

CORE COURSE SEMESTER - 1 ZOOLOGY (HONS)

ZOO. CC – I (Th) : DIVERSITY AND EVOLUTION OF NON-CHORDATA (PROTISTA TO PSEUDOCOELOMATES)

Time – 3hrs F.M.: 100 [60(End sem)+15(Int)+25(Pr)] Credit- 6 [4(TH) +2(PR)]

Unit 1: Phylum Protozoa, Parazoa and Metazoa

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Plasmodium vivax*, *Trypanosomagambiense* and *Entamoeba histolytica*; Locomotion and reproduction in Protozoa; Evolution of Parazoa and Metazoa.

Unit 2: Phylum Porifera and Ctenophora

General characteristics and classification up to classes; Canal system in sponges; General characteristics and evolutionary significance.

Unit 3: Phylum Cnidaria

General characteristics and classification up to classes; Metagenesis in *Obelia*; Polymorphism in Cnidaria; Corals and coral reefs.

Unit 4: Phylum Platyhelminthes

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Fasciola hepatica* and *Taeniasolium*; Parasitic adaptations.

Unit 5 :Phylum Nematelminthes

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of *Ascarislumbricoides* and *Wuchereriabancrofti*; Parasitic adaptations.

Note: Classification to be followed from “Barnes RD (1982) Invertebrate Zoology. 5th Edition.”

ZOO.-CC-1(LAB)PRACTICALS

Marks 25

Phylum Protozoa

1. Morphology of *Paramecium*, Binary fission and Conjugation in *Paramecium*.
2. Life stages of *Plasmodium vivax*, *Trypanosomagambiense* and *Entamoeba histolytica* (Slides/ Micro- photographs).
3. Examination of pond water for protists.

Phylum Porifera

4. Study of *Sycon* (including T.S. and L.S.), *Hyalonema*, and *Euplectella*.
5. Temporary mounts of spicules, gemmules and spongin fibres.

Phylum Cnidaria

6. Study of *Obelia*, *Physalia*, *Millepora*, *Aurelia*, Ephyra larva, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia* and *Metridium* (including T.S. and L.S.).

Phylum Ctenophora

7. Any one specimen/slide.

Phylum Platyhelminthes

8. Study of adult *Fasciola hepatica*, *Taeniasolium* and their life stages (Slides/ microphotographs).

Phylum Nematelminthes

9. Study of adult *Ascarislumbricoides*, *Wuchereriabancrofti* and their life stages (Slides/ microphotographs).

Note: Classification to be followed from “Barnes RD (1982) Invertebrate Zoology. 5th Edition.”

SUGGESTED READINGS

1. Arora MP (2006) Non-Chordata-I. 1st edition. Himalaya Publishing House, New Delhi.
2. Arora MP (2008) Non-Chordata-II. 1st edition. Himalaya Publishing House, New Delhi.
3. Barnes RD (1982) Invertebrate Zoology. 6th Edition. Holt Saunders International Edition.
4. Barnes RSK, Calow P, Olive PJW, Golding DW & Spicer JI (2002) The Invertebrates: A New Synthesis. 3rd Edition. Blackwell Science, USA.
5. Barrington EJW (1979) Invertebrate Structure and Functions. 2nd Edition. ELBS and Nelson.
6. Boradale LA and Potts EA (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
7. Jordan EL and Verma PS (1963) Invertebrate Zoology. Revised Edition. S. Chand, New Delhi.

CORE COURSE SEMESTER - 1 ZOOLOGY (HONS)

ZOO- CC- II (Th) - PERSPECTIVES IN ECOLOGY (CREDITS: THEORY-4, PRACTICALS-2)

Time – 3hrs F.M.: 100 [60(End sem)+15(Int)+25(Pr)] Credit- 6 [4(TH) +2(PR)]

Unit 1: Introduction to Ecology

Relevance of studying ecology; History of ecology; Autecology and synecology; Levels of organization; Laws of limiting factors; Detailed study of temperature and light as physical factors.

Unit 2: Population

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 regulation - density-dependent and independent factors; Population interactions, Gause's Principle with laboratory and field examples; Lotka-Volterra equation for competition and Predation, functional and numerical responses.

Unit 3: Community

Community characteristics: dominance, diversity, species richness, abundance, stratification; Ecotone and edge effect; Ecosystem development (succession) with example and Theories pertaining to climax community.

Unit 4: Ecosystem

Types of ecosystem; 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, Nitrogen cycle and Sulphur cycle.

Unit 5;Conservation of Biodiversity

Types of biodiversity, its significance, loss of biodiversity; Conservation strategies (in situ and ex situ); Role of ZSI, WWF, IUCN; Wildlife (Protection) Act, 1972.

ZOO.-CC-II (LAB) PRACTICALS

Marks 25

1. Study of life tables and plot
2. ing of survivorship curves of different types from the hypothetical/real data provided.
3. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community.
4. Study of an aquatic ecosystem: fauna and flora Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content(Winkler's method), Chemical Oxygen Demand and free CO₂.
5. Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary.

SUGGESTED READINGS

1. Colinvaux PA (1993) *Ecology*. II Edition. John Wiley and Sons, Inc., USA.

2. Dash MC (1993) Fundamentals of Ecology. McGraw Hill Book Company, New Delhi.
3. Joshi N and Joshi PC (2012) Ecology and Environment. 1st Edition. Himalaya Publishing House, New Delhi.
4. Odum EP (2008) *Fundamentals of Ecology*. Indian Edition. Brooks/Cole.
5. Ricklefs, R.E., (2000). *Ecology*. 5th Edition. Chiron Press.
6. Robert Leo Smith Ecology and field biology Harper and Row.
7. Singh JS, Gupta SR and Singh SP (2014) Ecology, Environmental Science and Conservation. S. Chand, New Delhi.

CORE COURSE SEMESTER – II ZOOLOGY (HONS)

ZOO. CC – III (Th) : DIVERSITY AND EVOLUTION OF NON-CHORDATA (COELOMATE NONCHORDATES)

Time – 3hrs F.M.: 100 [60(End sem)+15(Int)+25(Pr)] Credit-6 [4(TH)+2(PR)]

Unit 1: Phylum Annelida

General characteristics and classification up to classes; Evolution of Coelom; Metamerism and Excretion in Annelida.

Unit 2: Phylum Arthropoda

General characteristics and classification up to classes; Vision in Arthropoda; Respiration in Arthropoda; Moulting in insects, Metamorphosis in insects; Social life in insects (bees and termites) and Larval forms in Crustacea.

Unit 3: Phylum Onychophora

General characteristics, evolutionary significance and affinities of *Peripatus*.

Unit 4: Phylum Mollusca

General characteristics and classification up to classes; Respiration in Mollusca; Torsion and detorsion in Gastropoda; Pearl formation in bivalves and Evolutionary significance of trochophore larva.

Unit 5: Phylum Echinodermata

General characteristics and classification up to classes; Water-vascular system in Asterozoa; Larval forms in Echinodermata and Evolutionary significance (Affinities with Chordates).

Note: Classification to be followed from “Barnes, R.D. (1982). *Invertebrate Zoology*,

5th Edition, Holt Saunders International Edition.”

Phylum Annelida

1. Study of *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Terebella*, *Serpula*, *Chaetopterus*, *Pheretima* and *Hirudinaria*.
2. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
3. T.S. through crop of leech.

Phylum Arthropoda

4. Study of *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, termite, louse, honeybee, silk moth, wasp and dragon fly.

Phylum Onychophora

5. Any one specimen/slide.

Phylum Mollusca

6. Study of *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Ostrea*, *Mytilus*, *Loligo*, *Sepia*, *Octopus* and *Nautilus* and *Cypraea* (cowrie).

Phylum Echinodermata

7. Study of echinoderm larvae.
8. Study of *Pentaceros*, *Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Echinocardium*, *Cucumaria* and *Antedon*.

Note: Classification to be followed from “Barnes, R.D. (1982). *Invertebrate Zoology*, 5th Edition, Holt Saunders International Edition”.

SUGGESTED READINGS

1. Arora MP (2006) Non-Chordata-I. 1st edition. Himalaya Publishing House, New Delhi.
2. Arora MP (2008) Non-Chordata-II. 1st edition. Himalaya Publishing House, New Delhi.
3. Barnes RD (1982) *Invertebrate Zoology*. 6th Edition. Holt Saunders International Edition.
4. Barnes RSK, Calow P, Olive PJW, Golding DW & Spicer JI (2002) *The Invertebrates: A New Synthesis*. 3rd Edition. Blackwell Science, USA.
5. Barrington EJW (1979) *Invertebrate Structure and Functions*. 2nd Edition. ELBS and Nelson.
6. Boradale LA and Potts EA (1961) *Invertebrates: A Manual for the use of Students*. Asia Publishing Home.
7. Jordan EL and Verma PS (1963) *Invertebrate Zoology*. Revised Edition. S. Chand, New Delhi.
8. Mohanty PK (2000) *Illustrated Dictionary of Biology*. Kalyani Publishers, Ludhiana.

CORE COURSE SEMESTER – II ZOOLOGY (HONS)

ZOO. CC – IV (Th) : PHYSIOLOGY: LIFE SUSTAINING SYSTEMS (CREDITS: THEORY-4, PRACTICALS-2)

Time – 3hrs F.M.: 100 [60(End sem)+15(Int)+25(Pr)] Credit- 6 [4(TH) +2(PR)]

THEORY LECTURES: 60

Marks 75

Unit 1: Digestive System

Structural organization, histology and functions of gastrointestinal tract and its associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Role of gastrointestinal hormones on the secretion and control of enzymes of gastrointestinal tract.

Unit 2: Respiratory System

Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volume and capacity; Transport of oxygen in the blood; Oxygen-hemoglobin and myoglobin, dissociation curve and the factors influencing it; Carbon monoxide poisoning; Carbon dioxide transport in the blood; buffering action of blood and haemoglobin and Control of respiration.

Unit 3: Excretory System

Structure of kidney and its histological details; Renal blood supply; Mechanism of urine formation and its regulation and Regulation of acid-base balance.

Unit 4: Blood

Components of blood and their functions; Structure and functions of haemoglobin; Haemopoiesis; Haemostasis and Coagulation of blood and Disorders of blood.

Unit 5: Heart

Structure of heart; Coronary circulation; Structure of conducting and working of myocardial fibers; Origin and conduction of cardiac impulses functions of AV node; Cardiac cycle; Cardiac output and its regulation-Frank-Starling Law of the heart; Nervous and chemical regulation of heart rate; Blood pressure and its regulation and Electrocardiogram.

ZOO. – CC-IV (LAB) PRACTICAL

Marks 25

1. Enumeration of red blood cells using haemocytometer.

2. Estimation of haemoglobin using Sahli's haemoglobinometer.
3. Preparation of haemin and haemochromogen crystals.
4. Recording of blood pressure using a Sphygmomanometer.
5. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung and kidney.

SUGGESTED READINGS

1. Arey LB (1974) Human Histology. 4th Edition. W.B. Saunders, USA.
2. Chatterjee CC (2008) Human Physiology. Vol. I and II. Medical Allied Agency, Kolkata.
3. Guyton AC and Hall JE (2006) Textbook of Medical Physiology. 9th Edition. W.B. Saunders Company, Philadelphia.
4. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
5. Tortora GJ and Derrickson B (2012) Principles of Anatomy & Physiology. 13th Edition John Wiley and sons, USA.
6. Victor PE (2008) diFiore's Atlas of Histology with Functional Correlations. 12th Edition. Lippincott W. & Wilkins, USA.

GENERIC ELECTIVE COURSE SEMESTER – 1/III ZOOLOGY (INTERDISCIPLINARY

ZOO. GE – I (Th) : FOOD, NUTRITION AND HEALTH

Time – 3hrs F.M.: 100 [60(End sem)+15(Int)+25(Pr)] Credit-6 [4(TH) +2(PR)]

THEORY LECTURES: 60

Marks 75

Unit 1: Food; Diet; Nutrient; Vitamins; Disorders due to deficiency of vitamins; Synthetic foods and drinks.

Unit 2: Functions of food; Components of food; Nutrients (Macro and micronutrients): their biochemical role and dietary sources; Food groups and the concept of a balanced diet; Causes of food spoilage; Food adulteration; Nutrition through the life cycle- Physiological considerations, nutrient needs and dietary pattern for various groups- adults, pregnant and nursing mothers, infants, preschool and school children, adolescents and elderly.

Unit 3: Nutritional Biochemistry Carbohydrates, Lipids, Proteins - Definition, Classification, Structure and properties Significance of acid value, iodine value and saponification value of lipids; Essential and Non-essential amino acids; Enzymes- Definition, Classification, Properties; Coenzymes Vitamins- Fat-soluble and Water-soluble vitamins; their Structure and properties Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc and their properties.

Unit 4: Introduction to health- Definition and concept of health; Major nutritional deficiency Diseases: Protein Energy Malnutrition; Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary or lifestyle modifications. Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS); Common ailments- cold, cough, fevers, diarrhoea, constipation: their causes and dietary treatment.

Unit 5 ; Food hygiene, Potable water- sources and methods of purification, Food and Waterborne Infections.

ZOO.- GE-1 LAB PRACTICALS

Marks 25

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric.
2. To determine absorbed oil content in fried foods.
3. Estimation of lactose in milk.
4. Ascorbic acid estimation in food by titrimetry.
5. Estimation of calcium in foods by titrimetry.
6. Preparation of temporary mounts of various stored grain pests.
7. Project- Undertake computer aided diet analysis and nutrition counselling for different age groups. OR Identify nutrient rich sources of foods, their seasonal availability and price; study of Nutrition labelling on selected foods.

SUGGESTED BOOKS

1. Bamji MS, Rao NP and Reddy V (2009) Text Book of Human Nutrition. Oxford & IBH Publishing Co. Pvt Ltd.
2. Jain P et al. (2007) Poshanvaswasthyakemooolsiddhant (Hindi). 1st Ed. AcademicPratibha.
3. Lakra P and Singh MD (2008) Textbook of Nutrition and Health. 1st Edition. Academic Excellence.
4. Manay MS, Shadaksharaswamy (1998) Food-Facts and Principles. New Age International (P) Ltd.
5. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
6. Mudambi SR and Rajagopal MV (2007) Fundamentals of Foods, Nutrition and Diet Therapy. 5th Edition. New Age International Publishers.
7. Srilakshmi B (2002) Nutrition Science. 4th Edition. New Age International (P) Ltd.
8. Srilakshmi B (2007) Food Science. 4th Edition. New Age International (P) Ltd.
9. Swaminathan M (1986) Handbook of Foods and Nutrition. 5th Edition. BAPPCO.
10. Wardlaw GM, Hampl JS (2007) Perspectives in Nutrition. 7th Edition. McGraw Hill.

ZOOL.-DSC- I OF SEM-I IS SAME AS CC-I OF SEM-I

GENERIC ELECTIVE COURSE SEMESTER – II / IV ZOOLOGY (INTERDISCIPLINARY)

ZOO. GE – II (Th) : HUMAN PHYSIOLOGY

Time – 3hrs F.M.: 100 [60(End sem)+15(Int)+25(Pr)] Credit-6 [4(TH)+2(PR)]

Unit 1: Digestion and absorption of Food

Structure and function of digestive gland ; Digestion and absorption of carbohydrates, Fats and Proteins ; Nervous and hormonal control of digestion (in brief).

Unit 1i : Functioning of excitable tissue (Nerve and Muscle)

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 1II : Respiratory Physiology

Ventilation ,External and internal respiration. Transport of Oxygen and Carbon dioxide in blood, factors affecting transport of gases.

Unit 1V : Renal and cardio vascular Physiology

Functional anatomy of Kidney, mechanism and regulation of urine formation. Structure of heart, coordination of heart beat, Cardiac cycle, ECG.

Unit V : Endocrine and Reproductive Physiology

Structure and function of endocrine gland (Pituitary thyroid, parathyroid, pancreas, adrenal, ovaries and testes), Brief account of spermatogenesis and oogenesis, menstrual cycle .

ZOO.- GE-1i - LAB PRACTICALS

Marks 25

1. Preparation of temporary mounts : neurons and Blood film.
2. Preparation of haemin and haemochromogen crystals.
3. Estimation of haemoglobin, using Sahi's haemoglobinometer.
4. Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, Kidney, Thyroid, Pancreas, adrenal, testes, ovary.

Suggested Readings

1. Tora G.J. Derickson, B.H. (2009). Principles of Anatomy and Physiology, XII Ed John Wiley and Sons. Inc.
2. Winmair, E.P. Raff. H. And Strand, K. T. (2008) Vander's Human Physiology, XI Ed. Mc Graw

Hill. 3. Gayton, A.C. Hill. J.E. (2011), Textbook of medical physiology. Xii Ed. Harcourt Asia Pvt. Ltd. / W.B. Saunders Company.

4. Marieb, E. (1998). Human Anatomy and Physiology. Iv Ed. Addison-Wesley.

5. Kesar. S. And Vashisht, N. (2007). Experimental Physiology, heritage Publishers.

6. Prakash, G. (2012). Lab Manual on Blood analysis and medical diagnostics, S.Chand and

company Ltd. **Zoo.-DSC- II OF SEM-II IS SAME AS CC-II**

OF SEM-I

Core Courses Semester III- ZOOLOGY(Hons) CC-V

CORE COURSE: ZOOLOGY

PAPER V

DIVERSITY AND DISTRIBUTION OF CHORDATA

(CREDITS: THEORY-4, PRACTICALS-2)

Time – 3 hrs. F.M. – 100 [60(Sem) +15 (Int.) + 25 (Pr.)] Credits: -04(Th.) +02(Pr.)

Lectures – 60 [40(Th.) +20 (Pr.)

Unit 1: Protochordata and Origin of Chordates

General characters of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata; Dipleurula concept and the Echinoderm theory of origin of chordates.

Unit 2: Introduction to Vertebrata and Agnatha

Advanced features of vertebrates over Protochordata; General characters and classification of cyclostomes up to class; Structural peculiarities and affinities of *Petromyzon* and *Myxine*.

Unit 3: Pisces and Amphibia

General characters of Chondrichthyes and Osteichthyes and classification up to order; Migration; Osmoregulation and Parental care in fishes; Scales in fishes; Origin of *Tetrapoda* (Evolution of terrestrial ectotherms); General characters and classification up to order and Parental care in Amphibians.

Unit 4: Reptilia and Aves

General characters and classification up to order; Skull in Reptilia; Affinities of *Sphenodon*; Poison apparatus and Biting mechanism in snakes; General characters and classification up to order; Principles and aerodynamics of flight, Flight adaptations; *Archaeopteryx*- a connecting link and Migration in birds.

Unit 5: Mammals and Zoogeography

General characters and classification up to order; Affinities of Prototheria and Metatheria; Dentition in mammals; Adaptive radiation with reference to locomotory appendages; Zoogeographical realms; Theories pertaining to distribution of animals and Distribution of vertebrates in different realms.

PRACTICAL

Marks 25

1. Protochordata

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

2. Agnatha

5. *Petromyzon* and *Myxine*.

3. Fishes

6. *Sphyrna*, *Pristis*, *Trygon*, *Torpedo*, *Chimaera*, *Notopterus*, *Mystus*, *Heteropneustes*, *Hippocampus*, *Exocoetus*, *Echeneis*, *Anguilla*, *Tetrodon*, *Diodon*, *Anabas* and Flat fish.

4. Amphibia

7. *Ichthyophis/Ureotyphlus*, *Necturus*, *Duttaphrynus*, *Polypedates*, *Hyla*, *Alytes* and *Salamandra*.

5. Reptiles

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

6. Aves

10. Study of six common birds from different orders.
11. Types of beaks and claws.
12. Types of feathers.

7. Mammalia

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

SUGGESTED READINGS

1. Agarwal VK (2011) Zoology for degree students. S. Chand, New Delhi.
2. Arora MP (2006) Chordata-1. 1 Edition. Himalaya Publishing House, New Delhi.

3. Hall BK and Hallgrimsson B (2008) *Strickberger's Evolution*. 4th Edition. Jones and Bartlett Publishers Inc., USA.
4. Jordan EL and Verma PS (1963) *Chordate Zoology*. Revised Edition. S. Chand, New Delhi.
5. Mohanty PK (2000) *Illustrated Dictionary of Biology*. Kalyani Publishers, Ludhiana.
6. Young JZ (2004) *The Life of Vertebrates*. 3rd Edition. Oxford University Press, USA.

Core Courses Semester- III ZOOLOGY(Hons) CC-VI

CORE COURSE: ZOOLOGY

PAPER VI

PHYSIOLOGY – CONTROLLING AND COORDINATING SYSTEM

(CREDITS: THEORY-4, PRACTICALS-2)

Time – 3 hrs. F.M. – 100 [60(Sem) +15 (Int.) + 25 (Pr.)] Credits: -04(Th.) +02(Pr.)
Lectures – 60 [40(Th.) +20 (Pr.)]

Unit 1: Tissues and Glands, Bone and cartilage

Structure, location, function and classification of Epithelial tissue, Connective tissue, Muscular tissue, Nervous tissue; Types of glands and their functions; Structure and types of bones and cartilages; Ossification, bone growth and resorption.

Unit 2: Nervous System

Structure of neuron, resting membrane potential; Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; types of synapsis, Synaptic transmission; Neuromuscular junction; Reflex action and its types, Reflex arc and Physiology of hearing and vision.

Unit 3: Muscle

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor Unit, summation and tetanus.

Unit 4: Reproductive System

Histology of male and female reproductive systems; Puberty; Physiology of reproduction of male and female; Methods of contraception (depicted through flow chart).

Unit 5: Endocrine System

Functional Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, thymus, pancreas, adrenals; Hormones secreted by them and their mechanism of

action; Gonadal hormones; Classification of hormones; Regulation of their secretion; Mode of hormone action; Signal transduction pathways utilized by steroidal and non-steroidal hormones; Hypothalamus (neuroendocrine gland), principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system and Placental hormones.

PRACTICALS

Marks 25

1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells.
3. Examination of sections of mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.

SUGGESTED BOOKS

1. Arey LB (1974) Human Histology. 4th Edition. W.B. Saunders, USA.
2. Chatterjee CC (2008) Human Physiology. Vol. I and II. Medical Allied Agency, Kolkata.
3. Guyton AC and Hall JE (2006) Textbook of Medical Physiology. 9th Edition. W.B. Saunders Company, Philadelphia.
4. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
5. Tortora GJ and Derrickson B (2012) Principles of Anatomy & Physiology. 13th Edition John Wiley and sons, USA.
6. Victor PE (2008) diFiore's Atlas of Histology with Functional Correlations. 12th Edition. Lippincott W. and Wilkins, USA.

Core Courses Semester- III ZOOLOGY(Hons) CC-VII

CORE COURSE: ZOOLOGY

PAPER VII

COMPARATIVE ANATOMY OF VERTEBRATES (CREDITS: THEORY-4, PRACTICALS-2)

**Time – 3 hrs. F.M. – 100 [60(Sem) +15 (Int.) + 25 (Pr.)] Credits: -04(Th.) +02(Pr.)
Lectures – 60 [40(Th.) +20 (Pr.)**

Unit 1: Integumentary System and Skeletal System

Structure, functions and derivatives of integument; Axial and appendicular skeletons; Jaw suspensorium in vertebrates.

Unit 2: Digestive and Respiratory System

Alimentary canal and associated glands; Skin, gills, lungs and air sacs and Accessory respiratory organs in fishes.

Unit 3: Circulatory System

General plan of circulation; Evolution of heart and aortic arches.

Unit 4: Urinogenital System

Succession of kidney; Evolution of urinogenital ducts and Types of mammalian uteri.

Unit 5: Nervous System and Sense Organs

Comparative account of brain; Autonomic nervous system; Spinal Nerves; Spinal cord; Cranial nerves in Mammals; Classification of receptors; visual receptors, chemoreceptors and mechanoreceptors.

PRACTICAL

Marks 25

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.
2. Disarticulated skeleton of Frog, *Varanus*, Fowl and Rabbit.
3. Carapace and plastron of turtle or tortoise.
4. Mammalian skulls (One herbivorous and one carnivorous animal).

SUGGESTED READINGS

1. Hilderbrand M and Gaslow GE. Analysis of Vertebrate Structure. John Wiley and Sons., USA.
2. Kardong ^{KV}_{th} (2005) Vertebrates' Comparative Anatomy, Function and Evolution. 4th Edition. McGraw-Hill Higher Education, New York.
3. Kent GC and Carr RK (2000) Comparative Anatomy of the Vertebrates. 9th Edition. The McGraw-Hill Companies, New York.
4. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
5. Weichert CK and William Presch (1970) Elements of Chordate Anatomy. Tata McGraw Hill, New York.

Core Courses **Semester- IV ZOOLOGY(Hons) CC-VIII**
CORE COURSE: ZOOLOGY
PAPER VIII

BIOCHEMISTRY OF METABOLIC PROCESSES
(CREDITS: THEORY-4, PRACTICALS-2)

Time – 3 hrs. F.M. – 100 [60(Sem) +15 (Int.) + 25 (Pr.)] Credits: -04(Th.) +02(Pr.)
Lectures – 60 [40(Th.) + 20(Pr.)

Unit 1: Biomolecules

Structures and properties of important mono-, di- and polysaccharides; Fatty acids, triglycerides and steroids; and amino acids and proteins.

Unit 2: Carbohydrate Metabolism

Glycolysis; Citric acid cycle; pentose phosphate pathway; Gluconeogenesis; Shuttle systems(Malate-aspartate shuttle, Glycerol 3-phosphate shuttle); Glycogenolysis; Glycogenesis.

Unit 3: Lipid Metabolism

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

Unit 4: Protein Metabolism

Catabolism of amino acids: Transamination, Deamination; Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids.

Unit 5: Enzymes and Oxidative Phosphorylation

Kinetics and Mechanism of action of enzymes; Inhibition of enzyme action; Allosteric enzymes; Oxidative phosphorylation in mitochondria; Respiratory chain, ATP synthase, Inhibitors and Uncouplers.

PRACTICALS

Marks 25

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose).
2. Colour tests of functional groups in protein solutions.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH on the action of salivary amylase.
5. Effect of temperature on the action of salivary amylase.
6. Estimation of total protein in given solutions by Lowry's method.

SUGGESTED READINGS

1. Berg JM, Tymoczko JL and Stryer L (2007) Biochemistry. 6th Edition, W.H. Freeman and Co., New York.
2. Cox MM and Nelson DL (2008) Lehninger Principles of Biochemistry. 5th Edition. W.H. Freeman and Co., New York.
3. Devesena T (2014) Enzymology. 2nd Edition. Oxford University Press, UK,
4. Hames BD and Hooper NM (2000) Instant Notes in Biochemistry. 2nd Edition. BIOS Scientific Publishers Ltd., U.K.
5. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
6. Murray RK, Bender DA, Botham KM, Kennelly PJ, Rodwell VW and Well PA (2009) Harper's Illustrated Biochemistry. 28th Edition. International Edition. The McGraw-Hill Companies Inc., New York.

Core Courses Semester- IV ZOOLOGY(Hons) CC-IX

CORE COURSE: ZOOLOGY

PAPER IX

CELL BIOLOGY

(CREDITS: THEORY-4, PRACTICALS-2)

Time – 3 hrs. F.M. – 100 [60(Sem) +15 (Int.) + 25 (Pr.)] Credits: -04(Th.) +02(Pr.)

Lectures – 60 [40(Th.) + (Pr.)

Unit 1: Cells and Plasma Membrane

Prokaryotic and Eukaryotic cells; Mycoplasma; Virus, Viroids, Virions and Prions; Various models of plasma membrane; Transport across membranes; Cell junctions: Occluding junctions (Tight junctions), Anchoring junctions (desmosomes), Communicating junctions (gap junctions) and Plasmodesmata.

Unit 2: Endomembrane System, Mitochondria and Peroxisomes

The Endoplasmic Reticulum; Golgi apparatus; Mechanism of vesicular transport; Lysosomes; Structure and function of mitochondria: Chemi-osmotic hypothesis; Semiautonomous nature of mitochondria; Endosymbiotic hypothesis and Peroxisomes.

Unit 3: Cytoskeleton and Nucleus

Structure and functions of intermediate filament, microtubules and microfilaments; Ultra structure of nucleus; Nuclear envelope: Structure of nuclear pore complex; Chromosomal DNA and its packaging; Structure and function of Nucleolus.

Unit 4: Cell Cycle and Cell Signaling

Cell cycle, Regulation of cell cycle; Signaling molecules and their receptors.

Unit 5: Apoptosis and Cancer

Extrinsic (Death Receptor) Pathway and Intrinsic (Mitochondrial) Pathway; Growth and development of tumors and Metastasis.

PRACTICAL

Marks 25

1. Gram's staining technique for visualization of prokaryotic cells.
2. Study various stages of mitosis from permanent slides.

3. Study various stages of meiosis from permanent slides.
4. Study the presence of Barr body in human female blood cells/cheek cells. (Preparation of permanent slides).
5. Cytochemical demonstration (Preparation of permanent slides).
 - i. DNA by Feulgen reaction.
 - ii. Mucopolysaccharides by PAS reaction.
 - iii. Proteins by Mercurobromophenol blue.
 - iv. DNA and RNA by Methyl Green Pyronin.

(In practical examination, 05 marks should be of permanent slide submission; one mark each for DNA, PAS, Proteins, MGP and Barr body slide.)

SUGGESTED READINGS

1. Becker WM, Kleinsmith LJ, Hardin J and Bertoni G P (2009) The World of the Cell. 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008) Molecular Biology of the Cell. 5th Edition. Garland publishing Inc., New York.
3. Cooper GM and Hausman RE (2009) The Cell: A Molecular Approach. 5th Edition. ASM Press, Washington D.C.
4. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology. 8th Edition. Lippincott Williams and Wilkins, Philadelphia.
5. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley and Sons. Inc., USA.
6. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.

Core Courses Semester- IV ZOOLOGY(Hons) CC-X

CORE COURSE: ZOOLOGY

PAPER X

PRINCIPLES OF GENETICS

(CREDITS: THEORY-4, PRACTICALS-2)

Time – 3 hrs. F.M. – 100 [60(Sem) +15 (Int.) + 25 (Pr.)] Credits: -04(Th.) +02(Pr.)
Lectures – 60 [40(Th.) +20 (Pr.)]

Unit 1: Mendelian Genetics and its Extension

Principles of inheritance; Incomplete dominance and co-dominance; Multiple alleles, Lethal alleles; Epistasis; Pleiotropy; Sex-linked inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping

Linkage and crossing over; Cytological basis of crossing over; Molecular mechanisms of crossing over; Recombination frequency as a measure of linkage intensity; Two factor and three factor crosses; Interference and coincidence and Somatic cell hybridization.

Unit 3: Mutations

Gene mutations; Chromosomal mutations: Deletion, duplication, inversion, translocation; Aneuploidy and polyploidy; Induced versus spontaneous mutations; Backward and forward mutations; Suppressor mutations; Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method and DNA repair mechanisms.

Unit 4: Sex Determination and Quantitative Genetics

Chromosomal mechanisms of sex determination; Sex-linked, sex-influenced and sex limited characters; Polygenic inheritance and Transgressive variation.

Unit 5: Extra-chromosomal Inheritance

Criteria for extra-chromosomal inheritance; Antibiotic resistance in *Chlamydomonas*; Mitochondrial mutations and Maternal effects.

PRACTICAL

Marks 25

1. To study the Mendelian laws and gene interactions and their verification by Chi-square analyses using seeds/beads/*Drosophila*.
2. Identification of various mutants of *Drosophila*.
3. To calculate allelic frequencies by Hardy-Weinberg Law.
4. Linkage maps based on data from crosses of *Drosophila*.
5. Study of human karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited traits.
7. Preparation of polytene chromosomes from larva of *Chironomus/Drosophila*.
8. To study mutagenicity in *Salmonella/E. coli* by Ames test.

SUGGESTED READINGS

1. Gardner EJ, Simmons MJ, Snustad DP (2008) Principles of Genetics. 8th Edition. Wiley India.
2. Griffiths A.J.F, Wessler SR, Lewontin RC and Carroll SB. Introduction to Genetic Analysis. 9th Edition. W. H. Freeman and Co., New York.
3. Klug WS, Cummings MR, Spencer CA and Palladino MA (2012) Concepts of Genetics. 10th Edition. Pearson Education, Inc., USA.
4. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
5. Russell PJ (2009) Genetics- A Molecular Approach. 3rd Edition. Benjamin Cummings, USA.
6. Snustad DP and Simmons MJ (2012) Principles of Genetics. 6th Edition. John Wiley and Sons Inc., USA.
7. Verma PS and Agarwal VK (2010) Genetics. 9th Edition. S. Chand, New Delhi.

VERMICOMPOST TECHNOLOGY (SEC-II)

Time: 2hours Full Mark-50 [(40 (End Sem) + 10 (Pr)] Credit-2

THEORY: 40

Unit-I

Introduction to vermiculture: definition, meaning, history, economic important, their value in maintenance of soil structure, role as four R's: reduce, reuse, recycle, and restore.

Unit-II

Choosing the right worm: Useful species of earthworms: Taxonomy, Morphology and Anatomy, Local species of earthworms, Exotic species of earthworms, Key to identify the species of earthworms

Unit-III

Biology of *Eiseniafetida* and *Eudriluseugeniae*: physiology and reproduction, Vital cycle of *Eiseniafetida*: alimentation, fecundity, annual reproduction potential

Unit-IV

Vermicompost Technology: Small Scale Earthworm farming for home gardens - Earthworm compost for home gardens, Earthworm Composting on larger scale, Earthworm Farming (Vermiculture), vermicomposting harvest and processing. Nutritional Composition of Vermicompost for plants, comparison with other fertilizers, Vermiwash and their utility.

Practical

Marks 10

Project based on syllabus –i. Vermiculture, ii. Vermicompost, iii. Vermiwash
(**Project -07marks and Viva-03 marks**). (To be conducted by the Internal Examiner only)

Suggested Books:

1. Bhatt J.V. & S.R. Khambata (1959) "Role of Earthworms in Agriculture" Indian Council of Agricultural Research, New Delhi
2. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) " Verms and Vermicomposting" Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, JyotiVihar, Orissa.
3. Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney.
4. Wallwork, J.A. (1983) "Earthworm Biology" Edward Arnold (Publishers) Ltd. London.

SEMESTER-III, ZOOLOGY -DSC-III
CORE COURSE: ZOOLOGY
PAPER III
DIVERSITY AND EVOLUTION OF NON-CHORDATA (COELOMATE
NONCHORDATES)
(CREDITS: THEORY-4, PRACTICALS-2)

Time – 3 hrs. F.M. – 100 [60(Sem) +15 (Int.) + 25 (Pr.)] Credits: -04(Th.) +02(Pr.)
Lectures – 60 [40(Th.) +20 (Pr.)

Unit 1: Phylum Annelida

General characteristics and classification up to classes; Metamerism and Excretion in Annelida.

Unit 2: Phylum Arthropoda

General characteristics and classification up to classes; Vision in Arthropoda; Respiration in Arthropoda; Moulting in insects, Metamorphosis in insects; Social life in insects (bees and termites) and Larval forms in Crustacea.

Unit 3: Phylum Onychophora

General characteristics, evolutionary significance and Affinities of *Peripatus*.

Unit 4: Phylum Mollusca

General characteristics and classification up to classes; Respiration in Mollusca; Torsion and detorsion in Gastropoda; Pearl formation in bivalves.

Unit 5: Phylum Echinodermata

General characteristics and classification up to classes; Water-vascular system in Asterozoa; Larval forms in Echinodermata.

Note: Classification to be followed from “Barnes, R.D. (1982).*Invertebrate Zoology*, 5 Edition, Holt Saunders International Edition.”th

Phylum Annelida

8. Study of *Aphrodite*, *Nereis*, *Sabella*, *Terebella*, *Serpula*, *Chaetopterus*, *Pheretima* and *Hirudinaria*.
9. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
10. T.S. through crop of leech.

Phylum Arthropoda

4. Study of *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, termite, louse, honeybee, silk moth, wasp and dragon fly.

Phylum Onychophora

5. Any one specimen/slide.

Phylum Mollusca

5. Study of *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Ostrea*, *Mytilus*, *Loligo*, *Sepia*, *Octopus* and *Nautilus* and *Cyprea* (cowrie).

Phylum Echinodermata

7. Study of echinoderm larvae.
8. Study of *Pentaceros*, *Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Echinocardium*, *Cucumaria* and *Antedon*.

Note: Classification to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, 5th Edition, Holt Saunders International Edition".

SUGGESTED READINGS

9. Arora MP (2006) Non-Chordata-I. 1st edition. Himalaya Publishing House, New Delhi.
10. Arora MP (2008) Non-Chordata-II. 1st edition. Himalaya Publishing House, New Delhi.
11. Barnes RD (1982) *Invertebrate Zoology*. 6th Edition. Holt Saunders International Edition.
12. Barnes RSK, Calow P, Olive PJW, Golding DW & Spicer JI (2002) *The Invertebrates: A New Synthesis*. 3rd Edition. Blackwell Science, USA.
13. Barrington EJW (1979) *Invertebrate Structure and Functions*. 2nd Edition. ELBS and Nelson.
14. Boradale LA and Potts EA (1961) *Invertebrates: A Manual for the use of Students*. Asia Publishing Home.
15. Jordan EL and Verma PS (1963) *Invertebrate Zoology*. Revised Edition. S. Chand, New Delhi.
16. Mohanty PK (2000) *Illustrated Dictionary of Biology*. Kalyani Publishers, Ludhiana.

SEM-IV ZOO DSC-IV IS SAME AS CC-V

ZOOLOGY (HONOURS)

SEMESTER- V

Core Course

CC- XI : Molecular Biology (6 Credit)

Full mark 100: **Theory – 75** (Mid Sem 15 + End Sem 60), Practical – 25

Unit 1: Nucleic Acids, DNA Replication & Repair

Salient features of DNA and RNA. Watson and Crick model of DNA. DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear *ds*-DNA, replication of telomeres. Pyrimidine dimerization and mismatch repair.

Unit 2: Transcription & Translation

RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors and regulation of transcription. 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

Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA.

Unit 4: Gene Regulation & Regulatory RNAs

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, RNA interference, miRNA, siRNA.

1. chromosomes from Chironomous / *Drosophila* larvae
2. Preparation of liquid culture medium (LB) and raise culture of *E. coli*
3. Estimation of the growth kinetics of *E. coli* by turbidity method
4. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking
5. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer ($A_{260\text{nm}}$ measurement)
6. Quantitative estimation of RNA using Orcinol reaction

7. Study and interpretation of electron micrographs/ photograph showing

- (a) DNA replication
- (b) Transcription
- (c) Split genes

SUGGESTED READINGS

1. 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.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: *Molecular Biology of the Cell*, IV Edition.
3. Cooper G. M. and Robert E. Hausman R. E. *The Cell: A Molecular Approach*, V Edition, ASM Press and Sinauer Associates.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
5. Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
6. Lewin B. (2013). *Gene XI*, Jones and Bartlett
7. McLennan A., Bates A., Turner, P. and White M. (2015). *Molecular Biology* IV Edition. GS, Taylor and Francis Group, New York and London.

ZOOLOGY (HONOURS)

SEMESTER- V

Core Course

CC- XII :Fundamentals of Biochemistry (6 Credit)

Full mark 100: **Theory – 75** (Mid Sem 15 + End Sem 60), Practical – 25

Unit 1: Carbohydrates & Lipids

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates; Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids.

Unit 2: Proteins

Amino acids: Structure, Classification and General properties of α -amino acids; Physiological importance of essential and non-essential α -amino acids.

Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Renaturation, Denaturation; Introduction to simple and conjugate proteins

Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants.

Unit 3: Nucleic Acids

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves: Base pairing, Denaturation and Renaturation of DNA, Types of DNA and RNA, Complementarity of DNA, Hypo-Hyperchromaticity of DNA.

Unit 4: Enzymes

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 K_m and V_{max} , Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.

PRACTICAL – 25 (End Semester Evaluation)

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./Urease/acid or alkaline phosphatase
5. Demonstration of proteins separation by SDS-PAGE.

SUGGESTED READING

1. Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
3. 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.
4. Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II Edition, BIOS Scientific Publishers Ltd., U.K.
5. 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 Publication.
6. Jain J L, Jain S and Jain N. *Fundamentals of Biochemistry*. S Chand Publication
7. Bhatt S M. *Enzymology and Enzyme Technology*. S Chand Publication

ZOOLOGY (HONOURS)
SEMESTER- V
Discipline Specific Elective Course
DSE 1 : Immunology (6 Credit)

Full mark 100: **Theory – 75** (Mid Sem 15 + End Sem 60), Practical – 25

Unit 1: Innate and Adaptive Immunity

Historical perspective of Immunology, Early theories of Immunology, 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 and tolerance, AIDS).

Unit 2: Antigens and Immunoglobulins

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes, Immunoglobulins Structure and functions of different classes of immunoglobulins, Antigen antibody interactions, Immunoassays (ELISA- Direct, Indirect, Competitive, Sandwich and RIA)

Unit 3: Major Histocompatibility Complex, Cytokines and Complement system

Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation; Cytokines -Properties and functions of cytokines, Therapeutics Cytokines Complement System -Components and pathways of complement activation.

Unit 4: Hypersensitivity and Vaccines

Gell and Coombs' classification and brief description of various types of hypersensitivities Vaccines -various types of vaccines.

PRACTICAL – 25. (End Semester Evaluation)

1. Study of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of White blood cells.
4. ABO blood group determination.
5. Total WBC counting.
6. Demonstration of ELISA.
7. Demonstration of Bone marrow smears to study Immune cells.

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 Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology*. V Edition. Saunders Publication.

DISCIPLINE SPECIFIC ELECTIVE (DSE II)

ANIMAL BEHAVIOUR AND CRONOBIOLOGY (CREDITS: THEORY-4, PRACTICALS-2)

Full mark 100: **Theory – 75** (Mid Sem 15 + End Sem 60), Practical – 25

THEORY LECTURES: 60

Unit 1: Animal Behaviour

Origin and history of Ethology; Brief profiles of Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen; Proximate and ultimate behavior; Objective of behaviour, Behaviour as a basis of evolution; Behaviour as a discipline of science; Innate behaviour, Instinct, Stimulus filtering, Sign stimuli and Code breakers.

Unit 2: Patterns of Behaviour

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

Unit 3: Social and Sexual Behaviour

Social Behaviour: Concept of Society; Communication and the senses; Altruism; Insects' society with Honey bee as example; Foraging in honey bee 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: Chronobiology

Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period. Adaptive significance of biological clocks, Relevance 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.

PRACTICAL Marks 25

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 condition.
3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Study and actogram construction of locomotor activity of suitable animal models.
6. Study of circadian functions in humans (daily eating, sleep and temperature patterns).
7. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.

SUGGESTED READINGS

1. David McF. Animal Behaviour. Pitman Publishing Limited, London, UK.
2. John A (2001) Animal Behaviour. 7th Edition. Sinauer Associate Inc., USA.
3. Manning A and Dawkins MS. An Introduction to Animal Behaviour. Cambridge University Press, USA.
4. Paul WS and John A (2013) Exploring Animal Behaviour. 6th Edition. Sinauer Associate Inc., Massachusetts, USA.
5. Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Chronobiology Biological Timekeeping: J, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.
6. Vinod Kumar (2002) Biological Rhythms: Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

Skill Enhancement Course

SEC-3 -APICULTURE (2 Credits)

Full Mark: 50 (Mid Sem 10 + End Sem 40)

Unit 1: Biology of Bees

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

Unit 2: Rearing of Bees

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

Bees: Diseases and Enemies, Control and Preventive measures

Unit 4: Bees Economy and Entrepreneurship in Apiculture

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen
Etc. Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial
Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

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

Zoo DSE-I Sem.-V (for Gen.) is same as DSE-I (Immunology) Sem.-V (for Hons)

ZOOLOGY (HONOURS)

SEMESTER- VI

Core Course

CC-XIII: Developmental Biology (6 Credit)

Full mark 100: **Theory – 75** (Mid Sem 15 + End Sem 60), **Practical – 25**

Unit 1: Introduction to Developmental Biology, Gametogenesis & Fertilization

Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, 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.

Unit 2: Early Embryonic Development

Cleavage: 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 3: Late Embryonic Development

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

Unit 4: Post Embryonic Development & Implications of Developmental Biology

Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories. Teratogenesis: Teratogenic agents and their effects on embryonic development; *In vitro* fertilization, Stem cell (ESC), Amniocentesis.

PRACTICAL – 25 (End Semester Evaluation)

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. Study of the developmental stages and life cycle of *Drosophila* from stock culture.
4. Study of different sections of placenta (photomicrograph/ slides).
5. Project report on *Drosophila* culture/chick embryo development.

6. Study of developmental stages by raising chick embryo in the laboratory

SUGGESTED READINGS

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press.
3. Carlson, R. F. Patten's Foundations of Embryology.
4. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers.
5. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press.
6. Verma PS and Agrawal VK, Chordata Embryology (S Chand Publication)
- 7.

ZOOLOGY (HONOURS)

SEMESTER- VI

Core Course

CC-XIV: Evolutionary Biology (6 Credit)

Full mark 100: **Theory – 75** (Mid Sem 15 + End Sem 60), **Practical – 25**

Unit 1: Theories, Evidences of Evolution and Extinction

Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes. 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, Sources of variations: Heritable variations and their role in evolution. Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction.

Unit 2: Process of Evolutionary changes

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.

Unit 3: Species concept and Speciation

Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Parapatric.

Adaptive radiation / macroevolution (exemplified by Galapagos finches);

Unit 4: Concept of Origin and Evolution of man

Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from *Dryopithecus* leading to *Homo sapiens*, molecular analysis of human origin. Phylogenetic trees, Multiple sequence alignment, construction and interpretation of phylogenetic trees.

PRACTICAL – 25 (End Semester Evaluation)

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Demonstration of 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. Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation.

SUGGESTED READINGS

1. Ridley, M (2004) Evolution III Edition Blackwell publishing Hall,
2. B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
3. Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
4. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates. Snustad. S Principles of Genetics.
5. Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell
6. Rastogi BB, Organic Evolution, Ramnath and Kedarnath Publication
7. Freeman Scott and Herron JC, Evolutionary analysis, 4th edition, 2016, Pearson education India

ZOOLOGY (HONOURS)

SEMESTER- VI

Discipline Specific Elective Course

DSE 3 : Animal Biotechnology (6 Credit)

Full mark 100: **Theory – 75** (Mid Sem 15 + End Sem 60), Practical – 25

Unit 1. Introduction to Animal Biotechnology

Concept and scope of biotechnology, Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC and Expression vectors (characteristics).

Restriction enzymes: Nomenclature, detailed study of Type II, Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

Transformation techniques: Calcium chloride method and electroporation

Unit 2. Molecular Techniques

Southern, Northern and Western blotting, DNA sequencing: Sanger method

Polymerase Chain Reaction, DNA Finger Printing and DNA microarray

Unit 3. Genetically Modified Organisms

Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection, Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.

Unit 4. Culture Techniques and Applications

Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Thalassemia, Haemophilia and Sickle cell anemia), Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy.

PRACTICAL – 25 (End Semester Evaluation)

1. Genomic DNA isolation from *E. coli* / Animal tissue
2. Plasmid DNA isolation (pUC 18/19) from *E. coli*
3. Restriction digestion of plasmid DNA / Lambda Phage DNA
4. Construction of circular and linear restriction map from the data provided.

5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs

- a. Southern Blotting
- b. Northern Blotting
- c. Western Blotting
- d. DNA Sequencing (Sanger's Method)
- e. PCR
- f. DNA fingerprinting

Suggested Readings

Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNA Analysis*. II Edition, Academic Press, California, USA.

Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.

Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). *An Introduction to Genetic Analysis*. IX Edition. Freeman and Co., N.Y.,USA.

Snustad, D.P. and Simmons, M.J. (2009). *Principles of Genetics*. V Edition, John Wiley and Sons Inc.

Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). *Recombinant DNA- Genes and Genomes- A Short Course*. III Edition, Freeman and Co., N.Y.,USA.

Beauchamp, T.I. and Childress, J.F. (2008). *Principles of Biomedical Ethics*. VI Edition, Oxford University Press.

SEMESTER- VI

**Discipline Specific Elective Course
DSE 4 : PROJECT**

| | |
|---------------|----------|
| Dissertation: | 60 Marks |
| Presentation: | 25 Marks |
| Viva-voce: | 15 Marks |

Projects submitted by the students are to be evaluated by the Internal Examiner and External Examiner appointed by University. Students should opt for Supervision of Dissertation from the internal faculties of his own college/Institution. The Supervisor in consultation with the concerned Head of the Department should decide the topic. The presentation should be open to all faculties as well as graduate students of the concerned Department

Skill Enhancement Course

SEC-4 -SERICULTURE(2 Credits)

Full Mark: 50 (End semester evaluation)

Unit 1: Biology of Silkworm

Life cycle of *Bombyx mori*, Structure of silk gland and secretion of silk, 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: Rearing of Silkworms

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

Unit 3: Pests and Diseases

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

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

SUGGESTED READINGS

1. Food and Agriculture Organisation (1976) Manual on Sericulture, Rome
2. S.R. Ullal and M.N. Narasimhanna , Handbook of Practical Sericulture: CSB, Bangalore
3. Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
4. M. S. Jolly, Appropriate Sericultural Techniques; (Ed., Director,) CSR & TI, Mysore.
5. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1(1972), Fuzi Pub. Co. Ltd., Tokyo, Japan.
6. M. N. Narasimhanna (1988), Manual of Silkworm Egg Production;, CSB, Bangalore.
7. K. Sengupta (1989) A Guide for Bivoltine Sericulture; Director, CSR & TI, Mysore.
8. S. Krishnaswamy (1986) Improved Method of Rearing Young age silkworm;, reprinted CSB,Bangalore.

Zoo DSE-II Sem.-VI (for Gen.) is same as DSE-III (Animal Bio-Technology) Sem.-VI (for Hons)