **Unit 1: Mendelism and its Extension**

1. Principles of inheritance
2. Incomplete dominance and co-dominance
3. Allele concept – multiple alleles, pseudo allele and lethal allele
4. Epistasis, hypostasis and pleiotrophy

### **Unit 2: Linkage, Crossing Over and Mutation**

1. Linkage – types of linkage, linkage groups and significance
2. Crossing over – types of crossing over, mechanism and significance
3. Mutation – Gene and chromosome mutations

### **Unit 3: Sex Determination, Sex-linked Inheritance and Extra-chromosomal Inheritance**

1. Chromosomal, cytoplasmic, hormonal and environmental basis of sex determination
2. Sex-linked inheritance
3. Extra-chromosomal inheritance

### **Unit 4: Nucleic Acids**

1. Salient features and chemical composition of DNA and RNA
2. Watson and Crick model of DNA; Types and functions of DNA
3. Structure of RNA – its types and functions

### **Unit 5: DNA Replication, Transcription and Translation**

1. DNA replication – types and mechanism of DNA replication in Prokaryotes
2. Mechanism of transcription in Prokaryotes
3. Genetic code, mechanism of translation in Prokaryotes



**Course Outcome:** Students will be able to demonstrate a comprehensive understanding of genetics and molecular biology, including the ability to analyze genetic data.

**Suggested Readings:**

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings
- Strickberger MW (2015). *Genetics*. III Edition. Pearson Education India
- Russel PJ (2016). *iGenetics A molecular Approach*. III Edition. Pearson Education India
- Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: *Molecular Biology of the Cell*, IV Edition.



## SEMESTER - V

### ZOO: DSC-301

Course Title: **Animal Physiology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To understand different physiological mechanisms in Mammal*

#### **Unit 1: Physiology of Digestion in Mammals**

1. Mechanical and chemical events of digestion of food
2. Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins
3. Gastrointestinal hormones, hormonal control of secretion of enzymes in GI tract.

#### **Unit 2: Physiology of Respiration in Mammals**

1. Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities
2. Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning.
3. Control of respiration, effect of high altitude and deep sea diving on respiration

#### **Unit 3: Circulatory Physiology in Mammal**

1. Circulation of blood through the heart of mammal
2. Structure and working of conducting myocardial fibres; Cardiac cycle; Cardiac output and its regulation, ECG
3. Blood pressure and its regulation
4. Hemostasis, Mechanism of blood coagulation, Fibrinolytic system,

#### **Unit 4: Renal Physiology in Mammals**

1. Structure of kidney and its functional unit
2. Mechanism of urine formation Counter current mechanism
3. Hormonal regulation of water balance; Regulation of acid-base balance
4. Hormonal regulation of the volume of urine

#### **Unit 5: Neurophysiology in Mammals**

1. Resting membrane potential; Graded potential; Action potential: Properties, its origin and conduction across the myelinated and non-myelinated nerve fibres
2. Mechanism of Synaptic transmission, EPSPs and IPSPs
3. Neurotransmitters: Types and functions
4. Neurodegenerative disorders; EEG

**Course Outcome:** *Students will be able to comprehend and evaluate the diverse physiological processes, demonstrating a comprehensive understanding of animal physiology.*



### **Suggested Readings:**

- Hill RW, Wyse GA, Anderson M (2012). Animal Physiology. III Edition. Sinauer Associates Inc
- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
- Kim E. Barrett KE, Barman SM, Yuan J X.-J., Brooks H (2019). Ganong's Review of Medical Physiology, McGraw-Hill Education / Medical; 26<sup>th</sup> Edition.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
- Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

## **ZOO: DSC-302**

Course Title: **Biochemistry of Metabolic Processes**

Credits: 4

Contact hours: 60  
(All units are of equal credits)

Marks: 100

***Learning objectives:*** *To understand biochemical processes in metabolism*

### **Unit 1: Overview of Metabolism**

1. Basic concept of catabolism and Anabolism, Stages of catabolism, Shuttle systems, membrane transporters
2. ATP as "Energy Currency of cell"; coupled reactions
3. Intermediary metabolism and regulatory mechanisms

### **Unit 2: Carbohydrate Metabolism**

1. Sequence of reactions and regulation of glycolysis, fate of pyruvate
2. Citric acid cycle, Phosphate pentose pathway
3. Gluconeogenesis, Glycogenolysis and Glycogenesis

### **Unit 3: Lipid Metabolism**

1.  $\beta$ -oxidation of saturated fatty acids with even and odd number of carbon atoms
2. Biosynthesis of palmitic acid
3. Ketogenesis

### **Unit 4: Protein Metabolism**

1. Catabolism of amino acids: Transamination, Deamination
2. Urea Cycle
3. Fate of C-skeleton of Glucogenic and Ketogenic amino acids

### **Unit 5: Bioenergetics**

1. Concept of oxidative phosphorylation, Redox systems, concept of free energy
2. Chemiosmotic theory and mitochondrial respiratory chain
3. Inhibitors and un-couplers of Electron Transport System





**Course outcome:** *Students will gain a comprehensive understanding of the biochemistry underlying metabolic processes, enabling them to analyze and explain metabolic phenomena.*

### **Suggested Readings:**

- Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
- 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.
- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). *Molecular Biology of the Gene*, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

## **ZOO: DSC-303**

Course Title: **Practical – III (Animal Physiology and Biochemistry of Metabolic Processes)**

Credits: 4

Contact hours: 60

Marks: 100

**Learning objectives:** *To understand the physiological mechanisms underlying metabolic processes in animals.*

### **Animal Physiology**

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of blood pressure using a sphygmomanometer
6. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, pancreas, trachea, lung, kidney using permanent slides/ micro-photographs.

### **Biochemistry of Metabolic Processes**

1. Estimation of total protein in given solutions by Lowry's method
2. To study the enzymatic activity of Trypsin and Lipase
3. Detection of Alkaline Phosphatase assay from tissue
4. Estimation of glucose
5. Demonstration of effect of inhibitors on activity of Salivary amylase

**Course outcome:** *Students will demonstrate proficiency in applying physiological and biochemical principles to explain and interpret animal metabolic processes.*



## **ZOO: DSM-301**

Course Title: **Genetics and Molecular Biology**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning objectives:** *To understand the fundamental principles of genetics and molecular biology*

### **Unit 1: Mendelism and its Extension**

1. Principles of inheritance
2. Incomplete dominance and co-dominance
3. Allele concept – multiple alleles, pseudo allele and lethal allele
4. Epistasis, hypostasis and pleiotrophy

### **Unit 2: Linkage, Crossing Over and Mutation**

1. Linkage – types of linkage, linkage groups and significance
2. Crossing over – types of crossing over, mechanism and significance
3. Mutation – Gene and chromosome mutations

### **Unit 3: Sex Determination, Sex-linked Inheritance and Extra-chromosomal Inheritance**

1. Chromosomal, cytoplasmic, hormonal and environmental basis of sex determination
2. Sex-linked inheritance
3. Extra-chromosomal inheritance

### **Unit 4: Nucleic Acids**

1. Salient features and chemical composition of DNA and RNA
2. Watson and Crick model of DNA; Types and functions of DNA
3. Structure of RNA – its types and functions

### **Unit 5: DNA Replication, Transcription and Translation**

1. DNA replication – types and mechanism of DNA replication
2. RNA polymerases, mechanism of transcription if Prokaryotes
3. Genetic code, mechanism of translation in Prokaryotes

**Course Outcome:** *Students will be able to demonstrate a comprehensive understanding of genetics and molecular biology, including the ability to analyze genetic data.*

### **Suggested Readings:**

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co
- Strickberger MW (2015). *Genetics*. III Edition. Pearson Education India
- Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley
- Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: *Molecular Biology of the Cell*, IV Edition.



## **ZOO: DSM-302**

Course Title: **Evolution and Adaptation**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To understand the principles of evolutionary biology and their application to the diversity and adaptation of animal species.*

### **Unit 1: Origin, theories and Evidences**

1. Life's Beginnings: Chemogeny, RNA world, Biogeny
2. Origin of photosynthesis, Evolution of eukaryotes
3. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism
4. Evidences of Evolution: Fossil record (types, transitional forms, geological time scale)

### **Unit 2: Population Genetics**

1. Concept of gene pool, gene frequency and genotype frequency
2. Hardy-Weinberg Law: statement and derivation of equation
3. Genetic Drift: founder's effect, bottleneck phenomenon
4. Role of Migration and mutation in changing allele frequencies

### **Unit 3: Mechanism of Speciation**

1. Product of evolution: Micro evolutionary changes (inter-population variations, clines, Races; Species concept)
2. Isolating mechanisms, modes of speciation—allopatric, sympatric
3. Adaptive radiation / macroevolution (exemplified by Galapagos finches and mammals)

### **Unit 4: Evolution of Horse and Human**

1. Evolution of horse
2. Origin and evolution of man, Unique hominid characteristics contrasted with primate characteristics, primate phylogeny from *Dryopithecus* leading to *Homo sapiens*
3. Phylogenetic trees, Construction of phylogenetic trees and their interpretation

### **Unit 5: Adaptations**

1. Adaptations – physical, physiological and habitat adaptations and their significance
2. Different types of adaptation: Aquatic, Volant, Cursorial, Fossorial, Arid, and Arboreal
3. Colouration and mimicry

**Course Outcome:** *Students will demonstrate a comprehensive understanding of evolutionary biology, its relevance to the study of life, and the ability to critically evaluate and explain evolutionary processes and patterns.*

### **Suggested Readings:**

- Douglas, J. Futuyma (2006). Evolutionary Biology. Sinauer Associates Inc.,US.; III Revised Edition
- Ridley, M (2004). Evolution. III Edition Blackwell publishing
- Hall, B.K. and Hallgrimson, B (2008). Evolution. IV Edition. Jones and Barlett Publishers.
- Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin,
- Rastogi VB (2018). Organic Evolution. III Edition. MedTech



## SEMESTER - VI

### ZOO: DSC–C351

Course Title: **Molecular Biology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objective:** To know structure and functions of nucleic acids and principles of molecular biology

#### Unit 1: DNA Replication

1. Semi-conservative, bidirectional and semi-discontinuous replication
2. Mechanism of DNA Replication in prokaryotes
3. Basic difference between prokaryotic and eukaryotic Replication

#### Unit 2: Transcription

1. RNA polymerase and transcription Unit, Transcription factors
2. Mechanism of transcription in prokaryotes
3. Basic difference between prokaryotic and eukaryotic transcription
4. Post transcriptional Modifications: Capping, tailing and splicing

#### Unit 3: Translation

1. Genetic code, Wobble Hypothesis
2. Process of protein synthesis in prokaryotes
3. Post translational modifications
4. Difference between prokaryotic and eukaryotic translation

#### Unit 4: Gene Regulation

1. Concept of constitutive, regulated, inducible and repressible gene expression
2. Principles of transcriptional regulation with examples from lac operon and trp operon
3. RNA interference: miRNA and siRNA

#### Unit 5: DNA Repair, Mutations and Transposons

1. Mechanism of DNA Repair
2. Types and mechanism of gene mutation, Mutagens
3. Basic concept of Transposons and Transposable element

**Course Outcome:** Students will be able to demonstrate a comprehensive understanding of the molecular basis of biological processes.

#### Suggested Readings:

- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.
- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.



- Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Lodish H, Berk A, Kaiser CA, et al (2007). *Molecular Cell Biology*. VI Edition. W. H. Freeman
- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). *Molecular Biology of the Gene*, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

## **ZOO: DSC-352**

Course Title: **Evolutionary Biology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To understand the principles of evolutionary biology and their application to the diversity and adaptation of animal species.*

### **Unit 1: Origin, Theories and Evidences**

1. Life's Beginnings: Chemogeny, RNA world, Biogeny
2. Origin of photosynthesis, Evolution of eukaryotes
3. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism
4. Evidences of Evolution: Fossil record (types, transitional forms, geological time scale)

### **Unit 2: Population Genetics**

1. Concept of gene pool, gene frequency and genotype frequency
2. Hardy-Weinberg Law: statement and derivation of equation
3. Genetic Drift: founder's effect, bottleneck phenomenon
4. Role of Migration and Mutation in changing allele frequencies

### **Unit 3: Mechanism of Speciation**

1. Product of evolution: Micro evolutionary changes (inter-population variations, clines, Races; Species concept)
2. Isolating mechanisms, modes of speciation—allopatric, sympatric
3. Adaptive radiation / macroevolution (exemplified by Galapagos finches and mammals)

### **Unit 4: Evolution of Horse and Human**

1. Evolution of horse
2. Origin and evolution of man, Unique hominid characteristics contrasted with primate characteristics, primate phylogeny from *Dryopithecus* leading to *Homo sapiens*
3. Phylogenetic trees, Construction of phylogenetic trees and their interpretation

### **Unit 5: Zoogeography**

1. Zoogeographical realms, geographic range, Physical features and faunal composition; Distribution of animals, types; Continental drift
2. Barriers: Extrinsic and intrinsic barriers
3. Animal Dispersal – means of dispersal



**Course Outcome:** *Students will demonstrate a comprehensive understanding of evolutionary biology, its relevance to the study of life, and the ability to critically evaluate and explain evolutionary processes and patterns.*

**Suggested Readings:**

- Douglas, J. Futuyma (2006). Evolutionary Biology. Sinauer Associates Inc.,US.; III Revised Edition
- Ridley, M (2004). Evolution. III Edition Blackwell publishing
- Hall, B.K. and Hallgrimson, B (2008). Evolution. IV Edition. Jones and Barlett Publishers.
- Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin,
- Rastogi VB (2018). Organic Evolution. III Edition. MedTech
- Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell
- Darlington PJ (1980). Zoogeography: The Geographical Distribution of Animals. R. E. Krieger Publishing Company

**ZOO: DSC–353**

Course Title: **Reproductive and Developmental Biology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning objectives:** *To understand the mechanisms of reproduction and development in animals*

**Unit 1: Reproductive Endocrinology**

1. Reproductive System of Rat and Human, Development and differentiation of gonads, genital ducts, external genitalia.
2. Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis

**Unit 2: Hormonal Regulation of Female Reproductive Cycles**

1. Gametogenesis: Spermatogenesis, Oogenesis
2. Epididymal function and sperm maturation
3. Reproductive cycles (rat and human) and their regulation, changes in the female tract;
4. Ovum transport in the fallopian tubes; Sperm transport in the female tract

**Unit 3: Early Embryonic Development**

1. Types of eggs, Egg membranes
2. Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy
3. Planes and patterns of cleavage, blastulation
4. Early development of chick up to gastrulation

**Unit 4: Late Embryonic Development**

1. Fate of Germ Layers – Fate Map; organiser concept
2. Extra-embryonic membranes in birds and mammals
3. Implantation of embryo in humans
4. Placenta (Structure, types and functions of placenta)



## Unit 5: Post Embryonic Development

1. Metamorphosis: Changes, hormonal regulations in amphibians and insects
2. Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each)
3. Stem cell (ESC), Amniocentesis

**Course Outcome:** *Students will be able to comprehend and apply the knowledge of reproductive and developmental biology to analyze and explain the diverse reproductive strategies and developmental process.*

### Suggested Readings:

- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
- Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press
- Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
- Bolander FF (2004). Molecular Endocrinology. III Edition, Academic Press

## ZOO: DSC-354

Course Title: **Practical – IV (Molecular Biology, Evolution, Reproductive and Developmental Biology)**

Credits: 4

Contact hours: 60

Marks: 100

**Learning objectives:** *To understand the fundamental principles and techniques of molecular biology, evolution, reproductive biology, and developmental biology.*

### Molecular Biology:

1. Study of Polytene chromosomes from Chironomous / Drosophila larvae
2. Quantitative estimation of DNA using colorimeter or spectrophotometer

### Evolution:

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens

### Reproductive Biology:

1. Study of animal house through powerpoint presentation: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
2. Surgical techniques through powerpoint presentation: Ovaryectomy, hysterectomy, castration and vasectomy in rats.
3. Examination of histological sections from photomicrographs/ permanent slides of rat testis, epididymis and accessory glands of male reproductive systems.
4. Examination of histological sections from photomicrographs/ permanent slides of rat ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.





### **Developmental Biology:**

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation
3. Study of the developmental stages and life cycle of *Drosophila* through audio-visual aids

**Course outcome:** *Students will be able to apply molecular biology techniques and principles to investigate evolutionary relationships, reproductive processes, and developmental mechanisms in various organisms.*

## **ZOO: DSM-351**

Course Title: **Practical (Cell Biology, Histology, Genetics, Molecular Biology, Evolution)**

Credits: 4

Contact hours: 60

Marks: 100

**Learning Objectives:** *To develop practical skills on fundamental concepts of cell biology, histology, genetics, molecular biology, and evolution.*

### **Cell Biology:**

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female hair follicle cells

### **Histology:**

1. Recording of simple muscle twitch with electrical stimulation through PowerPoint presentation
2. Study of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Brain tissue, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid

### **Genetics and Evolutionary Biology**

4. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples.
5. Study of fossil evidences from plaster cast models and pictures
6. Study of homology and analogy from suitable specimens/ pictures

### **Molecular Biology:**

3. Study of Polytene chromosomes from Chironomous / *Drosophila* larvae
4. Quantitative estimation of DNA using colorimeter or spectrophotometer

**Course Outcome:** *Students will be able to apply their knowledge and skills to analyze and interpret biological phenomena at the cellular, histological, genetic, molecular, and evolutionary levels.*





## SEMESTER - VII

### ZOO: DSC-401

Course Title: **Immunology and Biotechnology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning objectives:** *To understand the principles of immunology and the fundamentals of biotechnology and its applications in various fields*

#### **Unit 1: Understanding Immune System**

1. Introduction to immune system, Clonal Selection, types of immunity, Innate and Adaptive immune system, Primary and Secondary immune responses
2. Molecules, cells and organs (primary and secondary lymphoid organs) of the immune system
3. Antigenicity and immunogenicity, basic properties of antigens, super antigen, haptens and adjuvants.
4. Structure, classes and function of antibodies, Affinity and Avidity

#### **Unit 2: Working of Immune System**

1. Structure and functions of MHC, exogenous and endogenous pathways of antigen processing and presentation
2. Components and pathways of Complement System
3. Properties, types and functions of cytokines
4. Monoclonal antibodies: Production and applications
5. General introduction to vaccines, Various types/generations of vaccines

#### **Unit 3: Basics of Biotechnology**

1. Recombinant DNA Technology, Restriction enzymes, DNA ligase, Polymerase etc.
2. Principles of Gene Cloning, Cloning Vehicles: Plasmids, Cosmids, Lambda phage. Selectable and Screening markers. Expression vector
3. Genomic and cDNA library, Methods of gene delivery, DNA Fingerprinting and DNA microarrays, Blue-white screening.

#### **Unit 4: Applied Biotechnology I**

1. Animal Tissue Culture: Culture media, Cell lines and applications, Transgenic animals, Gene therapy, Gene Knockout, Animal cloning
2. Gene Therapy.
3. Production of recombinant proteins:

#### **Unit 5: Applied Biotechnology II**

1. Application of computer in biology. Applications and Limitations of Bioinformatics Introduction to biological databases; Primary, secondary and composite databases; Drug discovery method (Basic concepts)
2. Importance, Goal, Scope; Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics.



**Course Outcome:** *Students will be able to demonstrate a comprehensive understanding of immunology and biotechnology, and apply their knowledge to address challenges in animal health and biomedical research.*

**Suggested readings:**

- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
- David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
- Abbas, K. Abul and Lichtman H. Andrew (2003-) Cellular and Molecular Immunology. V Edition. Saunders Publication.
- Coico R., and Sunshine G (2015). Immunology: A short course, VII Edition. WILEY Blackwell
- Brown T. A (2016). Gene Cloning & DNA Analysis: An Introduction, VIII Edition. WILEY Blackwell
- Thieman WJ and Palladino MA (2015). Introduction To Biotechnology. III Edition. Pearson India
- Glick BR, Patten CL (2022). Molecular Biotechnology: Principles and Applications of Recombinant DNA. VI Edition. ASM Press

## **ZOO: DSC-402**

Course Title: **Toxicology and Environmental Monitoring**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objectives:** *To understand the principles of toxicology and to acquire knowledge of environmental monitoring techniques*

### **Unit 1: Toxicology - I**

1. Introduction of toxicology – branches of toxicology
2. Classification of toxicants
3. Toxic agents – pesticides, radiation, environmental carcinogens, poisons and metals
4. Food additives

### **Unit 2: Toxicology - II**

1. Environmental pollution – sources and types of pollution
2. Air pollution – causes, effects and control of air pollution
3. Water pollution – causes, effects and control of water pollution
4. Soil pollution – causes, effects and control of soil pollution
5. Noise pollution – causes, effects and control of noise pollution

### **Unit 3: Environmental monitoring**

1. Ambient air monitoring: Methods of collection of gases and particulate pollutants
2. Methods of collection of water samples and analysis of physicochemical characteristics
3. Methods of collection of soil samples and analysis of physicochemical characteristics
4. Bio-monitoring and Bio-indication



#### **Unit 4: Adaptive physiology - I**

1. Adaptations, Stress and strain
2. Acclimation and acclimatization
3. Physiological adaptation to osmotic and ionic stress
4. Mechanism of cell volume regulation

#### **Unit 5: Adaptive physiology - II**

1. Osmoregulation in freshwater and marine environment Digestive system adaptations for different diets
2. Osmoregulation in terrestrial environment
3. Temperature regulation in animals – ectotherms and endotherms
4. Bioluminescence in animals

**Course Outcome:** *Students will be able to assess and mitigate the impacts of toxins on the environment and understand the importance of environmental monitoring in maintaining ecosystem health.*

#### **Suggested Readings**

- C.N. Samyer, P.L. McCarthy and G.E. Parkin, 2002. Chemistry for Environmental Engineering and Science. John Harvey Press
- H.H. Ramp, 2000. Laboratory manual for the extinction of water, waste water and soil. Wiley-VCH
- K. Pansey, J.P. Shukla and S.P. Trivedi, 2006. Fundamentals of Toxicology. New Central Book Agency(P) Ltd.
- Krut Schmidt-Nielsen, 2002. Animal Physiology- Adaptation and Environment, Cambridge University Press
- D. Randall, W. Burgger and K. French, 2001. Eckert's Animal Physiology: Mechanisms and Adaptations. W.H. Freeman & Co Ltd.

### **ZOO: DSC-403**

Course Title: **Animal Behavior and Chronobiology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To understand principles and mechanisms underlying animal behaviour.*

#### **Unit 1: Introduction to Animal Behaviour**

1. Origin and history of Ethology
2. Brief profiles of Karl Von Frisch, Ivan Pavlov, Konrad Lorenz and Niko Tinbergen, Proximate and ultimate causes of behaviour,
3. Methods and recording of animal behaviour

#### **Unit 2: Patterns of Behaviour**

1. Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns;
2. Instinct vs. Learnt Behaviour;
3. Associative learning, classical and operant conditioning, Habituation, Imprinting



### Unit 3: Social and Sexual Behaviour

1. Social Behaviour: Concept of Society; Communication and the senses;
2. Altruism; Insects' society with Honeybee as example;
3. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice,
4. Intra-sexual selection (male rivalry), Inter-sexual selection (female choice)

### Unit 4: Introduction to Chronobiology

1. Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period.
2. Biological clocks: Adaptive significance of biological clocks;
3. Chronopharmacology, Chronomedicine, Chronotherapy, Role of melatonin

### Unit 5: Biological Rhythm

1. Types and characteristics of biological rhythms: Short- and Long- term rhythms;
2. Circadian rhythms, Tidal rhythms, Lunar rhythms, Circannual rhythms; Concept of synchronization and masking
3. Photoperiod and regulation seasonal reproduction of vertebrates

**Course Outcome:** *Students will be able to explain and predict animal behaviour patterns, and understand the importance of chronobiology in maintaining biological rhythms.*

### Suggested Readings:

- Manning A. and Dawkins, MS (2016). An Introduction to Animal Behaviour, Cambridge University Press India Private Limited
- Alcock J, Sherman PW (2005). Animal Behaviour, Sinauer Associate Inc
- Dunlap JC (2004). Chronobiology Biological Timekeeping. Sinauer Associates, Inc.
- Vinod Kumar (2002). Biological Rhythms: Narosa Publishing House, Delhi/ Springer-Verlag
- Attenborough D (2022). The Trials of Life: A Natural History of Animal Behaviour. William Collins

## ZOO: DSC-404

Course Title: **Practical – V (Immunology, Biotechnology, Toxicology and Environmental Monitoring, Animal Behaviour)**

Credits: 4

Contact hours: 60

Marks: 100

**Learning Objectives:** *To get practical understanding on the the principles of immunology, biotechnology, toxicology and environmental monitoring and animal behaviour.*

### Immunology:

1. Demonstration of lymphoid organs through audio-visual aids
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination.
5. Demonstration of ELISA and Immuno-electrophoresis through audio-visual aids

**Biotechnology:**

1. Basic quality control measures and aseptic techniques in tissue culture.
2. Plant and Animal tissue culture media and their preparation.
3. Demonstration of Leukocyte culture technique from peripheral blood cells.

**Toxicology and Environmental Monitoring:**

1. Determination of BOD and COD of water from different sources
2. Determination of LC50/LD50 of selected pollutants in suitable indicator aquatic species like fish, water flea or tadpoles

**Animal Behaviour:**

1. To study nests and nesting habits of the birds and social insects.
2. To study geotaxis behaviour in earthworm.
3. To study the phototaxis behaviour in insect larvae.
4. Visit to National Park/ Wildlife sanctuary/ Biodiversity park/Places of Zoological importance to study Animal behaviour and submission of an academic field report on such visits/Project work.

**Course Outcome:** *Students will be able to demonstrate proficiency in practical techniques of immunology, biotechnology, toxicology, environmental monitoring, and analyzing animal behavior data.*

## **ZOO: DSM-401**

Course Title: **Evolution and Adaptation**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objective:** *To understand the principles of evolutionary biology and their application to the diversity and adaptation of animal species.*

**Unit 1: Origin, theories and Evidences**

1. Life's Beginnings: Chemogeny, RNA world, Biogeny
2. Origin of photosynthesis, Evolution of eukaryotes
3. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism
4. Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale)

**Unit 2: Population Genetics**

1. Concept of gene pool, gene frequency and genotype frequency
2. Hardy-Weinberg Law: statement and derivation of equation
3. Genetic Drift: founder's effect, bottleneck phenomenon
4. Role of Migration and Mutation in changing allele frequencies



### **Unit 3: Mechanism of Speciation**

1. Product of evolution: Micro evolutionary changes (inter-population variations, clines, Races; Species concept)
2. Isolating mechanisms, modes of speciation—allopatric, sympatric
3. Adaptive radiation / macroevolution (exemplified by Galapagos finches and mammals)

### **Unit 4: Evolution of Horse and Human**

1. Evolution of horse
2. Origin and evolution of man, Unique hominid characteristics contrasted with primate characteristics, primate phylogeny from *Dryopithecus* leading to *Homo sapiens*
3. Phylogenetic trees, Construction of phylogenetic trees and their interpretation

### **Unit 5: Adaptations**

1. Introduction to adaptations – physical, physiological and habitat adaptations and their significance
2. Different types of adaptation: Aquatic, Volant, Cursorial, Fossorial, Arid, and Arboreal
3. Colouration and mimicry

**Course Outcome:** *Students will demonstrate a comprehensive understanding of evolutionary biology, its relevance to the study of life, and the ability to critically evaluate and explain evolutionary processes and patterns.*

### **Suggested Readings:**

- Douglas, J. Futuyma (2006). Evolutionary Biology. Sinauer Associates Inc.,US.; III Revised Edition
- Ridley, M (2004). Evolution. III Edition Blackwell publishing
- Hall, B.K. and Hallgrimson, B (2008). Evolution. IV Edition. Jones and Barlett Publishers.
- Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin,
- Rastogi VB (2018). Organic Evolution. III Edition. MedTech
- Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell



## SEMESTER - VIII

### ZOO: DSC-451

Course Title: **Research methodology/ Biotechniques & Biostatistics**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning objectives:** *To understand various biotechniques statistical tools used in biology*

#### Unit 1: Microscopic and Spectroscopic Techniques

1. Concept of Magnification, Resolving power, Contrast and Fluorescence
2. Light Microscope: Basic working principles and applications of compound microscope, Phase contrast microscope, Dark field microscope, Fluorescence microscope
3. Electron Microscope: Working principles and applications of SEM and TEM.
4. Spectroscope: Basic principles and applications of UV- Spectroscope, IR- Spectroscope, and NMR in biological field

#### Unit 2: Separation Techniques

1. Chromatography: Principle and applications of Paper chromatography, TLC, Column Chromatography, Ion exchange Chromatography, Affinity chromatography and HPLC
2. Centrifugation: Principles and applications; Density gradient Centrifugation
3. Electrophoresis: Principle, Types (Agarose, PAGE, 2D) and their applications; Immunoelectrophoresis

#### Unit 3: Detection Technique and Tracers

1. PCR: Basic working principles and applications of RT-PCR, Quantitative PCR and Real-Time PCR, limitations, RFLP
2. Immunoassay: Working principles and applications of RIA, ELISA, Blotting (Western, Southern and Northern) techniques
3. *In situ* hybridization, FISH
4. Radioisotopes: Types and applications in tracing

#### Unit 4: Biostatistics I

1. Data, Types of Data, Frequency distribution for discrete and continuous data
2. Measures of Central Tendency: Mean (AM, GM, HM), Median, Mode
3. Measures of Dispersion (Range, Mean deviation, Standard deviation, Variance), Skewness and Kurtosis

#### Unit 5: Biostatistics II

1. Correlation, uses and interpretations
2. Regression: Simple linear regression, lines of regression, interpretation of the regression coefficients
3. Testing of Hypothesis: Types of hypotheses, Types of error, Standard error of mean, Sampling distribution (t-test and Chi-square test, F-test)



**Course outcome:** *Students will be able to effectively utilize biotechniques and biostatistics to conduct and analyze zoological research.*

**Suggested Readings:**

- Hofmann A, Clokie S (2018). Wilson and Walkers Principles and Techniques of Biochemistry and Molecular Biology. VIII Edition. Cambridge University Press.
- Dillon PF (2012). Biophysics: A Physiological Approach. Cambridge University Press
- Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- Gupta PK (2022). Biotechnology, Immunology, Biotechniques & Biostatistics. I Edition. Medtech Science Press
- Rana SVS (2018). Biotechniques (Theory & Practice). III Edition. Rastogi Publications
- Zar JH (2014). Biostatistical Analysis. V Edition. Pearson Education India

**ZOO: DSC-452**

Course Title: **Fish and Fisheries**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objectives:** *To understand the principles and practices of fishery management and sustainable fishing techniques.*

**Unit 1: Introduction and Classification**

1. General description of fish; Account of systematic classification of fishes
2. Classification based on feeding habit, habitat and manner of reproduction.

**Unit 2: Morphology and Physiology**

1. Types of fins and their modifications; Locomotion in fishes; Hydrodynamics;
2. Types of Scales, Use of scales in Classification and determination of age of fish
3. Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy
4. Osmoregulation in fishes; Electric organs; Bioluminescence; Schooling;
5. Parental care; Migration

**Unit 3: Fisheries**

1. Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Bay of Bengal
2. Fishing crafts and Gears; Depletion of fisheries resources
3. Application of remote sensing and GIS in fisheries; Fisheries law and regulations

**Unit 4: Aquaculture**

1. Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish
2. Pen and cage culture; Polyculture; Composite fish culture; Brood stock management
3. Induced breeding of fish; Management of finfish hatcheries;
4. Preparation and maintenance of fish aquarium; Preparation of compound diets for fish  
Role of water quality in aquaculture





## Unit 5: Fish Diseases and fishery By-products

1. Fish diseases: Bacterial, viral and parasitic; EUS
2. Preservation and processing of harvested fish
3. Fishery by-products

**Course Outcome:** *Students will be able to analyze and evaluate fish populations, habitats, and fisheries, and propose sustainable strategies for their conservation and management.*

### Suggested Readings:

- Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK
- von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
- C.B.L. Srivastava, Fish Biology, Narendra Publishing House
- J.R. Norman, A history of Fishes, Hill and Wang Publishers
- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House

## ZOO: DSC-453

Course Title: **Applied Zoology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objectives:** *To know the economic importance of animals and their applications in various human activities.*

### Unit 1: Medical Zoology

1. Concept of host and parasite, host-parasite relationship, zoonotic diseases with examples, epidemiology, communicable and non-communicable diseases with examples
2. Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*
3. Life cycle and pathogenicity of *Fasciola hepatica* and *Wuchereria bancrofti*

### Unit 2: Applied Entomology

1. Beneficial and Harmful insects
2. Integrated pest management
3. Culture of lac insect for lac production

### Unit 3: Animal Husbandry I

1. Importance of animal husbandry in agriculture and food production
2. Overview of different livestock organisms used in Assam and their characteristics
3. Artificial insemination in cattle population: Process, advantages, limitations
4. Common diseases affecting livestock and their prevention; Vaccination schedules



## Unit 4: Animal Husbandry II

1. Prawn and Pearl Oyster culture
2. Poultry farming, common diseases and preventive measures
3. Selection criteria for dairy animals, balanced diets and feeding practices for optimal milk production, milking techniques and equipment, Managing reproductive cycles and lactation in dairy cows
4. Ethical considerations in using animals for research, and animal husbandry practices

## Unit 5: Tool and Techniques in Wildlife Conservation

1. Methods for habitat assessment and mapping
2. Habitat restoration techniques and approaches
3. Wildlife monitoring – Acoustic, Radio telemetry, GPS tracking, Conservation drones and Camera trapping
4. Geospatial analysis, Artificial intelligence and machine learning in conservation

**Course Outcome:** *Students will be able to apply zoological concepts and techniques to address practical challenges in areas such as wildlife conservation, animal husbandry, and sustainable resource management.*

### Suggested Readings:

- Paniker CKJ, Ghosh S (2018). Paniker's Textbook of Medical Parasitology. Jaypee Brothers Medical Publishers, 8<sup>th</sup> Edition
- Chatterjee KD (2019). Parasitology (Protozoology and Helminthology). CBS, 13<sup>th</sup> Edition
- Selby C. Beekeeping: *A Beginner's Guide to Backyard Beekeeping*. 2<sup>nd</sup> Edition
- Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
- Ullal SR, Narasimhanna MN (1981). Handbook of practical sericulture. Central Silk Board, Bombay.
- Shukla GS and Upadhyay VB (2016). Economic Zoology. Rastogi Publications. 5<sup>th</sup> Edition
- Islam A (2020). A Textbook of Economic Zoology. Dreamtech Press
- Mathialagan P (2020). Textbook of Animal Husbandry: Extension Education. CBS Publishers & Distributors; 4<sup>th</sup> Edition
- Banerjee GC (2019). Textbook of Animal Husbandry. Oxford; 8<sup>th</sup> Edition
- Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5<sup>th</sup> Edition. The Wildlife Society, Allen Press.
- Sutherland WJ. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
- Fang F, Tambe M, Dilkina B, Plumptre AJ (2019). Artificial Intelligence and Conservation. Cambridge University Press



## **ZOO: DSC-454**

Course Title: **Comparative Anatomy and Sense Organs**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning Objectives:** *To understand comparative structure and functions of different organs across vertebrate series.*

### **Unit 1: Integumentary and Skeletal Systems**

1. Structure, functions and derivatives of integument in vertebrates
2. Overview of axial and appendicular skeleton of vertebrates
3. Evolution of Visceral arches

### **Unit 2: Digestive and Respiratory Systems**

1. Comparative account of alimentary canal and associated glands in vertebrates
2. Comparative account of respiratory organs in fish, amphibians, birds and mammals

### **Unit 3: Circulatory and Urinogenital Systems**

1. Evolution of heart and aortic arches in vertebrates
2. Succession of kidney in vertebrates, Evolution of urinogenital ducts in vertebrates

### **Unit 4: Nervous Systems**

1. Comparative account of brain in vertebrates
2. Autonomic nervous system, Spinal cord, Cranial nerves in mammals

### **Unit 5: Sense Organs**

1. Classification of receptors, chemoreceptors, mechanoreceptors and magnetoreception
2. Brief account of visual receptors in human
3. Brief account of auditory receptors in human

**Course Outcome:** *Students will gain a comprehensive understanding of comparative anatomy and sense organs of vertebrates, enabling them to interpret and evaluate the anatomical diversity and sensory adaptations in the animal kingdom.*

### **Suggested Readings:**

- Kardong K (2018). *Vertebrates: Comparative Anatomy, Function, Evolution*. McGraw Hill; 8<sup>th</sup> Edition
- Kent GC, Carr RK (2000). *Comparative Anatomy of the Vertebrates*. McGraw Hill Higher Education; 9<sup>th</sup> Edition
- Pough H. *Vertebrate life*. Pearson International; 8<sup>th</sup> Edition
- Hildebrand M (2001). *Analysis of Vertebrate Structure*. John Wiley & Sons Inc; 5<sup>th</sup> Edition.



## **ZOO: DSM-451**

Course Title: **Biological Techniques**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

**Learning objectives:** *To understand various biotechniques statistical tools used in biology*

### **Unit 1: Microscopic and Spectroscopic Techniques**

1. Concept of Magnification, Resolving power, Contrast and Fluorescence
2. Light Microscope: Basic working principles and applications of compound microscope, Phase contrast microscope, Dark field microscope, Fluorescence microscope
3. Electron Microscope: Working principles and applications of SEM and TEM.
4. Spectroscope: Basic principles and applications of UV- Spectroscope, IR- Spectroscope, and NMR in biological field

### **Unit 2: Separation Techniques**

1. Chromatography: Principle and applications of Paper chromatography, TLC, Column Chromatography, Ion exchange Chromatography, Affinity chromatography and HPLC
2. Centrifugation: Principles and applications; Density gradient Centrifugation
3. Electrophoresis: Principle, Types (Agarose, PAGE, 2D) and their applications; Immunoelectrophoresis

### **Unit 3: Detection Technique and Tracers**

1. PCR: Basic working principles and applications of RT-PCR, Quantitative PCR and Real-Time PCR, limitations, RFLP
2. Immunoassay: Working principles and applications of RIA, ELISA, Blotting (Western, Southern and Northern) techniques
3. *In situ* hybridization, FISH
4. Radioisotopes: Types and applications in tracing

### **Unit 4: Biostatistics I**

1. Data, Types of Data, Frequency distribution for discrete and continuous data
2. Measures of Central Tendency: Mean (AM, GM, HM), Median, Mode
3. Measures of Dispersion (Range, Mean deviation, Standard deviation, Variance), Skewness and Kurtosis

### **Unit 5: Biostatistics II**

1. Correlation, uses and interpretations
2. Regression: Simple linear regression, lines of regression, interpretation of the regression coefficients
3. Testing of Hypothesis: Types of hypotheses, Types of error, Standard error of mean, Sampling distribution (t-test and Chi-square test, F-test)

**Course outcome:** *Students will be able to effectively utilize biotechniques and biostatistics to conduct and analyze zoological research.*



### **Suggested Readings:**

- Hofmann A, Clokie S (2018). Wilson and Walkers Principles and Techniques of Biochemistry and Molecular Biology. VIII Edition. Cambridge University Press.
- Dillon PF (2012). Biophysics: A Physiological Approach. Cambridge University Press
- Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- Gupta PK (2022). Biotechnology, Immunology, Biotechniques & Biostatistics. I Edition. Medtech Science Press
- Rana SVS (2018). Biotechniques (Theory & Practice). III Edition. Rastogi Publications
- Zar JH (2014). Biostatistical Analysis. V Edition. Pearson Education India