

**CBCS SYLLABUS FOR B.Sc.
HONOURS IN
ZOOLOGY**

Approved by Board of studies

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**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
	Cell Biology				
II	Non-chordates II: Coelomates	Env. Science			GE-2
	Principles of Ecology				
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			DCEC-1	
	Principles of Genetics			DCEC- 2	
VI	Developmental Biology			DCEC- 3	
	Evolutionary Biology			DCEC- 4	

Semester	Course Opted	Course Name	Credits
	Ability Enhancement Compulsory Course-I	English	2
		communications/	
		Environmental Science	
	Core course-I (60 THEORY ; 15 MID SEM; 25 PRACTICAL)	Non-chordates I: Protista to Pseudocoelomates	4
I	Core Course-I Practical		2
	Core course-II (60 THEORY ; 15 MID SEM; 25 PRACTICAL)	Principles of Ecology	4
	Core Course-II Practical		2
	Generic Elective -1 (75 THEORY)	GE-1	4
	Generic Elective -1 Practical/Tutorial (25 PRACTICAL)		2
	Ability Enhancement Compulsory Course-II	English communications/	2
		Environmental Science	
	Core course-III (60 THEORY ; 15 MID SEM; 25 PRACTICAL)	Non-chordates II: Coelomates	4
	Core Course-III Practical		2
II	Core course-IV (60 THEORY ; 15 MID SEM; 25 PRACTICAL)	Cell Biology	4
	Core Course-IV Practical		2
	Generic Elective -2	GE-2	4
	Generic Elective -2 Practical		2
	Core course-V	Diversity of chordates	4
	Core Course-V Practical		2
	Core course-VI	Physiology: Controlling and Coordinating systems	4
	Core Course-VI Practical		2
III	Core course-VII	Fundamentals of Biochemistry	4
	Core Course-VII Practical		2
	Skill Enhancement Course-1	SEC-1	4
	Generic Elective -3	GE-3	4
	Generic Elective -3 Practical		2

IV	Core course-VIII	Comparative anatomy of vertebrates	4
	Course-VIII Practical		2
	Core course-IX	Physiology: Life Sustaining Systems	4
	Course-IX Practical		2
	Core course-X	Biochemistry of Metabolic Processes	4
	Core Course- X Practical		2
	Skill Enhancement Course-2	SEC-2	4
	Generic Elective -4	GE-4	4
	Generic Elective – 4 Practical		2
V	Core course-XI	Molecular Biology	4
	Core Course-XI Practical		2
	Core course-XII	Principles of Genetics	4
	Core Course-XII Practical		2
	Discipline Specific Elective -1	DSE-1	4
	Discipline Specific Elective -1 Practical		2
	Discipline Specific Elective -2	DSE-2	4
	Discipline Specific Elective-2 Practical/Tutorial		2
	Core course-XIII	Developmental Biology	4
	Core Course-XIII Practical/Tutorial		2
	Core course-XIV	Evolutionary Biology	4
	Core Course-XIV Practical/Tutorial		2
VI	Discipline Centric Elective -3	DSE-3	4
	Discipline Centric Elective-3 Practical/Tutorial		2
	Discipline Centric Elective-4	DSE-4	4
	Discipline Centric Elective -4 Practical/Tutorial		2
		Total Credits	140

COURSES WITH CODES

S.No	CODES	NAME OF COURSE
1.	CC-I	Non-chordates I: Protista to Pseudocoelomates
2.	CC-II	Cell Biology
3.	CC-III	Perspectives in Ecology
4.	CC-IV	Principles of Ecology
5.	CC5	Diversity of Chordates
6.	CC6	Physiology: Controlling and Coordinating Systems
7.	CC7	Fundamentals of Biochemistry
8.	CC8	Comparative Anatomy of Vertebrates
9.	CC9	Physiology: Life Sustaining Systems
10.	CC10	Biochemistry of Metabolic Processes
11.	CC11	Molecular Biology
12.	CC12	Principles of Genetics
13.	CC13	Developmental Biology
14.	CC14	Evolutionary Biology
DISCIPLINE CENTRIC/SPECIFIC ELECTIVE COURSES		
15.	DCEC- 1	Animal Behaviour and Chronobiology
16.	DCEC-2	Animal Biotechnology
17.	DCEC-3	Basics of Neuroscience
18.	DCEC-4	Computational Biology
19.	DCEC-5	Endocrinology
20.	DCEC-6	Immunology

21.	DCEC-7	Parasitology
22.	DCEC-8	Fish and Fisheries
23.	DCEC-9	Wild Life Conservation and Management
GENERIC ELCTIVE COURSES		
24.	GE 1	Animal Diversity
25.	GE 2	Environment and Public Health
26.	GE 3	Human Physiology
27.	GE 4	Food, Nutrition and Health
28.	GE 5	Aquatic Biology
29.	GE 6	Exploring the Brain: Structure and Function
SKILL ENHANCEMENT COURSES		
30.	SEC-1	Sericulture
31.	SEC-2	Research Methodology
32.	SEC-3	Medical Diagnostics
33.	SEC-4	Apiculture
34.	SEC- 5	Aquarium Fish Keeping

B.Sc. Zoology Semester – I

CORE COURSE I

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

THEORY

(Credits 4)

Units	Topics	No of Lectures
Group : A		
Unit 1 : Protista, Parazoa and Metazoa	General characteristics and Classification up to classes ,Study of Amoeba and Paramecium Life cycle and pathogenicity of Plasmodium vivax Locomotion and Reproduction in Protista	14
Unit 2: Porifera	General characteristics and Classification up to classes Canal system and spicules in sponges	7
Unit 3: Cnidaria	General characteristics and Classification up to classes Metagenesis in Obelia Polymorphism in Cnidaria Corals and coral reefs	12
Group : B		
Unit 4: Ctenophora	General characteristics	2
Unit5: Platyhelminthes	General characteristics and Classification up to classes Life cycle and pathogenicity of Taenia solium	10
Unit6: Nematelminthes	General characteristics and Classification up to classes Life cycle, and pathogenicity of Wuchereria bancrofti Parasitic adaptations in helminthes	8

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

B.Sc. Zoology Semester – I
PRACTICALS LAB 1: NON-CHORDATES I

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Study of whole mount of Euglena and Paramecium.	
2	Examination of pond water collected from different places for diversity in protista	
3	Study of Sycon	
4	Study of Obelia, Physalia, Aurelia, Gorgonia, Metridium	
5	One specimen/slide of any ctenophore	
6	Study of adult Fasciola hepatica, Taenia solium and their life cycles (Slides/micro-photographs)	
7	To submit a Project Report on any related topic on life cycles/polymorphism, spicules in porifera.	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting (2X3=6)	06 marks
	Practical Records	03 marks
	Viva-voce	06 marks

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

B.Sc. Zoology Semester – I

CORE COURSE II

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

CELL BIOLOGY

THEORY

(Credits 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Overview of Cells	Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions	5
Unit 2: Plasma Membrane	Various models of plasma membrane structure Transport across membranes: Active and Passive transport, Facilitated transport, Cell junctions: Tight junctions, Desmosomes, Gap junctions	10
Unit 3: Endomembrane System	Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes	8
Group: B		
Unit 4: Mitochondria and Peroxisomes	Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis	10
Unit 5: Cytoskeleton	Structure and Functions: Microtubules, Microfilaments and Intermediate filaments	6
Unit 6: Nucleus	Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus, Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)	8
Unit 7: Cell Division	Mitosis, Meiosis	3
Unit 8: Cell Signaling	GPCR and Role of second messenger (cAMP)	2

SUGGESTED READINGS

- 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,
- Bruce Albert, et al (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

B.Sc. Zoology Semester – I
PRACTICAL LAB 2: CELL BIOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits-2
1	Preparation of temporary stained squash of onion root tip to study various stages of mitosis	
2	Study of various stages of meiosis.	
3	Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.	
4	To submit a Project Report on any related topic on Cell Organelles/Membrane Transport or Different Models Membrane Structure.	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting	06 marks
	Practical Records	03 marks
	Viva-voce	06 marks

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.

B.Sc. Zoology Semester II

CORE COURSE III

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

NON-CORDATES II: COELOMATES

THEORY

(Credits 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction to Coelomates	Evolution of coelom and metamerism	3
Unit 2: Annelida	General characteristics and Classification up to classes; Excretion in Annelida	3
Unit 3: Arthropoda	General characteristics and Classification up to classes, Metamorphosis in Insects, Social life in bees and termites	3
Group: B		
Unit 4: Onychophora	General characteristics and Evolutionary significance	3
Unit 5: Mollusca	General characteristics and Classification up to classes, Respiration in Mollusca; Torsion and detorsion in Gastropoda; Pearl formation in bivalves	5
Unit 6: Echinodermata	General characteristics and Classification up to classes, Water-vascular system in Asteroidea	4

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

B.Sc. Zoology Semester II
PRACTICALS LAB 3: NON – CHORDATES II: COELOMATES

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits- 2
1	Study of following specimens: Annelids - Nereis, Pheretima, Hirudinaria Arthropods - Limulus, Palaemon, Daphnia, Balanus, Bombyx, Peripatus, termites and honey bees. Molluscs - Pila, Unio, Sepia, Octopus. Echinodermates - Asterias, Echinus, Cucumaria.	
2	Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm	
3	T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm (slides/microphotographs)	
4	Study of local species of Drosophila	
5	To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting (2X3=6)	06 marks
	Practical Records	03 marks
	Viva-voce	06 marks

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

SEMESTER II B.Sc. Zoology Semester II

CORE COURSE IV

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

PRINCIPLES OF ECOLOGY

THEORY

(Credits 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction to Ecology	History of Ecology, Autoecology and Synecology, Levels of organization, Laws of limiting factors, Study of physical factors	6
Unit 2: Population	Unitary and Modular populations Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion Exponential and logistic growth, equation and patterns, r and K strategies Population regulation – density-dependent and independent factors. Population interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses	10
Group: B		
Unit 3: Community	Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example	6
Unit 4: Ecosystem	Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies. Nutrient and biogeochemical cycle with one example of Nitrogen cycle Human modified ecosystem	8
Unit 5: Applied Ecology	Ecology in Wildlife Conservation and Management	3

Suggested Readings:

- 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

B.Sc. Zoology Semester II
PRACTICALS LAB 4: PRINCIPLES OF ECOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided	
2	Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community	
3	Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of Ph.	
4	Report on a visit to National Park/Biodiversity Park/Wild life sanctuary	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting (2X3=6)	06 marks
	Practical Records	03 marks
	Viva-voce	06 marks

Suggested Readings:

- 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

B.Sc. Zoology Semester III

CORE COURSE V

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

Diversity of Chordates

THEORY

(Credits 4)

Units	Topics	No of Lecture
Group: A		
Unit 1: Introduction to Chordates	General characteristics and outline classification	2
Unit 2: Protochordata	General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata	4
Unit 3: Origin of Chordata	Dipleurula concept and the Echinoderm theory of origin of chordates, Advanced features of vertebrates over Protochordata	4
Unit 4: Agnatha	General characteristics and classification of cyclostomes up to orders	2
Unit 5: Pisces	General characteristics of Chondrichthyes and Osteichthyes, classification up to order Migration, Osmoregulation and Parental care in fishes	6
Group: B		
Unit 6: Amphibia	Origin of Tetrapoda General characteristics and classification up to order; Parental care in Amphibians	6
Unit 7: Reptilia	General characteristics and classification up to order; Affinities of Sphenodon; Poison apparatus and Biting mechanism in snakes	7
Unit 8: Aves	General characteristics and classification up to order Archaeopteryx—a connecting link; Important Birds areas in India (IBAS), and Migration in birds	8
Unit 9: Mammals	General characters and classification up to order; Affinities of Prototheria;; Adaptive radiation with reference to locomotory appendages	8
Unit 10: Zoogeography	Zoogeographical realms, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms	8

Suggested Readings:

- Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford uni. Press.
- Pough H. Vertebrate life, VIII Edition, Pearson International.
- Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co

B.Sc. Zoology Semester III
PRACTICALS LAB 5: DIVERSITY OF CHORDATA

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits- 2
1	Protochordata: Balanoglossus, Herdmania,	
2	Agnatha: Petromyzon, Myxine	
3	Fishes : Scoliodon, Torpedo, Heteropneustes, Labeo, Exocoetus, Hippocampus, Anabas,	
4	Amphibia: Necturus, Bufo, Hyla, Salamandra	
5	Reptilia : Chelone, Varanus, Chamaeleon, Draco, Bungarus, Vipera, Naja, Crocodylus Key for Identification of poisonous and non-poisonous snakes	
6	Aves: Study of six common birds from different orders. Types of beaks and claws	
7	Mammalia: Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous. Mount of weberian ossicles of Mystus, pecten from Fowl head Power point presentation on study of any one animals from two different classes by students	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting (2X3=6)	06 marks
	Practical Records	03 marks
	Viva-voce	06 marks

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.

B.Sc. Zoology Semester III

CORE COURSE VI

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

THEORY

(Credits 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Tissues	Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue	6
Unit 2: Bone and Cartilage	Structure and types of bones and cartilages, Ossification, bone growth and resorption	4
Unit 3: Nervous System	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.	10
Group: B		
Unit 4: Muscle	Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus	10
Unit 5: Reproductive System	Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female	8
Unit 6: Endocrine System	Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them ; Classification and Function of hormones; Regulation of their secretion; Mode of hormone action; Hypothalamus (neuroendocrine gland) - Principal nuclei involved in neuroendocrine control of anterior pituitary.	18

Suggested Readings:

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hecourt Asia PTE Ltd. /W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons

B.Sc. Zoology Semester III
PRACTICALS LAB 6: ANIMAL PHYSIOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits- 2
1	Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)	
2	Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid	
3	Microtomy: Preparation of permanent slide of any mammalian tissues.	
4	Power point presentation on study of any one ENDOCRINE GLAND from two different VERTEBRATE classes by students	
5		
6	Full Marks	25
7	One Major Experiment	10 marks
8	Spotting (2X3=6)	06 marks
9	Practical Records	03 marks
10	Viva-voce	06 marks

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.

B.Sc. Zoology Semester III

CORE COURSE VII

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

FUNDAMENTALS OF BIOCHEMISTRY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Carbohydrates	Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides.	6
Unit 2: Lipids	Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids	8
Unit 3: Proteins	Amino acids: Structure, Classification and General properties of α -amino acids; Essential and non-essential α -amino acids. Proteins: Bonds stabilizing protein structure; Levels of organization in Proteins. Immunoglobulins: Basic Structure, Classes and Function.	12
Group: B		
Unit 4: Nucleic Acids	Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Base pairing. Types of DNA and RNA, Complementarity of DNA, Hypo-Hyperchromaticity of DNA, Watson & Crick Model of DNA	10
Unit 5: Enzymes	Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Concept of K_m and V_{max} ; Enzyme inhibition; Allosteric enzymes	15

Suggested Readings:

- Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V 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.

B.Sc. Zoology Semester III
PRACTICALS LAB 7: FUNDAMENTALS OF BIOCHEMISTRY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	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	To submit a Project Report on any related topic Lipids/Proteins/Nucleic Acids/Enzymes	
6	Full Marks	25
7	One Major Experiment	10 marks
8	Spotting (2X3=6)	06 marks
9	Practical Records	03 marks
10	Viva-voce	06 marks

SUGGESTED READINGS

- Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
- 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.

B.Sc. Zoology Semester IV

CORE COURSE VIII

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

COMPARATIVE ANATOMY OF VERTEBRATES

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Integumentary System	Structure and functions of integument	6
Unit 2: Skeletal System	Overview of appendicular skeleton	6
Unit 3: Digestive System	Alimentary canal and associated glands.	6
Unit 4: Respiratory System	Accessory respiratory organs	8
Group: B		
Unit 5: Circulatory System	Evolution of heart and aortic arches	8
Unit 6: Urinogenital System	Succession of kidney, Evolution of urinogenital ducts.	8
Unit 7: Nervous System	Comparative account of brain, Cranial nerves in mammals	8

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

B.Sc. Zoology Semester IV
PRACTICALS LAB 8: COMPARATIVE ANATOMY OF VERTEBRATES

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits- 2
1	Study of placoid, cycloid and ctenoid scales through permanent slides/photographs	
2	Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit	
3	Carapace and plastron of turtle /tortoise	
4	Mammalian skulls: One herbivorous and one carnivorous animal	
5	Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording	
6	Project on skeletal modifications in vertebrates	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting (2X3=6)	06 marks
	Practical Records	03 marks
	Viva-voce	06 marks

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

B.Sc. Zoology Semester IV

CORE COURSE IX

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Physiology of Digestion	Physiology of Digestion and role of digestive enzymes; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins.	10
Unit 2: Physiology of Respiration	Mechanism of respiration; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Carbon monoxide poisoning.	10
Unit 3: Renal Physiology	Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance	10
Group: B		
Unit 4: Blood	Components of blood and their functions; Blood clotting system, Haemopoiesis, Blood Group, Rh Factor, ABO	10
Unit 5: Physiology of Heart	Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses Cardiac cycle; Cardiac output and its regulation, Nervous and chemical regulation of heart rate. Blood pressure and its regulation	14

Suggested Readings:

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

B.Sc. Zoology Semester IV

PRACTICALS LAB 9: ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Determination of ABO Blood group and Rh factors	
2	Enumeration of red blood cells and white blood cells using haemocytometer	
3	Demonstration of " Perfusion " using Buffer solution and with any other fixative.	
4	Recording of blood pressure using a sphygmomanometer	
5	Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting (2X3=6)	06 marks
	Practical Records	03 marks
	Viva-voce	06 marks

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

B.Sc. Zoology Semester IV

CORE COURSE X

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

BIOCHEMISTRY OF METABOLIC PROCESSES

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group : A		
Unit 1: Carbohydrate Metabolism	Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis	12
Unit 2: Lipid Metabolism	β -oxidation of saturated fatty acids with even and odd number of carbon atoms.	12
Group: B		
Unit 3: Protein Metabolism	Catabolism of amino acids: Transamination, Deamination, Urea cycle	10
Unit 4: Oxidative Phosphorylation	Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System	10

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.

B.Sc. Zoology Semester IV
PRACTICALS LAB 10: BIOCHEMISTRY OF METABOLIC
PROCESSES

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	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	Study of biological oxidation (SDH) [goat liver	
5	To perform the Acid and Alkaline phosphatase assay from serum/ tissue.	
6	Dry Lab: To trace the labelled C atoms of Acetyl-CoA till they evolve as CO ₂ in the TCA cycle	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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.

B.Sc. Zoology Semester V

CORE COURSE- XI

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

MOLECULAR BIOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Nucleic Acids	Salient features of DNA and RNA , Watson and Crick model of DNA	2
Unit 2: DNA Replication	DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear ds-DNA, replication of telomeres	12
Unit 3: Transcription	RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription Factors, Split genes: concept of intron and exons, RNA editing	8
Group: B		
Unit 4: Translation	Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain.	10
Unit 6: Gene Regulation	Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trp operon;	8
Unit 7: DNA Repair Mechanisms	Pyrimidine dimerization and mismatch repair	4
Unit 8: Regulatory RNAs	RNA interference, miRNA, siRNA	4

Suggested Readings:

- 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.
- Lewin B. (2008). Gene XI, Jones and Bartlett

B.Sc. Zoology Semester V
PRACTICALS LAB 11: MOLECULAR BIOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits- 2
1	Study of Polytene chromosomes from Chironomous / Drosophila larvae.	
2	Preparation of liquid culture medium (LB) and raise culture of E. coli	
3	Estimation of the growth kinetics of E. coli by turbidity method	
4	Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking	
5	Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement)	
6	Study and interpretation of electron micrographs/ photograph showing (a) DNA replication (b) Transcription (c) Split genes	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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.

B.Sc. Zoology Semester V

CORE COURSE- XII

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

PRINCIPLES OF GENETICS

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Mendelian Genetics and its Extension	Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, polygenic inheritance, Sex-linked, sex-influenced and sex-limited characters inheritance.	6
Unit 2: Linkage, Crossing Over and Chromosomal Mapping	Linkage and 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.	6
Unit 3: Mutations	Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Mutagens.	5
Group: B		
Unit 4: Sex Determination	Chromosomal mechanisms of sex determination in <i>Drosophila</i> and Man	3
Unit 5: Extra-chromosomal Inheritance	Criteria for extra-chromosomal inheritance, Mitochondria, Chloroplast	3
Unit 6: Recombination in Bacteria and Viruses	Conjugation, Transformation, Transduction.	3
Unit 8: Transposable Genetic Elements	Transposons in bacteria, Ac-Ds elements in maize and P elements in <i>Drosophila</i> .	3

Suggested Reading:

- 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

B.Sc. Zoology Semester V
PRACTICALS LAB 12: PRINCIPLES OF GENETICS

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits- 2
1	To study the Mendelian laws and gene interactions.	
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).	
6	Pedigree analysis of some human inherited traits.	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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.

B.Sc. Zoology Semester VI

CORE COURSE- XIII

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

DEVELOPMENTAL BIOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction	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	4
Unit 2: Early Embryonic Development	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.	20
Group: B		
Unit 3: Late Embryonic Development	Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of Embryo in humans, Placenta (Structure, types and functions of placenta)	8
Unit 4: Post Embryonic Development	Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each).	12
Unit 5: Implications of Developmental Biology	Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis	8

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, Edition, International Thompson Computer Press
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

B.Sc. Zoology Semester VI
PRACTICALS LAB 13: DEVELOPMENTAL BIOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, 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	Trapping and culturing of local Drosophila Species	
4	Study of the developmental stages and life cycle of Drosophila from stock culture	
5	Study of different sections of placenta (photomicrograph/ slides)	
6		
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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

B.Sc. Zoology Semester VI

CORE COURSE- XIV

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

EVOLUTIONARY BIOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1:	Life's Beginnings: Chemogeny, RNA world, Biogeny.	4
Unit 2:	Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism, Neutral theory of molecular evolution,	4
Unit 3:	Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse,	6
Unit 4:	Sources of variations: Heritable variations and their role in evolution	6
Group: B		
Unit 5:	Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Role of Migration and Mutation in changing allele frequencies	5
Unit 6:	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	8
Unit 7:	Origin and evolution of man, Primate phylogeny from Dryopithecus leading to Homo sapiens.	5
Unit 8:	Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees	2

Suggested Readings

- Riddle M. – Evolution. 2nd edn. Blackwell 1996
- Piyanka E.R.- Evolutionary Ecology 5th edn Harper Collins 1994
- Stricberger's - Evolution

B.Sc. Zoology Semester VI
PRACTICALS LAB 14: EVOLUTIONARY BIOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits-2
1	Study of fossils from models/ pictures	
2	Study of homology and analogy from suitable specimens	
3	Field Visit study report on any fossil park	
4	Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies	
5	Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.	
6	Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, W; Phylip, NJ) and its interpretation.	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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
(DCEC)**

B.Sc. Zoology Semester V

DCEC- 1

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction to Animal Behaviour	Origin and history of Ethology; Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen,	4
Unit 2: Patterns of Behaviour	Proximate and ultimate causes of behaviour, Methods and recording of a behaviour. Stereotyped. Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.	4
Unit 3: Social and Sexual Behaviour	Social Behaviour: Concept of Society; Communication and the senses; Altruism; Insects' society with Honey bee as example; Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.	8
Group: B		
Unit 4: Introduction to Chronobiology	Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period. Adaptive significance of biological clocks.	4
Unit 5: Biological Rhythm	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.	8
Unit 6: Biological Clocks	Relevance of biological clocks; Chronopharmacology, Chronomedicine, Chronotherapy.	4

Suggested Readings

- David McFarland, Animal Behaviour, Pitman Publishing Limited. UK

B.Sc. Zoology Semester V

PRACTICALS DCEC LAB 1: ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	To study nests and nesting habits of the birds and social insects.	
2	Study of circadian functions in humans (Daily Eating, Sleep and Body temperature patterns).	
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	To Study the activity patterns of native Drosophila .	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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. (3rdEd) 2002 Baren and Noble Inc. New York, USA
- Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

B.Sc. Zoology Semester V

DCEC- 2

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

ANIMAL BIOTECHNOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1. Introduction	Concept and scope of biotechnology	2
Unit 2. Molecular Techniques in Gene manipulation	Cloning vectors: Plasmids, Cosmids, Lambda Bacteriophage, 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, Northern and Western blotting DNA sequencing: Sanger method Polymerase Chain Reaction,	15
Group: B		
Unit 3. Genetically Modified Organisms	Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.	10
Unit 4. Culture Techniques and Applications	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	10

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.

B.Sc. Zoology Semester V
PRACTICALS DCEC LAB 2: ANIMAL BIOTECHNOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Genomic DNA isolation from E. coli	
2	Plasmid DNA isolation (pUC 18/19) from E. coli	
3	Restriction digestion of plasmid DNA	
4	Calculation of transformation efficiency from the data provided.	
5	To study following techniques through photographs a. Southern Blotting b. Northern Blotting c. Western Blotting d. DNA Sequencing (Sanger's Method) e. DNA fingerprinting	
6	Project report on animal cell culture	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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.

B.Sc. Zoology Semester V

DCEC- 3

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

BASICS OF NEUROSCIENCE

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction to Neuroscience	Origins of Neuroscience; Neuroanatomy, Neurophysiology, and Systems Neurobiology	5
UNIT 2: The Nervous system-An Introduction	Introduction to the structure and function of the nervous system: Cellular components: Neurons; Neuroglia; 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.	14
UNIT 3: Cellular and Molecular Neurobiology	Molecular and cellular approaches used to study the CNS at the level of single molecules, Synapse: Synaptic transmission, Types of synapses; synaptic function; Principles of chemical synaptic transmission; Principles of synaptic integration; EPSPs and IPSPs. Ion channels,	14
Group: B		
Unit 4. Neurotransmitters	Different types of neurotransmitters– catecholamines, amino acidergic and peptidergic neurotransmitters; G-protein coupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.	10
UNIT 5: Neurobiology and Neuropharmacology of Behaviour	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.	16

SUGGESTED READINGS

- Neuroscience: Exploring the brain by Mark F. Baer; Barry W. Connors.
- From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham

B.Sc. Zoology Semester V
PRACTICALS DCEC LAB 3: BASICS OF NEUROSCIENCE

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Study of Drosophila / Prawn Nervous System	
2	Study of chick brain/Rat Brain	
3	Nerve Cell preparation from the spinal cord.	
4	Study of neurons and/ or myelin by Nissl, Giemsa or Luxol Fast Blue staining.	
5	Study of olfaction in Drosophila larvae	
6	Study of novelty, anxiety and spatial learning in mice.	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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 Psychopharmacology- 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

B.Sc. Zoology Semester V

DCEC- 4

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

COMPUTATIONAL BIOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction to Bioinformatics	Importance, Goal, Scope; Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics, Molecular Phylogeny; Applications and Limitations of Bioinformatics	5
Unit 2: Biological Databases	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), journal databases (Pub Med)	8
Unit 3: Data Generation and Data Retrieval	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)	10
Group: B		
Unit 4: Basic Concepts of Sequence Alignment	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.	10
Unit 5: Applications of Bioinformatics	Structural Bioinformatics (3-D protein, PDB), Functional genomics (genome-wide and high throughput approaches to gene and protein function), Drug discovery method (Basic concepts)	6

B.Sc. Zoology Semester V
PRACTICALS DCEC LAB 4: COMPUTATIONAL BIOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	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.	
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).	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

SUGGESTED READINGS

- Ghosh Z and Mallick B. (2008). *Bioinformatics: Principle and Applications*, Oxford University Press.
- Pevsner J. (2009). *Bioinformatics and Functional Genomics*, 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

B.Sc. Zoology Semester V

DCEC- 5

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

ENDOCRINOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction to Endocrinology	History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones	5
Unit 2: Epiphysis, Hypothalamo-hypophysial Axis	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.	12
Group: B		
Unit 3: Peripheral Endocrine Glands	Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis Hormones in homeostasis, Disorders of endocrine glands	10
Unit 4: Regulation of Hormone Action	Hormone action at Cellular level: Hormone receptors, transduction and regulation Hormone action at Molecular level: Molecular mediators, Genetic control of hormone action	10

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.

B.Sc. Zoology Semester V
PRACTICALS DCEC LAB 5: ENDOCRINOLOGY

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Dissect and display of Endocrine glands in laboratory bred rat.	
2	Study of the permanent slides of all the endocrine glands	
3	Compensatory ovarian/ adrenal hypertrophy in vivo bioassay in laboratory bred rat	
4	Demonstration of Castration/ ovariectomy in laboratory bred rat	
5	Estimation of plasma level of any hormone using ELISA	
6	Designing of primers of any hormone	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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,

B.Sc. Zoology Semester VI

DCEC- 6

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

IMMUNOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Overview of Immune System	Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system	4
Unit 2: Innate and Adaptive Immunity	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).	8
Unit 3: Antigens	Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes	8
Unit 4: Immunoglobulins	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	8
Group: B		
Unit 5: Major Histocompatibility Complex	Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation	5
Unit 6: Cytokines	Properties and functions of cytokines, Therapeutics Cytokines	4
Unit 7: Complement System	Components and pathways of complement activation.	4
Unit 8:	Classification and brief description of	3

Hypersensitivity	various types of hypersensitivities	
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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.

B.Sc. Zoology Semester VI

PRACTICALS DCEC LAB 6: IMMUNOLOGY

Full Marks – 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Demonstration of lymphoid organs.	
2	Histological study of spleen, thymus and lymph nodes through slides/ photographs	
3	Preparation of stained blood film to study various types of blood cells	
4	ABO blood group determination	
5	Cell counting and viability test from splenocytes of farm bred animals/cell lines.	
6	Demonstration of : a. ELISA b. Immuno-electrophoresis	
	Full Marks	25 Marks
	One Major Experiment	12 Marks
	Spotting	04 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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.

B.Sc. Zoology Semester VI

DCEC- 7

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

PARASITOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction to Parasitology	Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship	3
Unit 2: Parasitic Protists	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani, Plasmodium vivax	15
Unit 3: Parasitic Platyhelminthes	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana	15
Group: B		
Unit 4: Parasitic Nematodes	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), Pratylenus (lesio nematode)	15
Unit 5: Parasitic Arthropoda	Biology, importance and control of ticks, mites, Pediculus humanus (head and body louse), Xenopsylla cheopis and Cimex lectularius	10
Unit 6: Parasitic Vertebrates	A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat	2

SUGGESTED READINGS

K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.

B.Sc. Zoology Semester VI
PRACTICALS DCEC LAB 7: PARASITOLOGY

Full Marks – 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Study of life stages of Entamoeba histolytica, Giardia intestinalis, Leishmania donovani and Plasmodium vivax through permanent slides/micro photographs.	
2	Study of adult and life stages of Schistosoma haematobium, and Taenia solium through permanent slides/micro photographs	
3	Study of adult and life stages of Ascaris lumbricoides, Wuchereria bancrofti and Trichinella spiralis through permanent slides/micro photographs	
4	Study of plant parasitic root knot nematode, Meloidogyne from the soil sample	
5	Study of Pediculus humanus (Head louse and Body louse), Xenopsylla cheopis and Cimex lectularius through permanent slides/ photographs	
6	Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]	
7	Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by product]	
8	Submission of a brief report on Parasitic Vertebrates	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

SUGGESTED READINGS

- 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
- 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.

B.Sc. Zoology Semester VI

DCEC- 8

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

FISH AND FISHERIES

THEORY	(CREDITS 4)	
Units	Topics	No of Lectures
Group: A		
UNIT 1: Introduction and Classification:	General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction.	6
UNIT 2: Morphology and Physiology:	Types of fins and their modifications; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Migration	18
UNIT 3: Fisheries	Inland Fisheries; Fisheries of Jharkhand. Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries;	12
Group: B		
Unit 4: Aquaculture	Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Induced breeding of fish; Management of fin fish hatcheries; Preparation and maintenance of fish aquarium; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products	20
UNIT 5: Fish in research	Transgenic fish, Zebrafish as a model organism in research	4

SUGGESTED READINGS

- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House.
- C.B.L. Srivastava, Fish Biology, Narendra Publishing House.
- J.R. Norman, A history of Fishes, Hill and Wang Publishers

B.Sc. Zoology Semester VI
PRACTICALS DCEC LAB 8: FISH AND FISHERIES

Full Marks – 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Morphometric and meristic characters of fishes	
2	Study of Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, 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,	
7	Demonstration of induced breeding in Fishes (video)Anabas and Clarias	
8	Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.	
9	Demonstration of parental care in fishes (video)	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva-voce	06 Marks

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

B.Sc. Zoology Semester VI

DCEC- 9

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

WILD LIFE CONSERVATION AND MANAGEMENT

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction to Wild Life	Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.	5
Unit 2: Evaluation and management of wild life	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.	6
Unit 3: Management of habitats	Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats	5
Group: B		
Unit 4: Population estimation	Population density, Natalty, 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.	6
Unit 5: Management planning of wild life	Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbence.	6
Unit 6: Management of excess population	Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal	4
Unit 7: Protected areas	National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.	4

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.

B.Sc. Zoology Semester VI
PRACTICALS DCEC LAB 9: WILD LIFE CONSERVATION AND
MANAGEMENT

Full Marks – 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Identification of flora, mammalian fauna, avian fauna, herpeto-fauna.	
2	Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)	
3	Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.	
4	Demonstration of different field techniques for flora and fauna	
5	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)	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva Voce	06 marks

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 COURSESE
(GE)**

B.Sc. Semester I GE 1(Subsidiary)

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

ANIMAL DIVERSITY

THEORY	(CREDITS 4)
Units	Topics
No of Lectures	
Group: A	
Unit 1. Protista	General characters of Protozoa; Life cycle of Plasmodium
Unit 2. Porifera	General characters and canal system in Porifera
Unit 3. Radiata	General characters of Cnidarians and polymorphism
Unit 4. Aceolomates	General characters of Helminthes; Life cycle of Taenia solium
Unit 5. Pseudocoelomates	General characters of Nemethehelminthes; Parasitic adaptations
Unit 6. Coelomate Protostomes	General characters of Annelida ; Metamerism.
Unit 7. Arthropoda	General characters. Social life in insects.
Group: B	
Unit 8. Mollusca	General characters of mollusca; Pearl Formation
Unit 9. Coelomate Deuterostomes	General characters of Echinodermata, Water Vascular system in Starfish.
Unit 10. Protochordata	Salient features
Unit 11. Pisces	Osmoregulation, Migration of Fishes
Unit 12. Amphibia	General characters, Adaptations for terrestrial life, Parental care in Amphibia.
Unit 13. Amniotes	Origin of reptiles. Terrestrial adaptations in reptiles.
Unit 14. Aves:	The origin of birds; Flight adaptations
Unit 15. Mammalia	Early evolution of mammals; Primates; Dentition in mammals.

Suggested Readings

- Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition,

B.Sc. Semester I
PRACTICALS GE (Subsidiary) LAB 1: ANIMAL DIVERSITY

Full Marks – 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Study of following specimens: Non Chordates: Euglena, Paramecium, Sycon, , Physalia, Metridium, Taenia, Ascaris, Nereis, Leech, Peripatus, Limulus, , Hermitcrab, Daphnia, Centipede, Beetle, Chiton, Octopus, Asterias, and Antedon. Chordates: Balanoglossus, Amphioxus, Petromyzon, Hippocampus, Labeo, Ichthyophis/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 <ul style="list-style-type: none"> • Septal & pharyngeal nephridia of earthworm. • Unstained mounts of Placoid, cycloid and ctenoid scales. 	
4	Dissections of <ul style="list-style-type: none"> • Digestive and nervous system of Prawn. • Urinogenital system of Rat 	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting	06 Marks
	Practical Records	03 Marks
	Viva voce	06 marks

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.

B.Sc. Semester II GE 2(Subsidiary)

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

ENVIRONMENT AND PUBLIC HEALTH

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
UNIT I: Introduction	Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.	6
UNIT II Climate Change	Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health	4
Unit III Pollution	Air, water, noise pollution sources and effects, Pollution control	4
Group: B		
Unit IV Waste Management Technologies	Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.	8
Unit 5 Diseases	Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid	4

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.

B.Sc. Semester II
PRACTICALS GE (Subsidiary) LAB 2: ENVIRONMENT AND
PUBLIC HEALTH

Full Marks - 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	To determine the pH of soil and water sample from different location	
2	To study the turbidity of the water	
3	To determine the presence of Cl in soil and water sample from different location	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting	06 Marks
	Practical Records	03 Marks
	Viva voce	06 marks

Suggested Readings

- 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.

B.Sc. Semester III GE-3(Subsidiary)

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

HUMAN PHYSIOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Digestion and Absorption	Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and hormonal control of digestion (in brief)	8
Unit 2: Functioning of Excitable Tissue (Nerve and Muscle)	Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory), Neuromuscular junction	8
Unit 3: Respiratory Physiology	External and internal Respiration, Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.	6
Group: B		
Unit 4: Renal Physiology	Functional anatomy of kidney, Mechanism and regulation of urine formation,	8
Unit 5: Cardiovascular Physiology	Structure of heart, Coordination of heart beat, Cardiac cycle,	8
Unit 6: Endocrine Physiology	Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes),	14

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. □

B.Sc. Semester III
PRACTICALS GE (Subsidiary) LAB 3: HUMAN PHYSIOLOGY

Full Marks – 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Preparation of temporary mounts: Neurons and Blood film.	
2	Preparation of haemin and haemochromogen crystals.	
3	Estimation of haemoglobin using Sahli's haemoglobinometer.	
4	Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary.	
Full Marks		25
One Major Experiment		10 Marks
Spotting		06 Marks
Practical Records		03 Marks
Viva voce		06 Marks

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. □

B.Sc. Semester IV GE- 4(Subsidiary)

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

FOOD, NUTRITION AND HEALTH

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
Unit 1: Basic concept of food and nutrition	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	10
Unit 2: Nutritional Biochemistry:	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	20
Group: B		
Unit 3: Health	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	15
Unit 4: Food hygiene:	Potable water- sources and methods of purification at domestic level , Food and Water borne infections: Bacterial infection: Cholera, typhoid fever, dysentery; Viral infection: Hepatitis, , Protozoan infection: amoebiasis, giardiasis; Parasitic infection: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention,	15

Suggested Readings

Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO

B.Sc. Semester IV
PRACTICALS GE (Subsidiary) LAB 4: FOOD, NUTRITION AND
HEALTH

Full Marks – 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric	
2	Estimation of Lactose / casin in milk	
3	Ascorbic acid estimation in food by titrimetry	
4	Estimation of Calcium in foods by titrimetry	
5	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	
6	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	
	Full Marks	25
	One Major Experiment	12 Marks
	Spotting	04 Marks
	Practical Records	03 Marks
	Viva voce	06 Marks

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.

B.Sc. Semester I/II/III/IV GE-5 (Subsidiary)

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

AQUATIC BIOLOGY

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group: A		
UNIT 1: Aquatic Biomes	Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.	5
UNIT 2: Freshwater Biology	Lakes: classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous. Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.	10
Group: B		
UNIT 3: Marine Biology	Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds	4
UNIT 4: Management of Aquatic Resources	Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment-BOD and COD.	6

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

B.Sc. Semester I/II/III/IV
PRACTICALS GE-5 (Subsidiary) LAB 5: AQUATIC BIOLOGY

Full Marks – 25

TIME: 2hrs

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Determine the area of a lake	
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/Fisheries Institutes	
6		
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting (2X3=6)	06 Marks
	Practical Records	03 Marks
	Viva voce	06 Marks

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

B.Sc. Semester I/II/III/IV

GE-6 (Subsidiary)

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

EXPLORING THE BRAIN: STRUCTURE AND FUNCTION

THEORY

(CREDITS 4)

Units	Topics	No of Lectures
Group : A		
Unit 1: Introduction:	Early and Nineteenth century views of the Brain; Neuroscience today	5
Unit 2: Neurons and Glia:	Neurons – Soma, Axon, Dendrite; Classification of Neurons; Glia – Astrocytes, Myelinating Glia, Non-neuronal cells	4
Unit 3: Evolution and Adaptation of Brain:	Brain evolution and behavioral adaptation; Theories of brain evolution – involving addition of structure or areas, involving new formation and reorganization of circuits.	4
Unit 4: Organization of the Brain:	Anatomical references, Cerebrum, cerebellum, brain stem, spinal cord; Cranial nerves,	5
Group: B		
Unit 5: Brain Development:	Formation of neural tube, Primary brain vesicles; Differentiation of forebrain, midbrain and hindbrain.	5
Unit 6: Chemical Control of Brain and Behaviour:	Structure and connection of the secretory hypothalamus; Diffuse modulatory systems of the brain – noradrenergic, serotonergic, dopaminergic and cholinergic system;	5
Unit 7: Rhythms of the Brain:	Electroencephalogram; Sleep – why do we sleep, Non-REM and REM sleep, neural mechanisms of sleep; Circadian rhythms.	4
Unit 8: Mental illness and the Brain:	Psychosocial and biological approaches to mental illness; Anxiety disorders; Mood disorders; Schizophrenia.	4

Suggested Readings

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

B.Sc. Semester I/II/III/IV
PRACTICALS GE (Subsidiary) LAB 6: EXPLORING THE BRAIN

S.No.	Topic- Experiments/Lab wok	Credits 2
1	Dissection and study of Nervous systems of Prawn, Pila, Fish and chick	
2	Study of different parts of Mammalian brain using slides and photographs	
3	Project report of evolution of brain structure and complexity	
	Full Marks	25
	One Major Experiment	10 Marks
	Spotting	06 Marks
	Practical Records	03 Marks
	Viva Voce	06 Marks

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.

**SKILL ENHANCEMENT COURSES
(SEC)**

B.Sc. Zoology Semester III

SEC-1

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

SERICULTURE

THEORY

(CREDITS 2)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction	Sericulture: Definition, history and present status; Silk route Types of silkworms, Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture	3
Unit 2: Biology of Silkworm	Life cycle of Bombyx mori Structure of silk gland and secretion of silk	3
Unit 3: Rearing of Silkworms	Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances Fectants: Formalin, bleaching powder, RKO, Silkworm rearing technology: Early age ate age rearing, Types of mountages ing, harvesting and storage of cocoons	10
Group: B		
Unit 4: Pests and Diseases	Pests of silkworm: Uzi fly, dermestid beetles and vertebrates Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases	4
Unit 5: Entrepreneurship in Sericulture	Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various sericulture centres.	2

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.

B.Sc. Zoology Semester III SEC-2

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

RESEARCH METHODOLOGY

THEORY

(CREDITS 2)

Units	Topics	
Group: A		
Unit 1: Foundations of Research	Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied	5
Unit 2: Research Design	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	8
Group: B		
Unit 3: Data Collection, Analysis and Report Writing	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	12
Unit 4: Ethical Issues	Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement	5

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.
- Wadhwa, 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

B.Sc. Zoology Semester IV SEC-3

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

MEDICAL DIAGNOSTICS

THEORY

(CREDITS 2)

Units	Topics	No of Lectures
Group: A		
Unit 1: Introduction	Introduction to Medical Diagnostics and its Importance	2
Unit 2: Diagnostics Methods Used for Analysis of Blood	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.)	10
Unit 3: Diagnostic Methods	Urine Analysis: Physical characteristics; Abnormal constituents	6
Group: B		
Unit 4: Non-infectious Diseases	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	6
Unit 5: Infectious Diseases	Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis	3
Unit 6: Tumours	Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).	3

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. Textbook of Medical Physiology, Saunders
- Robbins and Cortan, Pathologic Basis of Disease, VIII Edition, Saunders
- Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

B.Sc. Zoology Semester IV SEC-4

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

APICULTURE

THEORY

(CREDITS 2)

Units	Topics	No of Lectures
Group: A		
Unit 1: Biology of Bees	History, Classification and Biology of Honey Bees Social Organization of Bee Colony	4
Unit 2: Rearing of Bees	Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage, Selection of Bee Species for Apiculture, Bee Keeping Equipment Methods of Extraction of Honey (Indigenous and Modern)	10
Group: B		
Unit 3: Diseases and Enemies	Bee Diseases and Enemies Control and Preventive measures	5
Unit 4: Bee Economy	Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc	3
Unit 5: Entrepreneurship in Apiculture	Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens	5

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.

B.Sc. Zoology Semester I/II/III/IV

SEC-5

A total of eight questions will be asked (Four questions from each group). Question 1 will be of multiple choice type and compulsory (1X15=15 MARKS). From the rest seven questions any three (3X15 = 45 MARKS) are to be answered selecting not more than two from ANY group.

FM- 60

Duration: 3 Hrs

AQUARIUM FISH KEEPING

THEORY

(CREDITS 2)

Units	Topics	No of Lectures
Group: A		
Unit1: Introduction to Aquarium Fish Keeping	The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes	4
Unit 2: Biology of Aquarium Fishes	Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish	10
Group: B		
Unit 3: Food and feeding of Aquarium fishes	Use of live fish feed organisms. Preparation and composition of formulated fish feeds	6
Unit 4: Fish Transportation	Live fish transport - Fish handling, packing and forwarding techniques.	2
Unit 5: Maintenance of Aquarium	General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry.	4

Suggested Readings