

HONOURS COURSES AT A GLANCE

SUBJECT: ZOOLOGY

DISCIPLINE SPECIFIC CORE (14 PAPER)

Number	Semester	Title of the course	Credit	
			Theory	Practical/ Tutorial
DSC-H-ZOO-1	1st	Non-chordates I: Protista to Pseudocoelomates	4	2
DSC-H-ZOO-2		Perspectives in Ecology	4	2
DSC-H-ZOO-3	2nd	Non-chordates II: Coelomates	4	2
DSC-H-ZOO-4		Cell Biology	4	2
DSC-H-ZOO-5	3rd	Diversity of Chordates	4	2
DSC-H-ZOO-6		Physiology: Controlling and coordinating systems	4	2
DSC-H-ZOO-7		Biochemistry of Metabolic Processes	4	2
DSC-H-ZOO-8	4th	Comparative Anatomy of vertebrates	4	2
DSC-H-ZOO-9		Physiology: Life Sustaining Systems	4	2
DSC-H-ZOO-10		Biochemistry of Metabolic Processes	4	2
DSC-H-ZOO-11	5th	Molecular Biology	4	2
DSC-H-ZOO-12		Principles of Genetics	4	2
DSC-H-ZOO-13	6th	Developmental Biology	4	2
DSC-H-ZOO-14		Evolutionary Biology	4	2

DISCIPLINE SPECIFIC ELECTIVE (4 PAPERS)

Number	Semester	Title of the course	Credit	
			Theory	Practical/ Tutorial
DSE-H-ZOO-1	5th	Animal behavior and Chronobiology	4	2
DSE-H-ZOO-2		Fish and Fisheries	4	2
DSE-H-ZOO-3	6th	Immunology	4	2
DSE-H-ZOO-4		Wild Life conservation and management	4	2

GENERIC ELECTIVE (4PAPERS)

Number	Semester	Title of the course	Credit	
			Theory	Practical/ Tutorial
GE-ZOO-1	1st	Animal Diversity	4	2

GE-ZOO-2	2nd	Human Physiology	4	2
GE-ZOO-3	3rd	Environment and Public Health	4	2
GE-ZOO-4	4th	Aquatic Biology	4	2

SKILL ENHANCEMENT COURSES-LIST-A (Any 1 paper)

Number	Semester	Title of the course	Credit
			Theory
SEC-ZOO-H-1	3rd	Apiculture	4
SEC-ZOO-H-2	3rd	Sericulture	4

CORE COURSE I NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

Objective: This Course is designed to introduced the students to have indepth knowledge about invertebrates of different phyla.

THEORY	(Credits 4)
Unit 1: Protista, Parazoa and Metazoa	10
General characteristics and Classification up to classes of protozoa	
Life cycle and pathogenicity of <i>Plasmodium vivax</i> and <i>Entamoeba histolytica</i>	
Reproduction in Protista	
Unit 2: Porifera and cnidaria	17
General characteristics and Classification up to classes	
Canal system and spicules in sponges	
General characteristics and Classification up to classes	
Polymorphism in Cnidaria	
Corals and coral reefs	
Unit 3: Platyhelminthes	10
General characteristics and Classification up to classes	
Life cycle and pathogenicity of <i>Fasciola hepatica</i> and <i>Taenia solium</i>	
Unit 4: Nematelminthes	11
General characteristics and Classification up to classes	
Life cycle, and pathogenicity of <i>Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i>	
Parasitic adaptations in helminthes	

Outcome: Students would be able to represent invertebrates of different categories which affect the ecosystem in various ways.

NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

PRACTICALS

(Credits 2)

1. Study of whole mount/ culture of *Amoeba* and *Paramecium* to observe, Binary fission and Conjugation in *Paramecium*
2. Examination of pond water collected from different places for diversity in protista
3. Study of *Sycon* (T.S. and L.S.), *Hyalonema*, *Euplectella*, *Spongilla*
4. Study of *Obelia*, *Physalia*, *Millepora*, *Aurelia*, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium*, *Pennatula*, *Fungia*, *Meandrina*, *Madrepora*
5. Study of adult *Fasciola hepatica*, *Taenia solium* and their life cycles (Slides/microphotographs)
6. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs)
7. To submit a Project Report on any related topic on life cycles/coral/ coral reefs.

Note: Classification to be followed from “Ruppert and Barnes (2006) *Invertebrate Zoology*, 8th edition, Holt Saunders International Edition”

SUGGESTED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International 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
- Hyman Series - Invertebrates
- Parker and Haswell: Text book of Zoology (Vol I).

CORE COURSE II PRINCIPLES OF ECOLOGY

Objective: This core course would make students to have indepth knowledge about the eco system and their functioning, so that they will be crusader of environmental sustainability.

THEORY

(Credits 4)

Unit 1: Introduction to Ecology

6

Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors (Light and Temperature)

Unit 2: Population

18

Unitary and Modular populations

Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion
Exponential and logistic growth, equation and patterns, r and K strategies
Population interactions, Gause’s Principle with laboratory and field examples, competition and Predation, Symbiosis, Parasitism, mutualism

Unit 3: Community

12

Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example

Theories pertaining to climax community

Unit 4: Ecosystem

14

Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies
Nutrient and biogeochemical cycle with examples of Nitrogen and Carbon cycle

Outcome: Students will acquire knowledge of intricate relationship of main and environment.

PRINCIPLES OF ECOLOGY

PRACTICALS

(Credits 2)

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), Chemical Oxygen Demand and free CO₂
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary and/or any place of local Ecological Importance
5. Seminar presentation and Report

SUGGESTED READINGS

- Colinvaux, 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 Pres

CORE COURSE III NON-CHORDATES II: COELOMATES

Objective: This course is so designed to introduced students about the higher phyla of invertebrates and to know about taxonomy.

THEORY

(Credits 4)

Unit 1: Introduction to Coelomates and Annelida

Evolution of coelom and metamerism 12

General characteristics and Classification up to classes

Excretion in Annelida

Unit 2: Arthropoda and Onychophora 14

General characteristics and Classification up to classes

Vision and Respiration in Arthropoda

Metamorphosis in Insects

General characteristics and Evolutionary significance of Peripatus

Unit 3: Mollusca 10

General characteristics and Classification up to classes

Respiration in Mollusca

Torsion and detorsion in Gastropoda

Pearl formation in bivalves

Unit 4: Echinodermata 12

General characteristics and Classification up to classes

Water-vascular system in Asteroidea

Larval forms in Echinodermata

Outcome: Students would be able to represent the various aspect of higher invertebrates phyla for future research

NON-CHORDATES II: COELOMATES

PRACTICAL

(Credits 2)

1. Study of following specimens:

Annelids - *Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria*

Arthropods - *Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta*, termites and honey bees

Onychophora - *Peripatus*

Molluscs - *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus*

Echinodermates - *Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria* and *Antedon*

2. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm

3. Demonstration of excretory system of Annelids through computer model /photographs

4. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

SUGGESTED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International 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

CORE COURSE IV CELL BIOLOGY

Objective: *This course is to make students aware about the cytology and to know about the functioning of cells and components.*

THEORY

(Credits 4)

Unit 1: Overview of Cells and Plasma Membrane and Cell Signalling

6

Unit 1: Typical Animal cell, Cell theory, Difference between Prokaryotic and Eukaryotic cells, General Structure and Reproduction of virus and Bacteria, Origin of Eukaryotic cells **16**
Various models of plasma membrane structure

Transport across membranes: Active and Passive transport, Facilitated transport

Cell junctions: Tight junctions, Desmosomes, Gap junctions. Cell signalling

Unit 2: Endomembrane System and Mitochondria and peroxisomes

Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes **20**

Mitochondria: Structure, Semi-autonomous nature, Glycolysis, TCA cycle,

Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis

Peroxisomes

Unit 3: Nucleus **10**

Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus

Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Unit 4: Cell Division **8**

Mitosis, Meiosis, Cell cycle and its regulation

Outcome: *Students will acquire knowledge about the cells and apply their ability to design research work.*

CELL BIOLOGY

PRACTICAL

(Credits 2)

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 blood cells/cheek cells.
- 4. Demonstration of permanent slide and/or models:
 - i DNA
 - ii RNA
 - iii Protein, Carbohydrate, Lipid
- 5. Seminar presentation and report preparation

SUGGESTED READINGS

- Karp, G. (201). *Cell Biology*. VII Edition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- 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.
- 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 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.
- Cytology by Cohn

CORE COURSE V DIVERSITY OF CHORDATA

Objective: This course is so designed to make students aware of higher organisms and their taxonomy to correlate the evolutionary trend in organisms.

THEORY	(Credits 4)
Unit 1: Introduction to Chordates and Origin of Chordata	5
General characteristics and outline classification	
Dipleurula concept and the Echinoderm theory of origin of chordates	
Unit 2: Protochordata ,Agnatha and Pisces	
General characteristics of Hemichordata, Urochordata and Cephalochordata;	
Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata	
General characteristics and classification of cyclostomes up to class	16
General characteristics of Chondrichthyes and Osteichthyes, classification up to order Migration, Evolutionary significance of Dipnoi	
Unit 3: Amphibia ,Reptilia and Aves	19
Origin of <i>Tetrapoda</i> (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians	
General characteristics and classification up to order; Affinities of <i>Sphenodon</i> ; Poison apparatus and Biting mechanism in snakes	
General characteristics and classification up to order	
Flight adaptations and Migration in birds	
Unit 4: Mammals and Zoogeography	13
General characters and classification up to order; Affinities of Prototheria;	
Adaptive radiation with reference to locomotory appendages	
Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms	

Outcome: An indepth study for better application of mind to further approach towards biology.

DIVERSITY OF CHORDATA

(Credits 2)

PRACTICAL

1. Protochordata

Balanoglossus, *Herdmania*, *Branchiostoma*, Colonial Urochordata Sections of *Balanoglossus* through proboscis and branchiogenital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions. Permanent slide of *Herdmania* spicules

2. Agnatha

Petromyzon, *Myxine*

3. Fishes

Scoliodon, *Sphyrna*, *Pristis*, *Torpedo*, *Chimaera*, *Mystus*, *Heteropneustes*, *Labeo*, *Exocoetus*, *Echeneis*, *Anguilla*, *Hippocampus*, *Tetrodon/Diodon*, *Anabas*, Flat fish

4. Amphibia

Ichthyophis/Ureotyphlus, *Necturus*, *Bufo*, *Hyla*, *Alytes*, *Salamandra*

5. Reptilia

Chelone, *Trionyx*, *Hemidactylus*, *Varanus*, *Uromastix*, *Chamaeleon*, *Ophiosaurus*, *Draco*, *Bungarus*, *Vipera*, *Naja*, *Hydrophis*, *Zamenis*, *Crocodylus* Key for Identification of poisonous and non-poisonous snakes

6. Aves

Study of six common birds from different orders. Types of beaks and claws

7. Mammalia

Sorex, Bat (Insectivorous and Frugivorous), *Funambulus*, *Loris*, *Herpestes*, *Erinaceous*.

Study of feathers of bird

Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)/ Submission of album of local species (chordates)

Classification from Young, J. Z. (2004) to be followed

SUGGESTED READINGS

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger Pub Co.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition.

Jones and Bartlett Publishers Inc.

CORE COURSE VI
ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

Objective: This course would make students to know about the functioning of various system of organisms and their interrelationship for well-coordinated function.

THEORY **(Credits 4)**

Unit 1: Tissues and Bone and Cartilage

Structure, location, classification and functions of epithelial tissue (Elementary idea) **10**
Structure and types of bones and cartilages, Ossification, bone growth and resorption

Unit 2: Nervous System and Muscle **22**

Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc.
Histology of different types of muscle; Ultra structure and function of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus

Unit 3: Reproductive System **10**

Histology of testis and ovary; Physiology of male and female reproduction; Ovarian cycle.

Unit 4: Endocrine System **18**

Endocrine glands - pituitary, thyroid, pancreas and adrenal hormones, Placental hormones. Mechanism of hormone action.

Outcome: This course would make students well equipped with the process of body and its functioning.

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

PRACTICALS **(Credits 2)**

1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
2. Study of permanent slides/ photographs/computer model of Squamous epithelium, Striated muscle fibres and nerve cells
3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
5. Microtomy: Preparation of permanent slides.

SUGGESTED BOOKS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Herculat Asia PTE Ltd. /W.B. Saunders Company.
- 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.

CORE COURSE VII FUNDAMENTALS OF BIOCHEMISTRY

Objective: *This course will make students to know about the biochemical features in organisms and self.*

THEORY **(CREDITS 4)**

Unit 1: Carbohydrates and Lipids **16**

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids.

Unit 2: Proteins **14**

Amino acids: Structure, Classification and General properties .

Physiological importance of essential and non-essential amino acids

Proteins: Structure of protein, Bonds stabilizing protein structure.

Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants

Unit 3: Nucleic Acids **12**

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids

Cot Curves: Types of DNA and RNA (si RNA, mi RNA)

Unit 4: Enzymes **18**

Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action

Outcome: *Students will be able to conduct research work efficiently.*

FUNDAMENTALS OF BIOCHEMISTRY

PRACTICAL

(CREDITS 2)

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH, temperature and inhibitors on the action of salivary amylase.
5. Demonstration of proteins separation by SDS-PAGE (Project Report).
6. Seminar presentation and Report preparation.

SUGGESTED READING

- 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.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.
- 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.

CORE COURSE VIII COMPARATIVE ANATOMY OF VERTEBRATES

Objective: This core course is designed to make students to know the anatomical features of various organisms and their evolutionary trend.

THEORY	(CREDITS 4)
Unit 1: Integumentary System and Skeletal System	16
Structure, functions and derivatives of integument	
Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches	
Unit 2: Digestive System and Respiratory System	16
Alimentary canal and associated glands	
Skin, gills, lungs and air sacs; Accessory respiratory organs	
Unit 3: Circulatory System and Urinogenital System	14
Evolution of heart and aortic arches	
Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	
Unit 4: Nervous System and Sense Organs	14
Comparative account of brain	
Autonomic nervous system, Spinal cord, Cranial nerves in vertebrates	
Classification of receptors, Tonic and phasic receptors, receptor potential.	

Outcome: Students would be able to know and compare the different anatomical aspect of various organisms.

COMPARATIVE ANATOMY OF VERTEBRATES

PRACTICAL	(CREDITS 2)
1. Disarticulated skeleton of Frog, <i>Varanus</i> , Fowl, Rabbit	
2. Carapace and plastron of turtle /tortoise (Chart/computer model)	
3. Mammalian skulls (Chart/computer model): One herbivorous and one carnivorous animal	
4. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)	
5. Project on skeletal modifications in vertebrates (may be included if dissection not permitted)	
6. Field study report	

SUGGESTED READINGS

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

- Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons
- Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House

CORE COURSE IX
ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS.

Objective: This course will make students to know the functioning of various organs and their inter - relationship.

THEORY	(Credits 4)
Unit 1: Physiology of Digestion and Physiology of Respiration	26
Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins. Hormonal control of secretion of enzymes in Gastrointestinal tract.	
Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration	
Unit 2: Renal Physiology	8
Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance (mammal)	
Unit 3: Blood	14
Components of blood and their functions; Haemopoiesis	
Structure and functions of haemoglobin. Blood groups: Rh factor, ABO and MN	
Haemostasis: Blood clotting system, Kallikrein-Kininogen system, Complement system and Fibrinolytic system,	
Unit 4: Physiology of Heart	12
Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses	
Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation (mammal)	

Outcome: Students will acquire the knowledge of functioning of different body parts.

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

PRACTICALS	(CREDITS 2)
1. Enumeration of red blood cells and white blood cells using haemocytometer	
2. Estimation of haemoglobin using Sahli's haemoglobinometer	
3. Preparation of haemin and haemochromogen crystals	
4. Recording of frog's heart beat under <i>in situ</i> and perfused conditions*	
5. Recording of blood pressure using a sphygmomanometer	
6. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney	

SUGGESTED READINGS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Herculat Asia PTE Ltd. W.B. Saunders Company.
- 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

CORE COURSE X BIOCHEMISTRY OF METABOLIC PROCESSES

Objective: It is a well-designed course to make students to know about the various metabolic processes.

THEORY	(CREDITS 4)
Unit 1: Overview of Metabolism	10
Catabolism vs Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms	
Unit 2: Carbohydrate Metabolism	14
Glycolysis, TCA cycle and its regulation, oxidative phosphorylation, Gluconeogenesis and biosynthesis of complex carbohydrates.	
Unit 3: Lipid Metabolism and Protein Metabolism	24
β -oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms. Catabolism of amino acids: Transamination, Deamination, Urea cycle.	
Unit 4: Oxidative Phosphorylation	10
Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System	

Outcome: The students can apply the acquired knowledge for higher study.

BIOCHEMISTRY OF METABOLIC PROCESS

PRACTICALS	(CREDITS 2)
1. Estimation of total protein in given solutions by Lowry's method.	
2. Detection of SGOT and SGPT in serum/ tissue	
3. To study the enzymatic activity of Trypsin and Lipase/urease.	
4. Study of oxygen consumption in animals	
5. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.	
6. Estimation of casein content in milk	
7. Seminar presentation and Report preparation	

SUGGESTED READINGS

- Cox, M.M and Nelson, D.L. (2008). *Lehninger 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.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.
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**CORE COURSE XI
MOLECULAR BIOLOGY**

Objective: This course would make students to know about internal mechanism of functioning of body parts at cellular level.

THEORY	(CREDITS 4)
Unit 1: DNA Replication	12
DNA structure and types. DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear <i>ds</i> -DNA, replication of telomeres	
Unit 2: Transcription and Translation	22
RNA polymerase, mechanism of transcription in prokaryotes and eukaryotes, Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation	
Unit 3: Post Transcriptional Modifications and Processing of Eukaryotic RNA and Gene Regulation	16
Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from <i>lac</i> operon and <i>trp</i> operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing	
Unit 4: DNA Repair Mechanisms and Genetically Modified organism	6
DNA repair(Excision, mismatch, recombination) Genetic engineering, Transgenic animal, DNA finger printing technology	

Outcome: Students will get the knowledge of molecular functioning of body parts.

MOLECULAR BIOLOGY

PRACTICAL	(CREDITS 2)
1. Study of Polytene chromosomes in <i>Drosophila</i> larvae/ slide	
2. Preparation of liquid culture medium (LB) .	
3. Estimation of the growth kinetics of <i>E. coli</i> by turbidity method	
4. Preparation of solid culture medium (LB) and growth of <i>E. coli</i> by spreading and streaking	
5. Demonstration of antibiotic sensitivity/resistance of <i>E. coli</i> and interpretation of results	
6. Quantitative estimation DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement) (Project work)	
7. Quantitative estimation of RNA using Orcinol reaction (Project work)	
8. Study and interpretation of electron micrographs/ photograph showing	
(a) DNA replication	
(b) Transcription	
(c) Split genes	

SUGGESTED READINGS

- 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.

- Cooper G. M. and Robert E. Hausman R. E. *The Cell: A Molecular Approach*, V Edition, ASM Press and Sinauer Associates.

- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

- Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.

- Lewin B. (2008). *Gene XI*, Jones and Bartlett
McLennan A., Bates A., Turner, P. and White M. (2015). *Molecular Biology IV* Edition. GS, Taylor and Francis Group, New York and London.

**CORE COURSE XII
PRINCIPLES OF GENETICS**

Objective: This course is so designed to have indepth knowledge of heredity.

THEORY	(CREDITS 4)
Unit 1: Mendelian Genetics and its Extension and Mutations	18
Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex influenced and sex-limited characters inheritance.	
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens	
Unit 2: Linkage, Crossing Over and Chromosomal Mapping and Sex Determination	16
Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity	
Chromosomal mechanisms of sex determination in <i>Drosophila</i> and Man	
Unit 3: Extra-chromosomal Inheritance and Polygenic Inheritance	9
Criteria for extra-chromosomal inheritance, Antibiotic resistance in <i>Chlamydomonas</i> , Mitochondrial mutations in <i>Saccharomyces</i> .	
Polygenic inheritance with suitable examples; simple numericals based on it.	
Unit 4: Biometry	9
Use and scope of Biometry, Frequency distribution, graphical representation of data (frequency polygon, histogram). Measures of central tendency: Mean, median, mode. Measures of variation: Standard deviation and standard error of mean. T-test and chi square test.	

Outcome: Students will acquire knowledge of gene and its function.

PRINCIPLES OF GENETICS

PRACTICALS	(CREDITS 2)
1. To study the Mendelian laws and gene interactions with suitable numerical problem.	
2. Chi-square analyses using seeds/beads/ <i>Drosophila</i> .	
3. Linkage maps based on data from conjugation, transformation and transduction.	
4. Linkage maps based on data from <i>Drosophila</i> crosses.	
5. Project work on study of human karyotype (normal and abnormal).	
6. Pedigree analysis of some human inherited traits.	
7. Statistical problems related to the theory.	
8. Seminar presentation and Report	
SUGGESTED READINGS	
● Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). <i>Principles of Genetics</i> . VIII Edition. Wiley India	
● Snustad, D.P., Simmons, M.J. (2009). <i>Principles of Genetics</i> . V Edition. John Wiley and Sons Inc	
● Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). <i>Concepts of Genetics</i> . X Edition. Benjamin Cummings	
● Russell, P. J. (2009). <i>Genetics- A Molecular Approach</i> . III Edition. Benjamin Cummings	
● Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. <i>Introduction to Genetic Analysis</i> . IX Edition. W. H. Freeman and Co	
● Fletcher H. and Hickey I. (2015). <i>Genetics</i> . IV Edition. GS, Taylor and Francis Group, New York and London.	

CORE COURSE XIII

DEVELOPMENTAL BIOLOGY

Objective: *The course is so designed for acquiring knowledge to know the process of reproduction and the development of embryo.*

THEORY

(CREDITS 2)

Unit 1: Introduction and Early Embryonic Development

32

Historical perspective and basic concepts: Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division
Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit 2: Late Embryonic Development

8

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)

Unit 3: Post Embryonic Development

12

Metamorphosis: Changes, hormonal regulations in amphibians;
Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories

Unit 4: Implications of Developmental Biology

8

Teratogenesis: Teratogenic agents and their effects on embryonic development; *In vitro* fertilization, Stem cell (ESC), Amniocentesis

Outcome: *Students will be benefited about their reproductive processes.*

DEVELOPMENTAL BIOLOGY

PRACTICALS

(CREDITS 2)

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
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 (Hamilton and Hamburger stages)
3. Window preparation of chick egg
4. Study of different sections of placenta (photomicrograph/ slides)
5. Preparation of permanent slides of egg/ developmental stages of fish and amphibia
6. Project report on *Drosophila* culture/chick embryo development

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
- Carlson, R. F. Patten's Foundations of Embryology
- Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

EVOLUTIONARY BIOLOGY

Objective: *This course is designed for better understanding of evolutionary trends in development of organisms with time.*

THEORY	(CREDITS 4)
Unit 1: Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Molecular (universality of genetic code and protein synthesising machinery, three domains of life, neutral theory of molecular evolution,	14
Unit 2: Sources of variations: Heritable variations and their role in evolution Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches	15
Unit 3: Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies	7
Unit 4: Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction Origin and evolution of man and horse.	8

Outcome: *Students will be equipped in evolutionary approach.*

EVOLUTIONARY BIOLOGY

PRACTICALS	(CREDITS 2)
1. Study of fossils (man and Archeopteryx) from models/ pictures 2. Study of homology and analogy from suitable specimens 3. Study and verification of Hardy-Weinberg Law with simple numerical. 4. Project on the role of natural selection and genetic drift in changing allele frequencies using simulation studies 5. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex. 6. Seminar and field study report	

SUGGESTED READINGS

- 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, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- Snustad. S Principles of Genetics.
- Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell

DISCIPLINE CENTRIC ELECTIVE COURSES

DSE 1

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

Objective: *The course is designed to make students to know about the behavioral aspect of organisms.*

THEORY

(Credits 4)

Unit 1: Introduction to Animal Behaviour

Origin and history of Ethology; Brief profiles and contributions of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Proximate and ultimate causes of behavior

Unit 2: Patterns of Behaviour

Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour, fixed action pattern; conditioned and unconditioned reflex, Habituation, Imprinting.

Unit 3: Social and Sexual Behaviour

Social Behaviour: Concept of Society; Communication and the pheromones; Altruism; Insects' society with Honey bee as example; Foraging in honeybee and advantages of the waggle dance. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology and Biological Rhythm

Historical developments in chronobiology; Adaptive significance of biological clocks
Types and characteristics of biological rhythms: Short- and Long- term rhythms;
Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms;
Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin.

Outcome: Students will get knowledge for interpretation of behavior of organisms.

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

PRACTICAL

(Credits 2)

1. To study nests and nesting habits of the birds and social insects.
2. To study the behavioural responses of wood lice to dry and humid conditions.
3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
6. Study and actogram construction of locomotor activity of suitable animal models.
7. Study of taxes in animals (fishes in aquarium).
8. Project related to animal behavior of birds/mammals

SUGGESTED READINGS

- David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge, University Press, UK.
- John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
- Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
- Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. De Coursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
- Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rdEd) 2002 Baren and Noble Inc. New York, USA
- Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.
-

DSE 2 FISH AND FISHERIES

Objective: This course is designed for students for better understanding of fishes.

THEORY

(Credits 4)

UNIT 1: Introduction and Classification:

Systematic classification of native/exotic fishes (upto Classes)

UNIT 2: Morphology and Physiology:	18
Types of fins and their modifications; Locomotion in fishes; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fishes); Electric organs; Bioluminescence; Mechanoreceptors; Schooling; Migration	
UNIT 3: Fisheries	12
Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish; Fishing crafts and Gears; Depletion of fisheries resources; Fisheries law and regulations	
Unit 4: Aquaculture and Fish in research	24
Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products Transgenic fish, Zebra fish as a model organism in research	

Outcome: The students would be able to work for food sustainability and to know about aquatic organisms

FISH AND FISHERIES

PRACTICAL

(Credits 2)

1. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
2. Study of different types of scales (through permanent slides/ photographs).
3. Study of crafts and gears used in Fisheries
4. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
5. Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias*
6. Demonstration of induced breeding in Fishes (video)
8. Demonstration of parental care in fishes (video)
9. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.

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

DSE 3 IMMUNOLOGY

Objective: This course is designed to make students to know about immunological aspect of cell functioning.

THEORY

(Credits 4)

Unit 1: Overview of Immune System and Innate and Adaptive Immunity

20

Cells and organs of the Immune system

Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis, AIDS).

Unit 2: Antigens and Immunoglobulins

18

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes

Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis

Unit 3: Major Histocompatibility Complex and Cytokines

10

Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation

Properties and functions of cytokines, Therapeutics Cytokines

Unit 4: Complement System, Hypersensitivity and Vaccines

12

Components and pathways of complement activation.

Gell and Coombs' classification and brief description of various types of hypersensitivities

Various types of vaccines.

Outcome: Students will approach towards higher learning and research.

IMMUNOLOGY

PRACTICAL

(Credits 2)

1. Estimation of bleeding time, clotting time, haemoglobin and DC.
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 (project)

SUGGESTED READINGS

- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kubly, 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 Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology*. V Edition. Saunders Publication.
-

DSE 4

WILD LIFE CONSERVATION AND MANAGEMENT

Objective: This course is so designed to make students to know about their surroundings and the inter-relationship of man and animals.

THEORY

(CREDITS 4)

Unit 1: Introduction to Wild Life and Evaluation and management of wild life

Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies and wild life in India. Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures

Unit 2: Management of habitats and Population estimation

Setting back succession; Grazing logging; Mechanical treatment; Advancing the

successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats. In situ and ex-situ conservation, wild life protection Act, wild life trade and related laws.

Population density, Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

Unit 3: Management planning of wild life in protected areas and Management of excess population

Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbation.

Bio-telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal

Unit 4: Protected areas

National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve. RAMSAR, MAB, hot spots.

Outcome: Students would approach for better management of wild life for sustainability.

WILD LIFE CONSERVATION AND MANAGEMENT

PRACTICALS

(CREDITS 2)

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna(specimen)
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna
5. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)
6. Submission of field study report (national park/reserve forest/centenary).

SUGGESTED READINGS

- Caughley, G., and Sinclair, A.R.E. (1994). *Wildlife Ecology and Management*. Blackwell Science.
- Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). *People and Wildlife, Conflict or Co-existence?* Cambridge University.
- Bookhout, T.A. (1996). *Research and Management Techniques for Wildlife and Habitats*, 5th edition. The Wildlife Society, Allen Press.
- Sutherland, W.J. (2000). *The Conservation Handbook: Research, Management and Policy*. Blackwell Sciences
- Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). *Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Blackwell Publishing.

GENERIC ELECTIVE COURSES

GE 1

ANIMAL DIVERSITY

THEORY

(CREDITS 4)

Unit 1. Modern classification of animal kingdom with special reference to different phyla.

Protista, Porifera and Coelenterata

13

General characters of Protozoa; Life cycle of paramecium

General characters and canal system in Porifera

Polymorphism in coelenterata

Unit 2. Helminthes, Annelida and Arthropoda

10

General characters of platyhelminthes and Nemethehelminthes; Parasitic adaptations

General characters of Annelida ; excretion in annelida

General characters. Social life in insects.

Unit 3. Mollusca, Coelomate Deuterostomes, Protochordata and Pisces

12

General characters of mollusca; Torsions in gastropoda

General characters of Echinodermata, larval forms of echinodermata.

Salient features and diversity of protochordates

Pisces classification, Osmoregulation in Fishes.

Unit 4. Amphibia ,Reptilia , Aves and Mammalia

20

General characters, Parental care in Amphibia.

Origin of reptiles. Terrestrial adaptations in reptiles.

The origin of birds; Flight adaptations

Early evolution of mammals and its diversity.

PRACTICAL

(CREDITS 2)

1. Study of following specimens:

Non Chordates: *Euglena, Noctiluca, Paramecium, Sycon, Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus,* Hermitcrab, *Daphnia*, Millipede, Centipede, Beetle, *Chiton, Dentalium, Octopus, Asterias, and Antedon.*

Chordates: *Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Ichthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper,* any three common birds-(Crow, duck, Owl), Squirrel and Bat.

2. Study of following Permanent Slides:

Cross section of *Sycon, Ascaris*(male and female). T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine. Bipinnaria and Pluteus larva.

3. Temporary mounts of

- Septal & pharyngeal nephridia of earthworm.
- Unstained mounts of Placoid, cycloid and ctenoid scales.

SUGGESTED BOOKS

· Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.

· Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole

· Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.

· Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.

· Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi.

GE 2

HUMAN PHYSIOLOGY

THEORY

Unit 1. Animal Cell

(CREDITS 4)

Typical animal cell and components with special reference to plasma membrane and mitochondria.

04

Unit 2: Digestion and Absorption of Food and Functioning of Excitable Tissue (Nerve and Muscle

Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and hormonal control of digestion (*in brief*)

18

Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory), Neuromuscular junction

Unit 3: Respiratory Physiology and Renal Physiology

14

Ventilation, External and internal Respiration, Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.

Functional anatomy of kidney, Mechanism and regulation of urine formation,

Unit 4: Cardiovascular Physiology and Endocrine and Reproductive Physiology

22

Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG

Structure and function of endocrine glands (pituitary, pancreas, thyroid, adrenal, ovaries, and testes),

HUMAN PHYSIOLOGY

PRACTICAL

(CREDITS 2)

1. Preparation of temporary mounts: Neurons and Blood film.

2. Preparation of haemin and haemochromogen crystals.

3. Estimation of haemoglobin using Sahli's haemoglobinometer.

4. Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary.

SUGGESTED READINGS

- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley and Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008). *Vander's Human Physiology*, XI Edition, McGraw Hill.
- Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
- Marieb, E. (1998). *Human Anatomy and Physiology*, IV Edition, Addison-Wesley.
- Kesar, S. and Vashisht, N. (2007). *Experimental Physiology*, Heritage Publishers.
- Prakash, G. (2012). *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Company Ltd.

GE 3

ENVIRONMENT AND PUBLIC HEALTH

THEORY

(Credits 4)

UNIT I: Introduction and Climate Change

Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

Unit II Pollution

Air, water, noise pollution sources and effects, Pollution control

Unit III Waste Management Technologies

Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

Unit IV Diseases

Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid

ENVIRONMENT AND PUBLIC HEALTH

PRACTICAL

(Credits 2)

1. To determine pH, Cl, SO₄, NO₃ in soil and water samples from different locations.

SUGGESTED BOOKS

- Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
- Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment

and Management Handbook”, McGraw Hill Inc., New York, 1996.

● Kofi Asante Duah “Risk Assessment in Environmental management”, John Wiley and sons, Singapore, 1998.

● Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V.N. University Press, New York, 2003.

● Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.

●

GE 4 AQUATIC BIOLOGY

THEORY

(Credits 4)

UNIT 1: Aquatic Biomes

Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

UNIT 2: Freshwater Biology

Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous.

Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.

UNIT 3: Marine Biology

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

UNIT 4: Management of Aquatic Resources

Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.

PRACTICAL

(Credits 2)

1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
3. Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body.

4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
5. A Project Report on a visit to a Sewage treatment plant/Marine bioreserve/ Fisheries Institutes.

SUGGESTED READINGS

- Anathakrishnan : Bioresources Ecology 3rd Edition
- Goldman : Limnology, 2nd Edition
- Odum and Barrett : Fundamentals of Ecology, 5th Edition
- Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition
- Wetzel : Limnology, 3rd edition
- Trivedi and Goyal : Chemical and biological methods for water pollution studies
- Welch : Limnology Vols. I-II

SKILL ENHANCEMENT COURSES

SEC 1

APICULTURE

(CREDITS 2)

Unit 1: Biology of Bees

4

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

Unit 2: Rearing of Bees

10

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

Unit 3: Diseases and Enemies and Bee Economy

7

Bee Diseases and Enemies Control and Preventive measures
Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

Unit 4: Entrepreneurship in Apiculture

4

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial
Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

- Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
- Bisht D.S., *Apiculture*, ICAR Publication.
- Singh S., *Beekeeping in India*, Indian council of Agricultural Research, NewDelhi.
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SEC 2
SERICULTURE

(CREDITS 2)

Unit 1: Introduction

3

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

Unit 2: Biology of Silkworm

3

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

Unit 3: Rearing of Silkworms and Pests and Diseases

17

Selection of mulberry variety and establishment of mulberry garden
Rearing house and rearing appliances. Disinfectants: Formalin, bleaching powder, RKO
Silkworm rearing technology: Early age and Late age rearing. Types of mountages
Spinning, harvesting and storage of cocoons
Pests of silkworm: Uzi fly, dermestid beetles and vertebrates
Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial
Control and prevention of pests and diseases

Unit 4: Entrepreneurship in Sericulture

2

Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various sericulture centres.

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
- Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
- 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.
- Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
- A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
- Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

