Syllabus and Structure

For

B. Sc. ZOOLOGY HONOURS

Dibrugarh University
2018

Under

Choice Based Credit System (CBCS)

Passed in the Board of Studies in Life Sciences, Dibrugarh

University held on 8th April, 2019.

SCHEME AND SYLLABUS FOR CHOICE BASED CREDIT SYSTEM

FOR B.Sc. HONOURS ZOOLOGY

Semester	Core Course(14)	Ability Enhancement Compulsory Course (2)	Skill Enhancement Course SEC (2)	Discipline Specific Elective DCE (4)	Generic Elective GE (4)
I	Non-chordates I: Protista to Pseudocoelomates	English Communication			GE-1
	Principles of Ecology				
II	Non-chordates II: Coelomates	Environmental Science			GE-2
	Cell Biology				
III	Diversity of Chordates		**SEC -1**		GE-3
	Physiology: Controlling and Coordinating Systems				
	Fundamentals of Biochemistry				
IV	Comparative Anatomy of Vertebrates		**SEC -2**		GE-4
	Physiology: Life Sustaining Systems				
	Biochemistry of Metabolic Processes				
V	Molecular Biology			DSE-1	
	Principles of Genetics			DSE-2	
VI	Developmental Biology			DSE -3	,
	Evolutionary Biology			DSE-4	

Semester	Course Code	Course	Course Name	Credits
I		Ability Enhancement Compulsory Course-I	English communications	2
			Environmental Science	
	ZC101T	Core course-I	Non-chordates I: Protista to Pseudocoelomates	4
	ZC101P	Core Course-I (Practical)		2
	ZC102T	Core course-II	Principles of Ecology	4
	ZC102P	Core Course-II (Practical)		2
	ZG101T	Generic Elective -1	GE-1	4
	ZG101P	Generic Elective -1 Practical/Tutorial		2
II		Ability Enhancement Compulsory Course-II	English communications/ Environmental Science	2
	ZC203T	Core course-III	Non-chordates II: Coelomates	4
	ZC203P	Core Course-III (Practical)		2
	ZC204T	Core course-IV	Cell Biology	4
	ZC204P	Core Course-IV (Practical)		2
	ZG202T	Generic Elective -2	GE-2	4
	ZG202P	Generic Elective -2 (Practical)		2
III	ZC305T	Core course-V	Diversity of chordates	4
	ZC305P	Core Course-V (Practical)		2
	ZC306T	Core course-VI	Physiology: Controlling and Coordinating systems	4
	ZC306P	Core Course-VI (Practical)		2
	ZC307T	Core course-VII	Fundamentals of Biochemistry	4
	ZC307P	Core Course-VII (Practical)		2
	ZS301	Skill Enhancement Course-1	**SEC-1: Any one course from I to III** I. Apiculture II. Medical Diagnostic III. Sericulture	4
	ZG303T	Generic Elective -3	GE-3	4
	ZG303P	Generic Elective -3 (Practical)		2
IV	ZC408T	Core course-VIII	Comparative anatomy of vertebrates	4
	ZC408P	Course-VIII (Practical)		2
	ZC409T	Core course-IX	Physiology: Life Sustaining Systems	4
	ZC409P	Course-IX (Practical)		2
	ZC410T	Core course-X	Biochemistry of Metabolic Processes	4
	ZC410P	Core Course- X (Practical)		2
	ZS402	Skill Enhancement Course-2	**SEC-2: Any one course from IV to V** IV. Aquarium Fish Keeping V. Research Methodology	4
	ZG404T	Generic Elective -4	GE-4	4
	ZG404P	Generic Elective -4 (Practical)		2
V	ZC511T	Core course-XI	Molecular Biology	4
	ZC511P	Core Course-XI (Practical)		2
	ZC512T	Core course-XII	Principles of Genetics	4
	ZC512P	Core Course-XII (Practical)		2
Discipline Specific Elective: Students may opt any two of the following courses (Two Theory courses along with relevant Practical courses)				

	ZD501T	Discipline Specific Elective -1	DSE-1: Animal Behaviour and Chronobiology	4
	ZD501P	Discipline Specific Elective- 1 (Practical/Tutorial)		2
	ZD502 T	Discipline Specific Elective-2	DSE 2: Computational Biology	4
	ZD502P	Discipline Specific Elective- 2 (Practical)		2
	ZD503T	Discipline Specific Elective-3	DSE 3: Endocrinology	4
	ZD503P	Discipline Specific Elective- 3 (Practical)		2
	ZD504T	Discipline Specific Elective-4	DSE 4: Biology of Insecta	4
	ZD504P	Discipline Specific Elective-4 (Practical)		2
	ZD 505T	Discipline Specific Elective-5	DSE 5: Basics of Neuroscience	4
	ZD505P	Discipline Specific Elective-5 (Practical)		2
VI	ZC613T	Core course-XIII	Developmental Biology	4
	ZC613P	Core Course-XIII (Practical/Tutorial)		2
	ZC614T	Core course-XIV	Evolutionary Biology	4
	ZC614P	Core Course-XIV (Practical/Tutorial)		2
	Discipline Specific Elective: Students may opt any two of the following courses (Two Theory courses along with relevant Practical courses)			
	ZD606T	Discipline Specific Elective -6	DSE-6: Animal Biotechnology	4
	ZD606P	Discipline Specific Elective -6 (Practical/Tutorial)		2
	ZD607T	Discipline Specific Elective-7	DSE-7: Fish and Fisheries	4
	ZD607P	Discipline Specific Elective -7 (Practical/Tutorial)		2
	ZD608T	Discipline Specific Elective-8	DSE-8: Immunology	4
	ZD608P	Discipline Specific Elective -8 (Practical/Tutorial)		2
	ZD609T	Discipline Specific Elective-9	DSE-9: Parasitology	4
	ZD609P	Discipline Specific Elective -9 (Practical/Tutorial)		2
	ZD610T	Discipline Specific Elective-10	DSE-10: Reproductive Biology	4
	ZD610P	Discipline Specific Elective -10 (Practical/Tutorial)		2
	ZD611T	Discipline Specific Elective-11	DSE-11: Wild Life Conservation and Management	4
	ZD611P	Discipline Specific Elective -11 (Practical/Tutorial)		2
				140

Coding pattern: Z = Zoology, C= Core Course, D = Discipline Specific Elective, G= General Elective, S = Skill Enhancement Course, T = Theory, P = Practical

CORE COURSES	
CC I	Non-chordates I: Protista to Pseudocoelomates
CC II	Perspectives in Ecology
CC III	Non-chordates II: Coelomates
CC IV	Cell Biology
CC V	Diversity of Chordates
CC VI	Physiology: Controlling and Coordinating Systems
CC VII	Fundamentals of Biochemistry
CC VIII	Comparative Anatomy of Vertebrates
CC IX	Physiology: Life Sustaining Systems
CC X	Biochemistry of Metabolic Processes
CC XI	Molecular Biology
CC XII	Principles of Genetics
CC XIII	Developmental Biology
CC XIV	Evolutionary Biology

DISCIPLINE SPECIFIC ELECTIVE COURSES	
DSE I	Animal Behaviour and Chronobiology
DSE II	Computational Biology
DSE III	Endocrinology
DSE IV	Biology of Insecta
DSE V	Basics of Neuroscience
DSE VI	Animal Biotechnology
DSE VII	Fish and Fisheries
DSE VIII	Immunology
DSE IX	Parasitology
DSE X	Reproductive Biology
DSE XI	Wild Life Conservation and Management

GENERIC ELECTIVE COURSES	
GE I	Animal Cell Biotechnology
GE II	Animal Diversity
GE III	Aquatic Biology
GE IV	Environment and Public Health
GE V	Exploring the Brain: Structure and Function
GE VI	Food, Nutrition and Health
GE VII	Human Physiology
GE VIII	Insect Vectors and Diseases

SKILL ENHANCEMENT COURSES	
SEC I	Apiculture
SEC II	Medical Diagnostics
SEC III	Sericulture
SEC IV	Aquarium Fish Keeping
SEC V	Research Methodology

Course Code: ZC101T

CORE COURSE I: NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

****The objective of the course is to expose the students to various forms of protozoa and worms; their classification and structural anatomy.***

THEORY **(Credits 4)**
(Total Lectures=60)

Unit 1: Protista, Parazoa and Metazoa **19 Lectures**

General characteristics and Classification up to Classes
Structural organization & nutrition of *Euglena*, *Amoeba* and *Paramecium*
Life cycle and pathogenicity of *Plasmodium vivax*
Locomotion and Reproduction in Animal protista (Protozoa) Evolution of symmetry and segmentation of Metazoa

Unit 2: Porifera **7 Lectures**

General characteristics and Classification up to classes
Canal system and spicules in sponges

Unit 3: Cnidaria **12 Lectures**

General characteristics and Classification up to classes
Metagenesis in *Obelia*
Polymorphism in Cnidaria
Corals and coral reefs

Unit 4: Ctenophora **4 Lectures**

General characteristics and Evolutionary significance

Unit 5: Platyhelminthes **10 Lectures**

General characteristics and Classification up to classes
Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*

Unit 6: Nemathelminthes **8 Lectures**

General characteristics and Classification up to classes
Life cycle, and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti*
Parasitic adaptations in helminthes

Note: Classification to be followed from –Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition‖
Question to be set giving weightage in proportion to the number of class shown against each unit.

Course Code: ZC101P
NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

PRACTICALS **(Credits 2)**

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

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

Course Code: ZC102T

CORE COURSE II:

PRINCIPLES OF

ECOLOGY

****The objective of the course is to familiarize the students with fundamentals of ecology and impacts of ecological factors on living organisms.***

THEORY **(Credits 4)**
(Lectures=60)

Unit 1: Introduction to Ecology **6 Lectures**

History of ecology, Autecology and synecology, Levels of organization,
Laws of limiting factors, Study of abiotic factors

Unit 2: Population **24 Lectures**

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 **12 Lectures**

Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with hydrosere
Theories pertaining to climax community

Unit 4: Ecosystem **14 Lectures**

Types of ecosystems with one example in detail (Forest 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 with Nitrogen cycle
as an example
Human modified ecosystem

Unit 5: Applied Ecology **4 Lectures**

Concept of wildlife conservation (Usefulness, causes and consequences of degradation); Management strategies

Course Code: ZC102P

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 quadrate 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) and free CO_2
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary/Reserved forest

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

Course Code: ZC203T

CORE COURSE III

NON-CHORDATES II: COELOMATES

The objective of the course is to expose the students to various forms of coelomates, their classification and structural anatomy

THEORY **(Credits 4)**
(Lectures=60)

Unit 1: Introduction to Coelomates **2 Lectures**

Evolution of coelom and metamerism

Unit 2: Annelida **10 Lectures**

General characteristics and Classification up to classes
Excretion in Annelida

Unit 3: Arthropoda **17 Lectures**

General characteristics and Classification up to classes
Vision and Respiration in Arthropoda
Metamorphosis in Insects
Social life in bees and termites

Unit 4: Onychophora **4 Lectures**

General characteristics and Evolutionary significance

Unit 5: Mollusca

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

Unit 6: Echinodermata **12 Lectures**

General characteristics and Classification up to classes
Water-vascular system in Asteroidea
Larval forms in
Echinodermata Affinities
with Chordates

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

Course Code: ZC203P

NO PRACTICAL (Credits 2)

N-CHORDATES II: COELOMATES

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. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm
3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
4. Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta**
5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

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). *TheInvertebrates: A New Synthesis,* III Edition, Blackwell Science
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson

Course Code: ZC204T

CORE COURSE IV CELL BIOLOGY

The objective of the course is to expose the students to structure and function of a cell as the fundamental unit of life.

THEORY **(Credits 4)**
(Lectures=60)

Unit 1: Overview of Cells **3** Lectures

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions

Unit 2: Plasma Membrane **7** Lectures

Various models of plasma membrane structure
Transport across membranes: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Desmosomes, Gap junctions

Unit 3: Endomembrane System **10** Lectures

Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Unit 4: Mitochondria and Peroxisomes **8** Lectures

Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes

Unit 5: Cytoskeleton **8** Lectures

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Unit 6: Nucleus **12** Lectures

Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus
Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Unit 7: Cell Division **8** Lectures

Mitosis, Meosis, Cell cycle and its regulation

Unit 8: Cell Signaling **4** Lectures

GPCR and Role of second messenger (cAMP)

Course Code: ZC204P
CELL BIOLOGY

PRACTICAL **(Credits 2)**

1. Preparation of temporary stained squash of any suitable material 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. Preparation of permanent slide to demonstrate:
    i. DNA by Feulgen reaction
    ii. DNA and RNA by MGP
    iii. Mucopolysaccharides by PAS reaction
    iv. Proteins by Mercurobromophenol blue/Fast Green

SUGGESTED READINGS

- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI 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.

Course Code: ZC305T

CORE COURSE V: DIVERSITY OF CHORDATA

The objective of the course is to expose the students to various forms of chordates, their classification and structural anatomy.

THEORY **(Credits 4)**
(Lectures=60)

Unit 1: Introduction to Chordates **2** Lectures

General characteristics and outline classification

Unit 2: Protochordata **8** Lectures

General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata

Unit 3: Origin of Chordata **3** Lectures

Dipleurula concept and the Echinoderm theory of origin of chordates
Advanced features of vertebrates over Protochordata

Unit 4: Agnatha **2** Lectures

General characteristics and classification of cyclostomes up to class

Unit 5: Pisces **8** Lectures

General characteristics of Chondrichthyes and Osteichthyes, classification up to order Migration, Osmoregulation and Parental care in fishes

Unit 6: Amphibia **6** Lectures

Origin of *Tetrapoda* (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians

Unit 7: Reptilia **7** Lectures

General characteristics and classification up to order; Affinities of *Sphenodon*; Poison apparatus and Biting mechanism in snakes

Unit 8: Aves **8** Lectures

General characteristics and classification up to order *Archaeopteryx*-- a connecting link; Principles and aerodynamics of flight, Flight adaptations and Migration in birds

Unit 9: Mammals **8** Lectures

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

Unit 10: Zoogeography **8** Lectures

Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms

Course Code: ZC305P

DIVERSITY OF CHORDATA

PRACTICAL **(Credits 2)**

1. Identification :

(i) Protochordata

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

(ii) Agnatha

Petromyzon, Myxine

(iii) Fishes

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

(iv) Amphibia

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

(v) Reptilia

Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus

Key for Identification of poisonous and non-poisonous snakes

(vi) Aves

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

(vii) Mammalia

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

2. Dissection of weberian ossicles of *Mystus,* pecten from Fowl head

3. Dissection of Fowl head (Dissections and mounts subject to permission)

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

4. To study and prepare a chart of keys of identification of poisonous and non- poisonous snakes. 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.

Course Code: ZC306T

CORE COURSE VI:

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

****The objective of this course is to provide a foundation for understanding the complexities of the coordination system of animal body.***

THEORY **(Credits 4)**
(Lectures=60)

Unit 1: Tissues **6 Lectures**

Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue

Unit 2: Bone and Cartilage

Structure and types of bones and cartilages, Ossification, bone growth and resorption

Unit 3: Nervous System **10 Lectures**

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; Physiology of hearing and vision.

Unit 4: Muscle **12 Lectures**

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 5: Reproductive System **10 Lectures**

Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female

Unit 6: Endocrine System **18 Lectures**

Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones; Regulation of their secretion; Mode of hormone action, Signal transduction pathways for steroidal and non- steroidal hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones

Course Code: ZC306P

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

PRACTICALS **(Credits 2)**

*1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
4. 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 slide of any five mammalian (Goat/white rat) tissues

(*Subject to UGC guidelines)

SUGGESTED BOOKS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt 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.

Course Code: ZC307T

CORE COURSE VII:

FUNDAMENTALS OF BIOCHEMISTRY

The objective of this course is to expose the students to biomolecules of living organisms, their interactions for perpetuation of life.

THEORY **(CREDITS 4)**
(Lectures=60)

Unit 1: Carbohydrates **8 Lectures**

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

Unit 2: Lipids **8 Lectures**

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

Unit 3: Proteins **14 Lectures**

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; Denaturation; Introduction to simple and conjugate proteins

Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants

Unit 4: Nucleic Acids **12 Lectures**

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, Hpyo-Hyperchromaticity of DNA

Unit 5: Enzymes **18 Lectures**

Nomenclature and classification; Cofactors; Specificity of action; enzymes; 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, Isozymes; Regulation of enzyme action.

Course Code: ZC307P

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 (theoretically).

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.

Course Code: ZC408T

CORE COURSE VIII: COMPARATIVE ANATOMY OF VERTEBRATES

THEORY **(CREDITS 4)**
(Lectures=60)

Unit 1: Integumentary System **8 Lectures**

Structure, functions and derivatives of integument

Unit 2: Skeletal System **8 Lectures**

Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches

Unit 3: Digestive System **8 Lectures**

Alimentary canal and associated glands, dentition

Unit 4: Respiratory System **8 Lectures**

Skin, gills, lungs and air sacs; Accessory respiratory organs

Unit 5: Circulatory System **8 Lectures**

General plan of circulation, evolution of heart and aortic arches

Unit 6: Urinogenital System **6 Lectures**

Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

Unit 7: Nervous System **8 Lectures**

Comparative account of brain
Autonomic nervous system, Spinal cord, Cranial nerves in mammals

Unit 8: Sense Organs **6 Lectures**

Classification of receptors
Brief account of visual and auditory receptors in man

Course Code: ZC408P

COMPARATIVE ANATOMY OF VERTEBRATES

PRACTICAL **(CREDITS 2)**

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, *Varanus*, Fowl, Rabbit
3. Mammalian skulls: One herbivorous and one carnivorous animal
4. Dissection of fish (carp) to study efferent and afferent branchial system(subject to permission)
5. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)

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

Course Code: ZC409T

CORE COURSE IX:

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

THEORY **(Credits 4)**
(Lectures=60)

Unit 1: Physiology of Digestion **14 Lectures**

Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.

Unit 2: Physiology of Respiration **12 Lectures**

Histology of trachea and lung; Mechanism of respiration, pulmonary ventilation; Respiratory volumes and capacities; Respiratory pigments, Transport of oxygen and carbon dioxide in blood; Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration

Unit 3: Renal Physiology **8 Lectures**

Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance

Unit 4: Blood **14 Lectures**

Components of blood and their functions; Structure and functions of haemoglobin Haemostasis: Blood clotting system, Kallikrein-Kinninogen system, Complement system& Fibrinolytic system, Haemopoiesis Blood groups: Rh factor, ABO and MN

Unit 5: Physiology of Heart **12 Lectures**

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

Course Code: ZC409P

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

PRACTICALS **(CREDITS 2)**

1. Determination of ABO Blood group and Rh factor
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of frog's heart beat under *in situ* and perfused conditions*
6. Recording of blood pressure using a sphygmomanometer
7. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney

(*Subject to UGC guidelines)

SUGGESTED READINGS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt 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

Course Code: ZC410T

CORE COURSE X:

BIOCHEMISTRY OF METABOLIC PROCESSES

THEORY **(CREDITS 4)**
(Lectures=60)

Unit 1: Overview of Metabolism — 10 Lectures

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; basics of intermediary metabolism and overview of regulatory strategies

Unit 2: Carbohydrate Metabolism — 16 Lectures

Sequence of reactions and pathways of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis

Unit 3: Lipid Metabolism — 14 Lectures

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

Unit 4: Protein Metabolism — 10 Lectures

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

Unit 5: Oxidative Phosphorylation — 10 Lectures

Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

Course Code: ZC410P

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 or GST and GSH in serum/ tissue
3. To study the enzymatic activity of Trypsin and Lipase.
4. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.
5. Dry Lab: To trace the labelled C atoms of Acetyl-CoA till they evolve as CO_2 in the TCA cycle

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.

Course Code: ZC511T

CORE COURSE XI:
MOLECULAR BIOLOGY

THEORY **(CREDITS 4)**

(Lectures=60)

Unit 1: Nucleic Acids **4 Lectures**

Salient features of DNA and RNA
Watson and Crick model of DNA

Unit 2: DNA Replication **12 Lectures**

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,

Unit 3: Transcription **10 Lectures**

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

Unit 4: Translation **12 Lectures**

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 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA **6 Lectures**

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

Unit 6: Gene Regulation **10 Lectures**

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, Genetic imprinting

Unit 7: DNA Repair Mechanisms **3 Lectures**

Pyrimidine dimerization and mismatch repair

Unit 8: Regulatory RNAs **3 Lectures**

Concept of Ribo-switches, RNA interference, miRNA, siRNA

Course Code: ZC511P

MOLECULAR BIOLOGY

PRACTICAL **(CREDITS 2)**

1. Study of Polytene chromosomes from Chironomous / Drosophila larvae
2. Preparation of liquid culture medium (LB) and innoculation
3. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking
4. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent)
5. Quantitative estimation of RNA using Orcinol reaction
6. 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.

Course Code: ZC512T

CORE COURSE XII: PRINCIPLES OF GENETICS

THEORY **(CREDITS 4)**
(Lectures=60)

Unit 1: Mendelian Genetics and its Extension **8 Lectures**

Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping **12 Lectures**

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, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

Unit 3: Mutations **10 Lectures**

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; Detection of mutations: CLB method, attached *X* method.

Unit 4: Sex Determination **4 Lectures**

Chromosomal mechanisms of sex determination in Drosophila and Man

Unit 5: Extra-chromosomal Inheritance **6 Lectures**

Criteria for extra-chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*, Mitochondrial mutations in *Saccharomyces,* Infective heredity in *Paramecium* and Maternal effects

Unit 6: Polygenic Inheritance **3 Lectures**

Polygenic inheritance with suitable examples; simple numericals based on it.

Unit 7: Recombination in Bacteria and Viruses **9 Lectures**

Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 8: Transposable Genetic Elements **8 Lectures**

Transposons in bacteria, Ac-Ds elements in maize and P elements in *Drosophila*, Transposons in humans

Course Code: ZC512P

PRINCIPLES OF GENETICS

PRACTICALS **(CREDITS 2)**

1. To study the Mendelian laws and gene interactions (based on theory)
2. Chi-square analyses using seeds/beads/*Drosophila*.
3. Linkage maps based on data from conjugation, transformation and transduction.
4. Linkage maps based on data from *Drosophila* crosses.
5. Study of human karyotype (normal and abnormal) based on data.
6. Pedigree analysis of some human inherited traits.

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India
- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings
- Russell, P. J. (2009). *Genetics- A Molecular Approach.*III Edition. Benjamin Cummings
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co
- Fletcher H. and Hickey I. (2015). *Genetics.* IV Edition. GS, Taylor and Francis Group, New York and London.

Course Code: ZC613T
CORE COURSE XIII:
DEVELOPMENTAL BIOLOGY

THEORY **(CREDITS 4)**
(Lectures=60)

Unit 1: Introduction **4 Lectures**

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

Unit 2: Early Embryonic Development **28 Lectures**

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 3: Late Embryonic Development **8 Lectures**

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 **12 Lectures**

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

Unit 5: Implications of Developmental Biology **8 Lectures**

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

Course Code: ZC613P

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. Study of the developmental stages and life cycle of *Drosophila* from stock culture
4. Study of different sections of placenta (photomicropgraph/ slides)
5. 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

Course Code: ZC614T
CORE COURSE XIV:

EVOLUTIONARY BIOLOGY

THEORY **(CREDITS 4)**

(Lectures=60)

Unit 1: **7 Lectures**

Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes

Unit 2: **4 Lectures**

Historical review of evolutionary concept: Lamarckism, Darwinism, Neo- Darwinism

Unit 3: **10 Lectures**

Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, three domains of life, neutral theory of molecular evolution, molecular clock ,example of globin gene family

Unit 4: **8 Lectures**

Sources of variations: Heritable variations and their role in evolution

Unit 5: **13 Lectures**

Basic concept of 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, 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 6: **7 Lectures**

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

Unit 7: **2 Lectures**

Extinctions; Back ground and mass extinctions (causes and effects), detailed example of K-T extinction

Unit 8: **6 Lectures**

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

Unit 9: 2 **Lectures**

Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees

Course Code: ZC614P
EVOLUTIONARY BIOLOGY

PRACTICALS **(CREDITS 2)**

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.

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

Course Code: ZD501T

DSE Course I:

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

THEORY **(Credits 4)**

(**Lectures=60**)

Unit 1: Introduction to Animal Behavior **7 Lectures**

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

Unit 2: Patterns of Behaviour **10** Lectures

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 **14 Lectures**

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: Introduction to Chronobiology **9** Lectures

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

Unit 5: Biological Rhythm **13** Lectures

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.

Unit 8: Biological Clocks **7**

Relevance of biological clocks; Chronopharmacology, Chronomedicine, Chronotherapy.

Course Code: ZD501P
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 of circadian functions in humans (daily eating, sleep and temperature patterns).

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. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
- Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rd Ed) 2002 Barens and Noble Inc. New York, USA
- Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

Course Code: ZD502T

DSE Course: II COMPUTATIONAL BIOLOGY

THEORY **(Credits 4)**
(Lectures=60)

Unit 1: Introduction to Bioinformatics **5 Lectures**

Importance, Goal, Scope; Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics, Molecular Phylogeny; Applications and Limitations of Bioinformatics

Unit 2: Biological Databases **10 Lectures**

Introduction to biological databases; Primary, secondary and composite databases; Nucleic acid databases (GenBank, DDBJ, EMBL and NDB); Protein databases (PIR, SWISS-PROT, TrEMBL, PDB); Metabolic pathway database (KEGG, EcoCyc, and MetaCyc); Small molecule databases (PubChem, Drug Bank, ZINC, CSD)

Unit 3: Data Generation and Data Retrieval **14 Lectures**

Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)

Unit 3: Basic Concepts of Sequence Alignment **14 Lectures**

Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Local and global alignment, pair wise and multiple sequence alignments; Similarity, identity and homology of sequences.

Unit 4: Applications of Bioinformatics **7 Lectures**

Structural Bioinformatics (3-D protein, PDB), Functional genomics (genome- wide and high throughput approaches to gene and protein function), Drug discovery method (Basic concepts)

Unit 5: Biostatistics **10 Lectures**

Introduction, calculation of standard deviation, standard error, Co-efficient of Variance, Chi-square test, Z test, t-Test

Course Code: ZD502P
COMPUTATIONAL BIOLOGY

PRACTICAL (Credits 2)

1. Accessing biological databases
2. Retrieval of nucleotide and protein sequences from the databases.
3. To perform pair-wise alignment of sequences (BLAST) and interpret the output
4. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequences
5. Predict the structure of protein from its amino acid sequence by using homology modeling technique
6. To perform a –two-sample t- test‖ for a given set of data
7. To learn graphical representations of statistical data with the help of computers (e.g. MS Excel).

SUGGESTED READINGS

- Ghosh Z and Mallick B. (2008). Bioinformatics: *Principles and Applications*, Oxford University Press.
- Pevsner J. (2009). *Bioinformatics and Functional Genomic*s, II Edition, Wiley Blackwell.
- Zvelebil, Marketa and Baum O. Jeremy (2008). *Understanding Bioinformatics*, Garland Science, Taylor and Francis Group, USA.
- Zar, Jerrold H. (1999). *Biostatistical Analysis*, IV Edition, Pearson Education Inc and Dorling Kindersley Publishing Inc. USA
- Antonisamy, B., Christopher S. and Samuel, P. P. (2010). *Biostatistics: Principles and Practice*. Tata McGraw Hill Education Private Limited, India.
- Pagana, M. and Gavreau, K. (2000). *Principles of Biostatistics*, Duxberry Press, USA

Course Code: ZD503T
DSE Course III:
ENDOCRINOLOGY

THEORY **(Credits 4)**

(Lectures=60)

Unit 1: **Introduction to Endocrinology** **12 Lectures**

History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

Unit 2: Epiphysis, Hypothalamo-hypophysial Axis **15 Lectures**

Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction.

Structure of hypothalamus, Hypothalamic nuclei and their functions, Regulation of neuroendocrine glands, Feedback mechanisms

Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophysial portal system, Disorders of pituitary gland.

Unit 3: Peripheral Endocrine Glands **18 Lectures**

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis

Unit 4: Regulation of Hormone Action **15 Lectures**

Hormone action at Cellular level and molecular level:

Hormone receptor : signal transducer, second messenger
Hormones in homeostasis, Disorders of endocrine glands

Course Code: ZD503P

ENDOCRINOLOGY

PRACTICAL **(Credits 2)**

1. Dissect and display of Endocrine glands in laboratory bred (virtual) rat*
2. Study of the permanent slides of all the endocrine glands
3. Study of estrus cycle in bred rat*
4. Demonstration of Castration/ ovariectomy in laboratory bred rat*

 *** Subject to UGC guidelines**

SUGGESTED READINGS

- General Endocrinology C. Donnell Turner Pub- Saunders Toppan
- Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead.
- Oxford: BIOS Scientific Publishers; 2001.
- Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey.
- Vertebrate Endocrinology by David O. Norris,

Course Code: ZD504T

DSE Course IV: BIOLOGY OF INSECTA

THEORY **(Credits 4)**

(Lectures=60)

Unit I: Introduction **4** Lectures

General Features of Insects

Distribution and Success of Insects on the Earth

Unit II: Insect Taxonomy **4** Lectures

Basis of insect classification; Classification of insects up to orders

Unit III: General Morphology of Insects **8** Lectures

External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits

Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat

Abdominal appendages and genitalia

Unit IV: Physiology of Insects **28** Lectures

Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine and reproductive.

Sensory receptors and nervous system

Growth and metamorphosis

Unit IV: Insect Society **6** Lectures

Group of social insects and their social life

Social organization and social behaviour (w.r.t. any one example)

Unit V: Insect Plant Interaction **4** Lectures

Theory of co-evolution, role of allelochemicals in host plant mediation

Host-plant selection by phytophagous insects, Insects as plant pests

Unit VI: Insects as Vectors **6** Lectures

Insects as mechanical and Biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors

Course Code: ZD504P
BIOLOGY OF INSECTA

PRACTICAL **(CREDITS 2)**

1. Study of one specimen from each insect order
2. Study of different kinds of antennae, legs and mouth parts of insects
3. Study of head and sclerites of any one insect
4. Study of insect wings and their venation.
5. Prepare permanent slide of insect spiracles
6. Methodology of collection, preservation and identification of insects.
7. Morphological studies of various castes of *Apis,* and *Odontotermes*
8. Study of any three insect pests and their damages
9. Study of any three beneficial insects and their products

Field study of insects and submission of a project report on the insect diversity

SUGGESTED READINGS

- A general text book of entomology, Imms , A. D., Chapman & Hall, UK
- The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
- Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
- Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
- The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
- Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA
- Physiological system in Insects, Klowden, M. J., Academic Press, USA
- The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK
- Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA

Course Code: ZD505T
DSE Course V:
BASICS OF NEUROSCIENCE

THEORY **(Credits 4)**

(Lectures=60)

Unit 1: Introduction to Neuroscience **6 Lectures**

Origins of Neuroscience; Neuroanatomy, Neurophysiology, and Systems Neurobiology

UNIT 2: The Nervous system-An Introduction **14 Lectures**

Introduction to the structure and function of the nervous system: Cellular components: Neurons; Neuroglia; Neuron doctrine; The prototypical neuron – axons and dendrites as unique structural components of neurons. The ionic bases of resting membrane potential; The action potential- its generation and properties; The action potential conduction.

UNIT 3: Cellular and Molecular Neurobiology **14 Lectures**

Molecular and cellular approaches used to study the CNS at the level of single molecules, Synapse: Synaptic transmission, Principles of synaptic integration; EPSPs and IPSPs. Ion channels, Neural transmission,

Unit 4. Neurotransmitters **10 Lectures**

Different types of neurotranmitters– catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels; G-protein coupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.

UNIT 5: Neurobiology and Neuropharmacology of Behaviour **16 Lectures**

The principles of signal transduction and information processing in the vertebrate central nervous system, and the relationship of functional properties of neural systems with perception and behavior; sensory systems, molecular basis of behavior including learning and memory. Molecular pathogenesis of pain and neurodegenerative diseases such as Parkinson's, Alzheimer's, psychological disorders, addiction.

Course Code: ZD505P
BASICS OF NEUROSCIENCE

PRACTICAL **(CREDITS 2)**

1. Nerve Cell preparation from the spinal cord.
2. Study of neurons and/ or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
3. Study of olfaction in Drosophila.
4. Study of novelty, anxiety and spatial learning in mice.

SUGGESTED READINGS

- Neuroscience: Exploring the brain by Mark F. Baer; Barry W. Connors. 2015
- From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham
- Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates, Inc.-2004
- Principles of Neural Science-4th Edn-Eds. Kandel, Schwartz and Jessell- McGraw-Hill Companies-2000
- Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David Young- CUP-2003
- Essential Psychopharamacology-Neuroscientific Basis and Practical Applications- 2nd Edn.-Stephan M. Stahl-CUP-2000
- Phantoms in the Brain - Vilayanur S. Ramachandran and Sandra Blakeslee-1998
- The Human Brain Book - Rita Carter-2009

Course Code: ZD606T

DSE Course VI:

ANIMAL BIOTECHNOLOGY

THEORY **(Credits 4)**
(Lectures=60)

Unit 1. Introduction **8 Lectures**

Concept and scope of biotechnology

Unit 2. Molecular Techniques in Gene manipulation **24 Lectures**

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics).

Restriction enzymes: Nomenclature, detailed study of Type II.

Transformation techniques: Calcium chloride method and

electroporation.

Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

Southern blotting,

DNA sequencing: Sanger method

Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

Unit 3. Genetically Modified Organisms **18 Lectures**

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.

Applications of transgenic plants: insect and herbicide resistant plants.

Unit 4. Culture Techniques and Applications **10 Lectures**

Animal cell culture, expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)

Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy

Course Code: ZD606P

ANIMAL BIOTECHNOLOGY

PRACTICAL **(Credits 2)**

1. Genomic DNA isolation from *E. coli*
2. Plasmid DNA isolation (pUC 18/19) from *E. coli*
3. Restriction digestion of 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. PCR
   c. DNA fingerprinting
7. Project report on animal cell culture

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.

Course Code: ZD607T

DSE Course - VII:

FISH AND FISHERIES

THEORY **(Credits 4)**
(Lectures=60)

UNIT 1: Introduction and Classification: **6 Lectures**

General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction.

UNIT 2: Morphology and Physiology: **18 Lectures**

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; Communication in teleosts; Reproductive strategies (special reference to Indian fishes); Electric organs; Bioluminiscience; Mechanoreceptors; Schooling; Parental care; Migration

UNIT 3: Fisheries **12 Lectures**

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

Unit 4: Aquaculture **20** Lectures

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Fungal, Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by- products

UNIT 5: Fish in research **4 Lectures**

Transgenic fish, Zebrafish as a model organism in research

Course Code: ZD607P
FISH AND FISHERIES

PRACTICAL **(Credits 2)**

1. Morphometric and meristic characters of fishes
2. Study of *Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Sardinella, Tenualosa, Mugil, Gambusia, Labeo, Heteropneustes, Anabas*
3. Study of different types of scales (through permanent slides/ photographs).
4. Study of crafts and gears used in Fisheries
5. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
6. Study of air breathing organs in *Channa, Heteropneustes, Anabas* and *Clarias*
7. 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

Course Code: ZD608T
DSE Course VIII:
IMMUNOLOGY

THEORY **(Credits 4)**

(Lectures=60)

Unit 1: Overview of Immune System 10 **Lectures**

Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system

Unit 2: Innate and Adaptive Immunity 10 **Lectures**

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 3: Antigens

8 **Lectures**

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

Unit 4: Immunoglobulins

12 **Lectures**

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 5: Major Histocompatibility Complex

7 **Lectures**

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

Unit 6: Cytokines

4 **Lectures**

Properties and functions of cytokines, Therapeutics Cytokines

Unit 7: Complement System

4 **Lectures**

Components and pathways of complement activation.

Unit 8: Vaccines **5 Lectures**

Various types of vaccines.

Course Code: ZD608P

IMMUNOLOGY

PRACTICAL **(Credits 2)**

1.* Demonstration of lymphoid organs (by video)

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. Ouchterlony's double immuno-diffusion method.

5. ABO blood group determination.

6. Demonstration of ELISA

* The experiments can be performed depending upon usage of animals in UG courses.

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.

Course Code: ZD609T

DSE Course X: PARASITOLOGY

THEORY **(CREDITS 4)**
(Lectures=60)

Unit I: Introduction to Parasitology **3 Lectures**

Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship

Unit II: Parasitic Protists **15 Lectures**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani, Plasmodium vivax*

Unit III: Parasitic Platyhelminthes **15 Lectures**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciolopsis buski, Schistosoma haematobium, Taenia solium* and *Hymenolepis nana*

Unit IV: Parasitic Nematodes **15 Lectures**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti* and *Trichinella spiralis.* Study of structure, life cycle and importance of *Meloidogyne* (root knot nematode), *Pratylencus* (lesion nematode)

Unit IV: Parasitic Arthropoda **10 Lectures**

Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse), *Xenopsylla cheopis* and *Cimex lectularius*

Unit V: Parasitic Vertebrates **2 Lectures**

A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat

Course Code: ZD609P
PARASITOLOGY

PRACTICAL **(Credits2)**

- Study of life stages of *Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani* and *Plasmodium vivax* through permanent slides/micro photographs
- Study of adult and life stages of *Fasciolopsis buski, Schistosoma haematobium, Taenia solium* and *Hymenolepis nana* through permanent slides/micro photographs
- Study of adult and life stages of *Ascaris lumbricoides*, *Ancylostoma duodenale, Wuchereria bancrofti* and *Trichinella spiralis* through permanent slides/micro photographs
- Study of plant parasitic root knot nematode, *Meloidogyne* from the soil sample
- Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs
- Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]

Submission of a brief report on parasitic

vertebrates SUGGESTED READINGS

- Arora, D. R and Arora, B. (2001) *Medical Parasitology*. II Edition. CBS Publications and Distributors
- E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger
- Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) *Biology of Disease.* Taylor and Francis Group
- Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
- Rattan Lal Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
- Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
- K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS ***Publishers*** & Distributors (P) Ltd.

Course Code: ZD610T
DSE Course X:
REPRODUCTIVE BIOLOGY

THEORY **(CREDITS 4)**
(Lectures=60)

Unit 1: Reproductive Endocrinology **15 Lectures**

Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

Unit 2: Functional anatomy of male reproduction **15** Lectures

Outline and histological study of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal; Spermatogenesis: hormonal regulation; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract

Unit 3: Functional anatomy of female reproduction **20** Lectures

Outline and histological study of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; implantation, gestation, parturition, Lactation

Unit 4: Reproductive Health **10** Lectures

Infertility in male and female: causes; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning

Course Code: ZD610P

REPRODUCTIVE BIOLOGY

PRACTICAL **(CREDITS 2)**

1. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
2. Examination of vaginal smear rats from live animals.
3. Surgical techniques: principles of surgery in endocrinology. Ovarectomy, hysterectorny, castration and vasectomy in rats.
4. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
5. Study of modern contraceptive devices

SUGGESTED READINGS

- Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
- Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
- Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
- Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.

Course Code: ZD611T

DSE Course XI:

WILD LIFE CONSERVATION AND MANAGEMENT

THEORY **(CREDITS 4)**

(Lectures=60)

Unit 1: Introduction to Wild Life **5** Lectures

Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

Unit 2: Evaluation and management of wild life **11 Lectures**

Habitat analysis, Physical parameters: Topography, Geology, Soil and water; Biological Parameters: food, cover, forage, browse and cover estimation; Standard evaluation procedures: remote sensing and GIS.

Unit 3: Management of habitats **9 Lectures**

Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats

Unit 4: Population estimation **12** Lectures

Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

Unit 5: Management planning of wild life in protected areas **7 Lectures**

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

Unit 7: Management of excess population **7 Lectures**

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

Unit 8: Protected areas **9 Lectures**

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

Course Code: ZD611P
WILD LIFE CONSERVATION AND MANAGEMENT

PRACTICALS **(CREDITS 2)**

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna (Museum Specimens)
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 for population study
5. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

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,* 5 th 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 I:
ANIMAL CELL BIOTECHNOLOGY

THEORY **(CREDITS 4)**
(Lectures=60)

UNIT 1: Introduction **5 Lectures**

Concept and Scope of Biotechnology

UNIT2:Techniques in Gene manipulation **15 Lectures**

Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes, Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids, BAC, YAC, HAC. Shuttle and Expression Vectors**.**

12 Lectures

UNIT 3: Animal cell Culture

Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures.

Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting.

UNIT 4: Fermentation **8 Lectures**

Different types of Fermentation: Submerged & Solid state; batch, Fed batch &Continuous; Fixed Bed and Fluidized.

Downstream Processing: Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization.

UNIT 5: Transgenic Animal Technology

Production of transgenic animals: nuclear transplantation, Retroviral method, DNA microinjection method, Dolly and Polly.

UNIT6: Application in Health **8 Lectures**

Development of recombinant Vaccines, Hybridoma technology, Gene Therapy.

Production of recombinant Proteins: Insulin and growth hormones.

UNIT 7: Bio safety Physical and Biological containment. 4 **Lectures**

GE I: ANIMAL CELL BIOTECHNOLOGY

PRACTICAL **(CREDITS 2)**

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from *E. coli*/animals/ human.
4. Plasmid DNA isolation (pUC 18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).
5. Restriction digestion of lambda (λ) DNA using EcoR1 and Hind III.
6. Techniques: PCR, Southern Blot

SUGGESTED READINGS

- Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited.
- Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
- P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003).
- B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001).
- T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science (2001).
- Bernard R. Click & Jack J. Pasternak: Molecular Biotechnology, ASM Press, Washington (1998).
- Methods in Gene Biotechnology, W. Wu, M.J. Welsh, P.B. Kaufman & H.H. Zhang, 1997, CRC Press, New York
- 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 & Co., N.Y., USA

GE II:ANIMAL DIVERSITY

THEORY **(CREDITS 4)**
(Lectures=60)

Unit 1. Protista **4 Lectures**
General characters of Protozoa; Life cycle of Plasmodium

Unit 2. Porifera **3 Lectures**
General characters and canal system in Porifera

Unit 3. Radiata **3 Lectures**
General characters of Cnidarians and polymorphism

Unit 4. Aceolomates **3 Lectures**
General characters of Helminthes; Life cycle of *Taenia solium*

Unit 5. Pseudocoelomates **3 Lectures**
General characters of Nemethehelminthes; Parasitic adaptations

Unit 6. Coelomate Protostomes **3 Lectures**
General characters of Annelida ; Metamerism.

Unit 7. Arthropoda **4 Lectures**
General characters. Social life in insects.

Unit 8. Mollusca **3 Lectures**
General characters of mollusca; Pearl Formation

Unit 9. Coelomate Deuterostomes **3 Lectures**
General characters of Echinodermata, Water Vascular system in Starfish.

Unit 10. Protochordata **2 Lectures**
Salient features

Unit 11. Pisces **4 Lectures**
Osmoregulation, Migration of Fishes

Unit 12. Amphibia **4 Lectures**
General characters, Adaptations for terrestrial life, Parental care in Amphibia.

Unit 13. **5 Lectures**
Amniotes; Origin of reptiles. Terrestrial adaptations in reptiles.

Unit 14. Aves: **5 Lectures**
The origin of birds; Flight adaptations

Unit 15. Mammalia **6 Lectures**
Early evolution of mammals; Primates; Dentition in mammals.

GE II: ANIMAL 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, Icthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx,* any three common birds-*(Crow, duck, Owl),* Squirrel and Bat.
2. Study of following Permanent Slides:
   Cross section of Sycon, Sea anemone and *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.

4. Dissections of
   - Digestive and nervous system of Cockroach.
   - Urinogenital system of fish

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 III: AQUATIC BIOLOGY

THEORY **(Credits 4)**

(Lectures=60)

UNIT 1: Aquatic Biomes **10** Lectures

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 **15** Lectures

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.
River: Ecology of river, riverine biota (Fish, prawn, molluscs and mammals) **Streams:** Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes, coldwater fishes

UNIT 3: Marine Biology **10** Lectures

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds, major fishes and invertebrate groups

UNIT 4: Wetland Biology **15** Lectures

Definition & types of wetlands, major wetlands in Assam, wetland biota: Major inverterbartes (insects & prawns) and vertebrates (fish, reptiles and avian fauna)

UNIT 5: Management of Aquatic Resources **10** Lectures

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

GE III: AQUATIC BIOLOGY

PRACTICAL **(Credits 2)**

1. Determine the area of a freshwater body 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 bio- reserve/Fisheries Institutes/Wetlands

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

GE IV: ENVIRONMENT AND PUBLIC HEALTH

THEORY **(Credits 4)**
(Lectures=60)

UNIT I: Introduction **12** Lectures

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

UNIT II Climate Change **10** Lectures

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

Unit III Pollution **10** Lectures

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

Unit IV Waste Management Technologies **18** Lectures

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 5 Diseases **10** Lectures

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

GE IV: ENVIRONMENT AND PUBLIC HEALTH

PRACTICAL **(Credits 2)**

1. To determine pH, Cl, SO_4, NO_3 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 V:

EXPLORING THE BRAIN: STRUCTURE AND FUNCTION

THEORY **(Credits 4)**
(Lectures=60)

Unit 1: Introduction: **5 Lectures**

Early and Nineteenth century views of the Brain; Neuroscience today; Evolution of brain in vertebrates

Unit 2: Neurons and Glia: **4 Lectures**

Neurons – Soma, Axon, Dendrite; Classification of Neurons; Glia – Astrocytes, Myelinating Glia, Non-nueornal cells

Unit 3: Evolution and Adaptation of Brain: **8 Lectures**

Brain evolution and behavioral adaptation; Theories of brain evolution – involving addition of structure or areas, involving new formation and reorganization of circuits.

Unit 4: Organization of the Brain: **10 Lectures**

Anatomical references, Cerebrum, cerebellum, brain stem, spinal cord; Cranial nerves, Meninges, ventricular system; CT and MRI imaging of the brain

Unit 5: Understanding Brain Structure through Development: **10 Lectures**

Formation of neural tube, Primary brain vesicles; Differentiation of forebrain, midbrain and hindbrain. Cerebral cortex – neocortical evolution and structure-function relationship

Unit 6: Chemical Control of Brain and Behaviour: **8 Lectures**

Structure and connection of the secretory hypothalamus; Diffuse modulatory systems of the brain – noradrenergic, serotonergic, dominergic and cholinergic system; Drugs and diffuse modulatory systems.

Unit 7: Rhythms of the Brain: **7 Lectures**

Electroencephalogram; Sleep – why do we sleep, Non-REM and REM sleep, neural mechanisms of sleep; Circadian rhythms.

Unit 8: Mental illness and the Brain: **8 Lectures**

Psychosocial and biological approaches to mental illness; Anxiety disorders; Mood disorders; Schizophrenia.

GE V: EXPLORING THE BRAIN: STRUCTURE AND FUNCTION

PRACTICAL **(CREDITS 2)**

1. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.

SUGGESTED READINGS

1. Neuroscience: Exploring the Brain by Mark F. Bear, Barry W. Connors and Michael A. Paradiso.
2. Comparative vertebrate Neuroanatomy by Ann B. Butler and William Hoods.

Project work/ Home assignment

GE VI: FOOD, NUTRITION AND HEALTH

THEORY **(Credits 4)**
(Lectures=60)

Unit 1: Basic concept of food and nutrition **10 Lectures**

Food Components and food-nutrients

Concept of a balanced diet, nutrient needs and dietary pattern for various groups-adults, pregnant and nursing mothers, infants, school children, adolescents and elderly

Unit 2: Nutritional Biochemistry: **20 Lectures**

Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role

Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance

Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their Biological functions

Unit 3: Health **15 Lectures**

Introduction to health- Definition and concept of health Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programmes, if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention Common ailments- cold, cough, and fevers, their causes and treatment

Unit 4: Food hygiene: **15 Lectures**

Potable water- sources and methods of purification at domestic level Food and Water borne infections: **Bacterial infection**: Cholera, typhoid fever, dysentery; **Viral infection**: Hepatitis, Poliomyelitis, **Protozoan infection**: amoebiasis, giardiasis; **Parasitic infection**: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention

Brief account of food spoilage: Causes of food spoilage and their preventive measures

GE VI: FOOD, NUTRITION AND HEALTH

PRACTICAL **(Credits 2)**

1. Estimation of Lactose in milk
2. Ascorbic acid estimation in food by titrimetry
3. Estimation of Calcium in foods by titrimetry
4. Study of the stored grain pests from slides/ photograph(*Sitophilus oryzae*, *Trogoderma granarium*, *Callosobruchus chinensis* and *Tribolium castaneum*): their identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests.
5. Project- Undertake computer aided diet analysis and nutrition counseling for different age groups.

OR

Identify nutrient rich sources of foods **(fruits and vegetables),** their seasonal availability and price

OR

Study of nutrition labeling on selected foods

SUGGESTED BOOKS

- Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers
- Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
- Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
- Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
- Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co. Pvt Ltd.
- Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
- Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence.
- Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd.
- Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing

GE VII: HUMAN PHYSIOLOGY

THEORY **(CREDITS 4)**
(Lectures=60)

Unit 1: Digestion and Absorption of Food **12 Lectures**

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

Unit 2: Functioning of Excitable Tissue (Nerve and Muscle) **10 Lectures**

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 **6 Lectures**

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

Unit 4: Renal Physiology **8 Lectures**

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

Unit 5: Cardiovascular Physiology **10 Lectures**

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

Unit 6: Endocrine and Reproductive Physiology **14 Lectures**

Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle

GE VII: HUMAN PHYSIOLOGY

PRACTICAL **(CREDITS 2)**

1. Preparation of temporary mount of Blood film.
2. Preparation of haemin and haemochromogen crystals.
3. Estimation of haemoglobin using Sahli's haemoglobinometer.
4. Study of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary and nerve cells

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 VIII:
INSECT VECTORS AND DISEASES

THEORY **(Credits 4)**
(Lectures=60)

Unit I: Introduction to Insects **6** Lectures

General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits

Unit II: Concept of Vectors **6** Lectures

Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity

Unit III: Insects as Vectors **8 Lectures**

Classification of insects up to orders, detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit IV: Dipteran as Disease Vectors **24 Lectures**

Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies;

Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Control of mosquitoes

Study of sand fly-borne diseases – Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly

Study of house fly as important mechanical vector, Myiasis, Control of house fly

Unit IV: Siphonaptera as Disease Vectors **6 Lectures**

Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas

Unit V: Siphunculata as Disease Vectors **4 Lectures**

Human louse (Head, Body and Pubic louse) as important insect vectors; Study of louse-borne diseases –Typhus fever, Relapsing fever, Trench fever
Control of human louse

Unit VI: Hempitera as Disease Vectors **6 Lectures**

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures

GE VIII : INSECT VECTORS AND DISEASES

PRACTICAL **CREDITS -2**

1. Study of different kinds of mouth parts of insects
2. Study of following insect vectors through permanent slides/ photographs: *Aedes, Culex, Anopheles, Pediculus humanus capitis, Pediculus humanus corporis, Phithirus pubis, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica,* through permanent slides/ photographs
3. Study of different diseases transmitted by above insect vectors

Submission of a project report on any one of the insect vectors and disease transmitted

SUGGESTED READINGS

- Imms, A.D. (1977). *A General Text Book of Entomology*. Chapman & Hall, UK
- Chapman, R.F. (1998). *The Insects: Structure and Function.* IV Edition, Cambridge University Press, UK
- Pedigo L.P. (2002). *Entomology and Pest Management.* Prentice Hall Publication
- Mathews, G. (2011). *Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases*. Wiley-Blackwell

SKILL ENHANCEMENT COURSES

SEC I: APICULTURE

(CREDITS 2)
(Lectures=30)

THEORY

Unit 1: Biology of Bees (4)

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

Unit 2: Rearing of Bees **10 Lectures**

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 **5 Lectures**

Bee Diseases and Enemies
Control and Preventive measures

Unit 4: Bee Economy **2 Lectures**

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

Unit 5: Entrepreneurship in Apiculture **4 Lectures**

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.

SEC II: MEDICAL DIAGNOSTICS

THEORY **(Credits 2)**
(Lectures=30)

Unit 1: Introduction to Medical Diagnostics and its Importance **2 Lectures**

Unit 2: Diagnostics Methods Used for Analysis of Blood **10 Lectures**
Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)

Unit 3: Diagnostic Methods Used for Urine Analysis **6 Lectures**
Urine Analysis: Physical characteristics; Abnormal constituents

Unit 4:Non-infectious Diseases **6 Lectures**
Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit

Unit 5: Infectious Diseases **3 Lectures**
Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis

Unit 6: Tumours **3 Lectures**
Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, MRI and CT Scan (using photographs).

SUGGESTED READINGS

- Park, K. (2007), *Preventive and Social Medicine*, B.B. Publishers
- Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House
- Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
- Guyton A.C. and Hall J.E. T*extbook of Medical Physiology*, Saunders
- Robbins and Cortan, *Pathologic Basis of Disease*, VIIIEdition, Saunders
- Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd.

SEC III: SERICULTURE

THEORY **(CREDITS 2)**
(Lectures=30)

Unit 1: Introduction **3 Lectures**

Sericulture: Definition, history and present status; Silk route

Types of silkworms, Distribution and Races
Exotic and indigenous races, Hybrids
Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm **3 Lectures**
Life cycle of *Bombyx mori*
Structure of silk gland and secretion of silk
Sex linked traits

Unit 3: Rearing of Silkworms **15 Lectures**
Mulberry silkworm rearimg : 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
Non mulberry silkworm rearing: Host plants of non mulberry silkworm, maintenance of host palnts of *Anthereae assama*, rearing technology of *Anthereae spp* and *Samia cynthia ricini*

Unit 4: Pests and Diseases **4 Lectures**
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 5: Entrepreneurship in Sericulture **5 Lectures**
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, Japan1972.
- 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.

SEC IV: AQUARIUM FISH KEEPING

THEORY **(CREDITS 2)**

(Lectures =30)

Unit1: Introduction to Aquarium Fish Keeping **5** Lectures

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic andEndemic species of Aquarium Fishes

Unit 2: Biology of Aquarium Fishes **8** Lectures

Common characters and sexual dimorphism of Fresh water and Marine Aquariumfishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish, Botia, Gourami

Unit 3: Food and feeding of Aquarium fishes **5** Lectures

Use of live fish feed organisms. Preparation and composition of formulated fish feeds

Unit 4: Fish Transportation **5** Lectures

Live fish transport - Fish handling, packing and forwarding techniques.

Unit 5: Maintenance of Aquarium **7** Lectures

General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry

SEC V:

RESEARCH METHODOLOGY

THEORY **(CREDITS 2)**

(Lectures=30)

Unit 1: Foundations of Research **5 Lectures**

Meaning, Objectives, Motivation: Research Methods *vs* Methodology, Types of Research: Analytical *vs* Descriptive, Quantitative *vs* Qualitative, Basic *vs* Applied

Unit 2: Research Design **8 Lectures**

Need for research design: Features of good design, important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs

Unit 3: Data Collection, Analysis and Report Writing **12 Lectures**

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology

Unit 4: Ethical Issues **5 Lectures**

Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement

SUGGESTED READINGS

- Anthony, M, Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
- Walliman, N. 2011.Research Methods- The Basics. Taylor and Francis, London, New York.
- Wadhera, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing
- C.R.Kothari: Research Methodology, New Age International, 2009
- Coley, S.M. and Scheinberg, C.A. 1990, –Proposal writing|. Stage Publications.