

**SYLLABUS FOR FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP)
FOR
B. Sc ZOOLOGY
(AS PER NEP GUIDELINES)
SUBJECT CODE = ZOO**



**DR. SHYAMA PRASAD MUKHERJEE UNIVERSITY
DEPARTMENT OF ZOOLOGY
RANCHI**

COURSES WITH CODES

S. No.	CODES	NAME OF COURSE
MAJOR COURSES		
1.	MJ-101T	Non-chordates: Protista to Pseudocoelomates
2.	MJ-201T	Non-chordates: coelomates
3.	MJ-202T	Ecology
4.	MJ-301T	Chordates: Pisces to Mammals
5.	MJ-302T	Cell Biology
6.	MJ-401T	Animal physiology
7.	MJ-402T	Biochemistry
8.	MJ-403T	Comparative Anatomy of Vertebrates
9.	MJ-501T	Molecular Biology
10.	MJ-502T	Principles of Genetics
11.	MJ-503T	Developmental Biology
12.	MJ-601T	Evolution
13.	MJ-602T	Endocrinology
14.	MJ-603T	Animal Behaviour and Chronobiology
15.	MJ-604T	Immunology
16.	MJ-701T	Animal Biotechnology
17.	MJ-702T	Parasitology
18.	MJ-703T	Fish and Fisheries
19.	MJ-704T	Wild Life Conservation and Management
20.	MJ-801T	Exploring the Brain: Structure and Function

ADVANCED MAJOR COURSES		
21.	AMJ- 801T	Basics of Neuroscience
22.	AMJ-802T	Computational biology
23.	AMJ-803T	Biochemistry of Metabolic Processes
SKILL ENHANCEMENT COURSES		
24.	SEC-101T	Aquarium Fish Keeping
25.	SEC-201T	Sericulture
26.	SEC-301T	Medical Diagnostics
MINOR PAPER(TRADITIONAL)		
27.	MN-101T	Animal Diversity
28.	MN-301T	Environmental Studies
29.	MN-501T	Human Physiology
30.	MN-701	Public Health & Diseases
MINOR COURSE(VOCATIONAL)		
31.	MVC-201T	Food Nutrition & Health
32.	MVC-401T	Apiculture
33.	MVC-601T	Lac Culture
34.	MVC-801T	Aquatic Biology
MULTI-DISCIPLINARY COURSES		
35.	MDC-101T	
RESEARCH COURSE		
36.	RC-801T	RESEARCH METHODOLOGY

List of Abbreviation:

FM – Full Marks, PM – Pass Marks, MJ – Major Course, MN- Minor Course, MDC – Multidisciplinary Course, SEC- Skill Enhancement Course, AMJ – Advanced Major Course, RC – Research Course, Hrs – Hours.

B.Sc. Zoology Semester I
MJ-101T

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 of seven questions attempt any three (3X15 = 45 MARKS) selecting not more than two from ANY group.

NON-CHORDATES: PROTISTA TO PSEUDOCOELOMATES

FM:60, PM:24

TIME: 3Hrs

UNITS	TOPICS	CREDIT 3T
GROUP: A		No. of Lectures
Unit 1: Protista, Parazoa and Metazoa	Diagnostic characters, General organization and Classification up to classes, Study of <i>Amoeba</i> and <i>Paramecium</i> , Life cycle and pathogenicity of <i>Plasmodium vivax</i> , Locomotion and Reproduction in Protista.	9
Unit 2: Porifera	Diagnostic characters, General organization and Classification up to classes, The canal system and spicules in sponges.	6
Unit 3: Cnidaria	Diagnostic characters, General organization and Classification up to classes, Metagenesis in <i>Obelia</i> , Polymorphism in Cnidaria, Corals & Coral Reef	6
GROUP: B		
Unit 4: Ctenophora	Diagnostic characters, General organization & Affinities.	6
Unit 5: Platyhelminthes	Diagnostic characters, General organization and Classification up to classes, Life cycle and pathogenicity of <i>Taenia solium</i> .	6
Unit 6: Nemathelminths	Diagnostic characters, General organization and Classification up to classes, Life cycle and pathogenicity of <i>Wuchereria bancrofti</i> , Parasitic adaptations in helminths.	6

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.

PRACTICALS
MJ-101P: NON-CHORDATES

FM – 25, PM:10

TIME: 2 Hrs.

S.N.	TOPIC- EXPERIMENTS/LAB WOK	CREDIT 1P (30 Hrs.)
1	Study of whole mount of <i>Euglena</i> and <i>Paramecium</i> .	
2	Study of pond water and plankton diversity.	
3	Study of <i>Sycon</i> , <i>Demospongiae</i>	
4	Study of <i>Obelia</i> , <i>Physalia</i> , <i>Aurelia</i> , <i>Gorgonia</i> , <i>Metridium</i> .	
5	One specimen/slide of any ctenophore	
6	Study of adult <i>Fasciola hepatica</i> , <i>Taenia solium</i> 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	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

B.Sc. Zoology Semester II
MJ-201T

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 of seven questions attempt any three (3X15 = 45 MARKS)
selecting not more than two from ANY group.

NON-CHORDATES: COELOMATES

FM:60, PM:24

TIME:3 Hrs.

UNITS	TOPICS	CREDIT 3T
Group: A		No. of Lectures
Unit 1: Introduction to Coelomates	Evolution of coelom and metamerism.	6
Unit 2: Annelida	Diagnostic characters, general organization and Classification up to classes; Excretion in Annelida.	10
Unit 3: Arthropoda	Diagnostic characters, general organization and Classification up to classes, Metamorphosis in Insects, Social life in bees and termites, Pests of grains (wheat and rice)	10
Group: B		
Unit 4: Onychophora	Diagnostic characters, general organization and its evolutionary significance.	3
Unit 5: Mollusca	Diagnostic characters, general organization and Classification up to classes, Respiration in Mollusca; Torsion and detorsion in Gastropoda, Pearl formation.	8
Unit 6: Echinodermata	Diagnostic characters, general organization, and Classification up to classes, Water-vascular system in Asteroidea.	8

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

PRACTICALS**MJ-201P: NON – CHORDATES: COELOMATES****FM:25, PM:10****TIME:2Hrs**

S.N.	TOPIC- EXPERIMENTS/LAB WOK	CREDIT 1P(30hrs)
1	Study of following specimens: Annelids - <i>Nereis</i> , <i>Pheretima</i> , <i>Hirudinaria</i> Arthropods- <i>Limulus</i> , <i>Palaemon</i> , <i>Daphnia</i> , <i>Balanus</i> , <i>Bombyx</i> , <i>Peripatus</i> , termites and honey bees. Mollusca- <i>Pila</i> , <i>Unio</i> , <i>Sepia</i> , <i>Octopus</i> . Echinodermata- <i>Asterias</i> , <i>Echinus</i> , <i>Cucumaria</i> .	
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 <i>Drosophila</i>	
5	To submit a Project Report on any related topic to larval forms (Crustacean, Mollusca and Echinoderm)	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting	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.

**B.Sc. Zoology Semester II
MJ-202T**

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.

ECOLOGY

FM:60, PM:24

TIME:3Hrs

UNITS	TOPICS	CREDIT 3T
GROUP A		No. of Lectures
Unit 1: An Overview of Ecology	Structure and function of an ecosystem, Energy flow in an ecosystem: Lindeman's dynamic trophic concept, Food chain and Food web. Biome: An introduction and its type.	9
Unit2: Population Ecology:	Population its attributes, Survivorship curve. Exponential and logistic growth.	9
Unit 3: Community Ecology:	Community Characters, Analytical and synthetic characters, Community Diversity Indices Community Interactions: positive and Negative interactions, Niche concept, Community Dynamics-Succession and Climax concept.	9
GROUP B		
Unit 4: Environment Management	Natural resources-types; Biogeochemical cycles - Water, Carbon, Nitrogen; Biodiversity - Alpha, Beta, Gamma. Hotspots, Environmental Degradation: causes and its management.	9
Unit 5: Environmental movements	Chipko movement, Silent valley, Sardar Sarovar Mega Dam projects.	9

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

PRACTICALS
MJ-202P: ECOLOGY

FM:25, PM:10

TIME: 2Hrs

S.N.	TOPIC- EXPERIMENTS/LAB WORK	CREDIT 1P (30 Hrs.)
1	Study of life tables and plotting of survivorship curves of different types from the 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	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

MJ-301T

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, PM:24

CHORDATES

TIME:3 Hrs

UNITS	TOPICS	CREDIT 3T (45 Hrs.)
Unit 1: Chordata	Origin, characters and its outline classification of chordates.	4
Unit 2: Protochordates	Characters of Hemichordates, Urochordates and Cephalochordates.	5
Unit 3: Agnatha	General characters and classification of cyclostomes.	
Unit 4: Pisces	Characters of living group of fishes (cartilaginous & bony fishes), Classification of Chondrichthyes and Osteichthyes, Air breathing fishes.	6
Unit 5: Amphibia	Diagnostic characters, general organisation and classification up to classes, Neoteny & Metamorphosis.	5
Unit 6: Reptilia	Characters and classification of living reptiles, Poisonous Snakes & Poison apparatus.	5
Unit 7: Aves	Characters of living birds, Flightless bird, Flight adaptation and important bird's area of India (IBAS).	5
Unit 8: Mammalia	General characters and classification mammals Prototheria, Metatheria and Eutheria.	5

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

PRACTICALS
MJ-301P: CHORDATA

FM:25, PM:10

TIME:2Hrs

S.NO.	TOPIC- EXPERIMENTS/LAB WOK	CREDIT 1P (30 Hrs.)
1	Protochordata: <i>Balanoglossus, Herdmania,</i>	
2	Agnatha: <i>Petromyzon, Myxine</i>	
3	Fishes: <i>Scoliodon, Torpedo, Heteropneustes, Labeo, Exocoetus, Hippocampus, Anabas.</i>	
4	Amphibia: <i>Necturus, Bufo, Hyla, Salamandra.</i>	
5	Reptilia: <i>Chelone, Varanus, Chamaeleon, Draco, Bungarus, Vipera, Naja, Crocodylus.</i> 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: <i>Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous.</i> Mount of weberian ossicles, pecten from Fowl.	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting	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
MJ-302T**

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.

CELL BIOLOGY

FM:60, PM:24

TIME: 3 Hrs

UNIT	TOPIC	CREDIT 3T (45 Hrs.)
Group A		No. of Lectures
Unit 1: General concept	Prokaryotic and eukaryotic cells.	3
Unit 2: Cell Organelles	Cell theory, Cell structure and function of Mitochondria, Golgi complex, Endoplasmic reticulum, Ribosome, lysosome, Centriole and Nucleus.	10
Unit 3: Cell membrane	Cell transport and cell membrane structure.	6
Group B		
Unit 4: Cytoskeleton	Cytoskeleton: Composition and function Microtubules and microfilaments.	6
Unit 5: Cell cycle	Cell cycle, cell signalling and cell culture.	7
Unit 6: Mitosis and Meiosis	Mitosis and Meiosis, Cell division.	6
Unit 7: Cancer	Abnormal cell division (cancer cell).	7

Suggested Readings:

- Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition.
- De Roberti's, 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. 5. 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.

PRACTICALS
MJ-302P: CELL BIOLOGY

FM:25 PM: 10

Time: 2 Hrs.

S.N.	TOPIC- EXPERIMENT/LAB WORK	CREDITS 1P (30 Hrs.)
1.	Preparation of stained squash of onion root tip to study various stages of mitosis.	
2.	Study various stages of meiosis from permanent slides.	
3.	Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.	
4.	Demonstration of polytene chromosome from <i>Drosophila</i> / <i>Chironomus</i> larva.	
	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.
- E.D.P. De Robertis and E.M.F. De Robertis (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. 5. 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-IV
MJ-401T

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.

ANIMAL PHYSIOLOGY

FM:60, PM:24

TIME: 3Hrs

UNITS	TOPICS	CREDIT 3T (45 Hrs.)
GROUP A		No. of Lectures
Unit 1: Tissue	Tissue and its types.	2
Unit 2: Digestive system	Gastrointestinal tract and its associated glands, Mechanical and chemical digestion of food, Absorption of Carbohydrate, Protein, and Lipid	6
Unit 3: Respiratory System	Respiratory volumes, Respiratory Pigments, Transport of Gases.	5
Unit4: Circulatory system	Structure and Working of Mammalian Heart- cardiac cycle and ECG and its importance. Blood and its components, Blood clotting Mechanism, Blood groups and Rh factor.	6
Unit5: Skeletal system	Ultrastructure of Skeletal Muscle, Mechanism of muscle contraction.	5
GROUP B		
Unit6: Excretory System	Kidney: structure and function, Mechanism of urine formation, Counter- Current theory, urea cycle.	5
Unit7: Reproductive System	Male and female reproductive organs, physiology of reproduction in male and female, Accessory Reproductive organs, Reproductive hormones and Uterine cycle.	6
Unit 8: Endocrine system	Endocrine glands, Types and mechanism of hormone action. Elementary idea of Pituitary, Thyroid, Adrenal, Pancreas & Pineal gland.	6
Unit 9: Nervous System	Ultrastructure of Neuron, Nerve conduction and Reflex Action.	4

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

PRACTICALS
MJ-401P: ANIMAL PHYSIOLOGY

FM:25, PM: 10

TIME: 2Hrs

S.N.	TOPIC- EXPERIMENT/LAB WORK	CREDIT 1P (30 hrs.)
1.	Recording of simple muscle twitch with electrical stimulation (or virtual).	
2.	Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).	
3.	Preparation of temporary mounts: Squamous epithelium, Striated muscle fibers and blood film.	
4.	Study of various tissues of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.	
5.	Microtomy: Preparation of permanent slide of mammalian tissues.	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting	06 marks
	Practical Records	03 marks
	Viva-voce	06 marks

Suggested Readings:

- I. Guyton. A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt 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.
- Arey. L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
- De Fiore Atlas of Human histology. Physiology Vandor

B.Sc. Zoology Semester-IV
MJ – 402T

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.

BIOCHEMISTRY

FM:60, PM:24

TIME:3 Hrs

UNITS	TOPICS	CREDIT 3T (45 Hrs.)
Unit 1: Biomolecules	Water, Types of biomolecules and their importance.	08
Unit 2: Carbohydrates	Structure and classification of carbohydrates, Metabolism of carbohydrates. Glycolysis, Krebs's cycle, ETS and ATP synthesis. Glycogenesis, Gluconeogenesis, Glycogenesis HMP shunt, Glycogenolysis.	12
Unit 3: Lipids	Structure and classification of lipids.	06
Unit 4: Proteins	Composition, structure and biological significance of proteins. Amino acids: structure and classification. Catabolism of Amino acid: Transamination & Deamination.	10
Unit 5: Enzymes	Nomenclature and classification of enzymes. Enzyme kinetics (Michaelis Menton Equation) Regulation of Enzyme action, Coenzymes and Isoenzymes.	09

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., Kenneliy. P.J., Rodwell, V.W. and Well. P.A. (2009.). Harper's Illustrated Biochemist1Y, 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

PRACTICALS
MJ-402P: BIOCHEMISTRY

FM:25, PM: 10

TIME:2 Hrs

S.N.	TOPIC- EXPERIMENT/LAB WORK	CREDIT 1P
1.	Quantitative test of functional groups in carbohydrates, proteins and lipids.	
2.	Paper chromatography of amino acids.	
3.	Action of salivary amylase under optimum conditions.	
4.	Estimation of proteins by spectrophotometric method.	
5.	Estimation of DNA & RNA by spectrophotometric method.	
	Full Marks	25
	One Major Experiment	10 marks
	Spotting	06 marks
	Practical Records	03 marks
	Viva-voce	06 marks

Suggested Reading:

1. Practical manual of Biochemistry: Sabira Dabeer 2020
2. Textbook of Practical Biochemistry: Joshi A. Rashmi.

B.Sc. Zoology Semester-IV
MJ- 403T

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.

COMPARATIVE ANATOMY

FM:60, PM:24

TIME:3 Hrs

UNITS	TOPICS	CREDIT: 3T (45 Hrs.)
Group A		No. of Lectures
Unit 1: Skeletal System	An Overview of Axial and Appendicular Skeleton.	9
Unit 2: Digestive System	Alimentary Canal and associated glands, Dentition.	9
Unit 3: Circulatory System	Heart and Aortic arches.	8
GROUP B		
Unit 4: Urinogenital System	Succession of Kidney & Urinogenital duct.	9
Unit 5: Nervous system	Brain.	10

Suggested Readings:

1. Kardong. K. V. (2005) vertebrates 'Comparative Anatomy. Function and Evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
3. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills.
4. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
5. Walter, HSE. and Sayles, L.P., Biology of Vertebrates, Khosla Publishing House.
6. Vertebrate- Sinha, Adhi kary, Ganguly

PRACTICALS
MJ-403P: COMPARATIVE ANATOMY

FM: 25, PM:10

TIME: 3Hrs

S.N.	TOPIC- EXPERIMENT/LAB WORK	CREDIT 1P (30 Hrs.)
1.	Study of placoid, cycloid and ctenoid scales through permanent slides /photographs.	
2.	Study of Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit.	
3.	Carapace and plastron of turtle/ tortoise.	
4.	Mammalian skulls: herbivorous and carnivorous animal.	
5.	Virtual demonstration of rat to study arterial and urinogenital system. Study of structure of heart, kidney and eye from video recording.	
6.	Project on skeletal modifications in vertebrates.	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

B. Sc. Zoology Semester- V
MJ-501T

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.

MOLECULAR BIOLOGY

FM:60, PM: 24

TIME: 3 Hrs

UNITS	TOPICS	CREDIT: 3T (45 Hrs.)
GROUP A		No. of Lectures
Unit 1: DNA	Chemistry of nucleic acids (DNA & RNA): Nitrogenous bases, Pentose sugar, Nucleosides & Nucleotides, Watson-Crick model of DNA, Types of DNA (A, B & Z). Base pairing, Major & minor grooves of DNA, concept of gene.	6
Unit 2: Replication	DNA replication in prokaryotes, Mode of replication: Conservative, Semi-conservative & dispersive, DNA replication, Replication fork, DNA polymerases, Okazaki fragment, Initiation, elongation and termination. Fidelity of replication and DNA repair.	6
Unit 3: Transcription	Central dogma, Transcription in <i>E. coli</i> , Consensus sequences, Promoter -35 & -10 elements (Pribnow box), RNA polymerase, Phases: Initiation, Elongation and Termination.	7
GROUP B		
Unit 4: RNA	RNA: Chemistry of RNA, types and structure of RNA (mRNA, tRNA & rRNA)	7
Unit 5: Genetic codes	Genetic code, Features of genetic code, Wobble hypothesis.	6
Unit 6: Translation	Translation in prokaryotes, Translation factors, charging of tRNAs, Phases- initiation. elongation and termination, Ribozymes.	6
Unit 7: Operon concept	Operon and its types, Lac operon & Tryptophan operon.	7

Suggested books:

- Lenhinger Principles of biochemistry: Cox & Nelson, MacMillan & Freeman. USA
- Molecular biology of Gene: Watson et al., Pearson Publication, USA
- Principles of Genetics: Snustad & Simmons, John Wiley & Sons. USA
- Modern Genetics Analysis: Integrating Genes and Genomes. Griffith et al., W. H. Freeman & Company, USA
- Genetics: Russell & Benjamin, Cummings Publishing Company, USA.
- Genetics: PK Gupta. Rastogi Publication, New Delhi.

PRACTICALS
MJ-501P: MOLECULAR BIOLOGY

FM:25, PM:10

TIME:2Hrs

S.N.	TOPIC- EXPERIMENT/LAB WORK	CREDIT 1P (30 Hrs)
1.	Preparation of liquid culture medium (LB) and virtual demonstration of culture protocol for bacteria.	
2.	Estimation of the growth kinetics of E. coli by turbidity method.	
3.	Virtual Demonstration of antibiotic resistance/sensitivity of bacteria to antibiotic pressure and interpretation of results.	
4.	Quantitative estimation of DNA using spectrophotometer.	
5.	Study and interpretation of electron micrographs/ photograph showing DNA replication using virtual mode.	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

Suggested Readings:

- J. Sambrook & D. Russel. (1989). Molecular Cloning: A Laboratory Manuals: Cold spring Harbor National Laboratory Press.
- Verma das Singh, (2014) Laboratory Manual for Biotechnology, S Chand and Company Pvt Ltd.

B.Sc. Zoology Semester VI

MJ-502T

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.

GENETICS

FM:60, PM:24

TIME: 3Hrs

UNITS	TOPICS	CREDIT:3T (45 Hrs.)
GROUP A		No. of Lectures
Unit1: Mendel's Inheritance	Mendelian laws in genetics: Monohybrid & Dihybrid Cross, Laws of dominance, segregation & independent assortment, back cross & test cross.	5
Unit 2: Linkage	Coupling & repulsion hypothesis, Morgan's view of linkage, kinds of linkage & linkage map, Chromosomal theory of linkage, Crossing over or Genetic recombination, mechanism of crossing over.	6
Unit3: Chromosome	Eukaryotic Chromosomes: Structure & chemical composition of chromosomes Karyotype, Giant chromosome	5
Unit 4: Sex determination	Sex determination & Types of sex determination, Genic balance theory, Chromosomal theory & Environmental sex determination. Sex determination in Drosophila, Bird & Human.	6
GROUP B		
Unit 5: Sex linked Inheritance	Sex chromosomes, X-linked genes (colour blindness & haemophilia in humans). Y-linked inheritance. Sex-limited & Sex influenced traits.	6
Unit6: Pedigree Analysis	Pedigree analysis: Penetrance & expressivity, Pedigree analysis of dominance inheritance (polydactyly in man). Recessive inheritance (cystic fibrosis) and sex-linked inheritance (colour blindness).	6
Unit7: Mutation	Chromosomal mutation & gene mutation. Chromosomal aberrations in humans. Euploidy & aneuploidy, induced mutation and mutagens.	6
Unit8: Epigenetics	Epigenetics and its types.	5

Suggested Books

1. Strickberger's Genetics, Prinitis Hall of India (Pill), Delhi
2. Principles of Genetics: Snustad & Simmons. John Wiley & Sons, USA
3. Modern Genetics Analysis: Integrating Genes and Genomes, Griffith et al.
4. W. H. Freetnan & Company, USA
5. Genetics: Russell & Benjamin, Cummings Publishing Company. USA.
6. Principles of Genetics: Tamer, Tata McGraw Hills. Delhi
7. Genetics: PK Gupta. Rastogi Publication, New

PRACTICALS
MJ-502 P: GENETICS

FM: 25, PM:10

TIME:3 Hrs

S.N.	TOPICS	CREDIT:1P (30 Hrs.)
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	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

Suggested Books:

- 1 R. N. Jones, Robert Neil Jones, G. K. Richards · Practical Genetics 1991
- 2 Principles of Genetics: Tamer, Tata McGraw Hills. Delhi
- 3 Genetics: PK Gupta. Rastogi Publication, New

B. Sc. Zoology Semester-V
MJ-503T:

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.

Developmental Biology

FM:60, PM: 24

TIME: 3Hrs

UNITS	TOPICS	CREDIT 3T (45 hrs.)
GROUP A		
Unit 1: Gametogenesis	Gametogenesis: Spermatogenesis, Oogenesis.	4
Unit 2: Gametes	Gametes: sperm or male gametes: types of sperms, Eggs or Female gametes: types of eggs.	6
Unit 3: Egg Membrane	Egg membranes and its membrane	3
Unit 4: Fertilization	Fertilization & its mechanism in mammals	3
Unit 5: Cleavage	Planes and patterns of cleavage.	3
Unit 6: Blastula	Types of Blastula	3
GROUP B		
Unit 7: Fate maps	Fate Maps	2
Unit 8: Development	Early development of frog and chick up to gastrulation.	3
Unit 9: Phase of Development	Embryogenesis. Organogenesis. Blastogenetic in general	4
Unit 10: Pattern	Pattern formation.	2
Unit 11: Gene Expression	Differential gene expression: cytoplasmic determinants and asymmetric cell division.	4
Unit 12: Basic concept of Development	Potency, Commitment, Specification. Induction. Competence.	4
Unit 13: Placenta	Placenta: Structure. types and functions of placenta.	4

Suggested Readings:

- Gilbert, S. F. (2010). Developmental Biology. LX Edition, Sinauer Associates. Inc. Publishers. Sunderland. Massachusetts, USA.
- Belinsky B.L and Fabian B. C. (1981). An Introduction to Embryology. V Edition. International Thompson Computer Press.
- Kalthoff (2008). Analysis of Biological Development. II Edition. McGraw-Hill Publishers.
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

PRACTICALS
MJ-503P: DEVELOPMENTAL BIOLOGY

FM: 25, PM:10

TIME: 2Hrs

S.N.	TOPIC/ EXPERIMENT LAB WORK	CREDIT 1P (30 Hrs.)
1.	Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).	
2.	Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)	
3.	Study of different types of placentae (photomicrograph/ slides)	
4.	Project report on chick embryo development.	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

**B.Sc. Zoology Semester-VI
MJ-601T**

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.

EVOLUTION

FM:60, PM:24

TIME: 3 Hrs

UNITS	TOPICS	CREDITS: 3T (45 Hrs.)
GROUP A		
Unit 1: Origin of life and evolutionary theory	Origin of life, Lamarckism, Darwinism, Modern Synthetic Theory.	7
Unit 2: Evidence of Evolution	Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time & scale)	8
Unit 3: Process of Evolutionary change	Variation and its sources: Heritable variations and their role in evolution.	7
GROUP B		
Unit 4: Principles of Population genetics	Population genetics, Hardy — Weinberg law (statement and derivation of equation, application of law to human population) Factors influencing H-W equilibrium.	7
Unit 5: Species concept	Product of Evolution: Micro evolutionary changes (Inter population variations, clines, races), Species concept, Isolating mechanism, Modes of speciation- allopatric, sympatric. Macro evolution (Adaptive Radiation)	8
Unit 6: Phylogenetic trees	Multiple sequence alignment: Construction of Phylogenetic trees. Interpretation of trees.	8

Suggested Readings:

- Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
- Barton. N. Fl. Briggs, D. E. G., Eisen, J. A. Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring. Harbour Laboratory Press.
- Hall. B. K. and Hallgrimsson. B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers 4. Pevsner. J. (2009). Bioinformatics and Functional Genomics. II Edition. Wiley- Blackwell.

PRACTICALS
MJ-601P: Evolution

FM:25, PM:10

TIME: 3Hrs

S. N.	Topic	CREDIT:1P (30 Hrs.)
1.	Study of fossil evidences from plaster cast models and pictures & virtual mode	
2.	Study of homology and analogy from suitable specimens/ pictures.	
3.	Study and verification of Hardy — Weinberg Law by chi — square analysis	
4.	Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies.	
5.	Graphical representation and interpretation of data of height/weight of a sample of 100 humans in relation to their age and sex or related data	
6.	Construction of phylogenetic tree with the help of bioinformatics tools (Clustal X and Phylip) and its interpretation.	
7.	Evolution of man and horse by chart/virtual	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

B.Sc. Zoology Semester -VI
MJ-602T

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.

ENDOCRINOLOGY

FM:60, PM:24

TIME: 3Hrs

UNITS	TOPICS	CREDIT 3T (45 Hrs.)
GROUP A		No. of Lectures
Unit1: Introduction to Endocrinology	Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones. Mechanism of hormone action, receptor concept, second messenger.	14
Unit2: Epiphysis, Hypothalamo- hypophysial Axis	Structure of pineal gland, its hormones and their role in biological rhythms. Structure of pituitary gland, Hormones and their functions, Disorders of pituitary gland. Structure of hypothalamus, Hypothalamic nuclei and their functions, Regulation of neuroendocrine glands, Feedback mechanisms, Hypothalamo-hypophysial portal system.	15
GROUP B		
Unit3: Peripheral Endocrine Glands	Structure, Hormones, Functions of Thyroid, Parathyroid, Adrenal, Pancreas, Ovary and Testis. Hormones in homeostasis, Disorders of endocrine glands.	16

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.

PRACTICALS
MJ-602P: ENDOCRINOLOGY

FM: 25, PM:10

TIME: 2 Hrs

S.NO.	TOPIC- EXPERIMENTS/LAB WOK	CREDIT 1P (30 Hrs.)
1	Dissect and display of Endocrine glands in laboratory bred rat (virtual mode)	
2	Study of the permanent slides of all the endocrine glands.	
3	Compensatory ovarian/ adrenal hypertrophy in vivo bioassay in laboratory bred rat (virtual mode).	
4	Demonstration of Castration/ ovariectomy in laboratory bred rat (virtual mode).	
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	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.

B.Sc. Zoology Semester-VI
MJ- 603T

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.

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

FM: 60, PM: 24

TIME: 3 Hrs.

Units	Topics	CREDIT 3T (45 HRS.)
Group: A		No. of Lectures
Unit 1: Introduction to Animal Behaviour	Brief profiles of Karl Von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Raghavendra Gadagkar.	8
Unit 2: Patterns of Behaviour	Proximate and ultimate causes of behaviour, Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.	9
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.	10
Group: B		
Unit 4: Introduction to Chronobiology	Biological oscillation: the concept of Average, amplitude, phase and period. Adaptive significance of biological clocks.	8
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, Significance of biological clocks.	10

SUGGESTED READINGS:

- David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge, University Press, UK.
- John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
- Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
- Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
- Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R.D. Lewis. (3rd Ed) 2002 Baren's and Noble Inc. New York, USA

PRACTICALS

MJ-603P: ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

FM:25, PM:10

TIME:2Hrs

S.NO	TOPIC- EXPERIMENTS/LAB WOK	CREDITS 1P
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	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

**B.Sc. Zoology Semester VI
MJ-604T**

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.

Immunology

FM-60, PM: 24

TIME:3Hrs

Units	Topics	Credit 3T
Unit 1: Overview of Immune System	Concept of immunity, Cells & Organs of the Immune System.	5
Unit 2: Innate and Adaptive Immunity	Anatomical Barriers, Inflammation Cells & Molecules involved in Innate Immunity, Adaptive Immunity (Cell mediated + humoral)	6
Unit 3: Antigens	Antigenicity & Immunogenicity Immunogens, Adjuvants and Haptens, Epitopes, B and T cell	7
Unit 4: Immunoglobulins (Ig)	Structure, Function of different types of immunoglobulins. Antigen-antibody Interactions Immuno-assays (ELISA and RIA).	7
Unit 5: Major Histocompatibility Complex (MHC)	Structure function of MHC molecules, Structure of T-cell receptor & its signalling. T cell development.	7
Unit 6: Cytokines	Types, Properties and functions of Cytokines.	6
Unit 7: Hypersensitivity Vaccines	Classification and brief description of various types of hypersensitivity, Introduction to vaccine, Various types of vaccines.	7

Suggested Readings:

1. Kinditt, T.J., Golds by R.A., Osborne, B.A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
2. David, M., Jonathan, B., David, R.B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
3. Abbas, K. Abul and Lechtman H. Andrew (2003) Cellular and Molecular immunology. V edition. Saunders Publication.

PRACTICALS
MJ-604P: IMMUNOLOGY

FM:25, PM 10

Time: 2 Hrs.

S.N.	TOPIC	CREDIT 1P (30 Hrs)
1.	Virtual Demonstration of lymphoid organs.	
2.	Histological study of spleen, thymus, and lymph nodes through slides/ photographs.	
4.	ABO blood group determination	
5	Demonstration of a) ELISA (virtual) b) Immunoelectrophoresis	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

Suggested Readings:

1. F C Hay Olwyn M. R. Westwood, 2002. Practical Immunology. Blackwell Science Ltd

B.Sc. Zoology Semester VII

MJ-701T

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 = 45MARKS) are to be answered selecting not more than two from ANY group.

ANIMAL BIOTECHNOLOGY

FM:60, PM: 24

TIME:3 Hrs

Units	Topics	Credits 3T
GROUP: A		
Unit 1. Introduction	Concept and scope of biotechnology	5
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. Gene cloning technique. Construction of genomic and cDNA libraries. Hybridization technique: Southern, Northern and Western Blotting. DNA sequencing by Sanger method.	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, Animal disease model.	15
Unit 4. Culture Techniques & Applications	Animal cell and tissue culture, Basic concept of Gene therapy	9

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.

PRACTICALS
MJ-701P : ANIMAL BIOTECHNOLOGY

FM:25, PM:10

TIME: 2 Hrs

S.NO.	TOPIC- EXPERIMENTS/LAB WOK	CREDITS 1P
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)	
6	Project report on animal cell/tissue culture	
	Full Marks	25
	One major experiment	10 marks
	Spotting	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 VII
MJ-702T

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.

PARASITOLOGY

FM:60, PM:24

TIME: 3 Hrs.

UNITS	TOPICS	CREDIT 3T
GROUP: A		
Unit 1: Introduction to Parasitology	Brief introduction of Parasitism; Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite Relationship.	7
Unit 2: Parasitic Protists	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Entamoeba histolytica</i> , <i>Leishmania donovani</i> , <i>Plasmodium vivax</i> .	8
Unit 3: Parasitic Platyhelminthes	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Fasciola hepatica</i> , <i>Taenia solium</i> .	8
GROUP: B		
Unit 4: Parasitic Nematodes	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Ascaris lumbricoides</i> & <i>Wuchereria bancrofti</i>	8
Unit 5: Parasitic Arthropoda	Importance and control of ticks, mites, <i>Pediculus humanus</i> , <i>Cimex lectularius</i> .	7
Unit 6: Parasitic Vertebrates	A brief account of parasitic vertebrates: Cookicutter Shark and Vampire bat	7

Suggested Reading:

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

PRACTICALS
MJ-702P: PARASITOLOGY

FM:25, PM:10

TIME: 2 Hrs.

S.NO.	TOPIC- EXPERIMENTS/LAB WOK	CREDIT 1P
1	Study of life stages of <i>Entamoeba histolytica</i> , <i>Leishmania donovani</i> and <i>Plasmodium vivax</i> through permanent slides/micro photographs.	
2	Study of adult and life stages of <i>Taenia solium</i> through permanent slides/micro photographs	
3	Study of adult and life stages of <i>Ascaris lumbricoides</i> , <i>Wuchereria bancrofti</i> through permanent slides/micro photographs.	
4	Study of <i>Pediculus humanus</i> (Head louse and Body louse) and <i>Cimex lectularius</i> through permanent slides/ photographs).	
5	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 either ecto or endo parasite of humans.	
	Full Marks	25
	One major experiment	10 marks
	Spotting	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-VII
MJ-703T

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.

FISH & FISHERIES

FM:60, PM: 24

TIME: 3 Hrs.

UNITS	TOPICS	CREDIT 3T
GROUP: A		
UNIT 1: Introduction & Classification:	General description of fish; Account of systematic classification of fishes (up to classes); Classification based on feeding habit, habitat and manner of reproduction.	8
UNIT 2: Morphology & 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	10
UNIT 3: Fisheries	Inland Fisheries; Fisheries of Jharkhand. Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries;	9
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	12
UNIT 5: Fish in research	Transgenic fish, Zebra fish as a model organism in research	6

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

PRACTICALS
MJ-703P: FISH & FISHERIES

FM: 25, PM:10

TIME:2Hrs

S.NO.	TOPIC- EXPERIMENTS/LAB WOK	CREDIT-1P
1	Morphometric and meristic characters of fishes	
2	Study of <i>Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas</i>	
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 <i>Channa, Heteropneustes,</i>	
7	Demonstration of induced breeding in Fishes (video) <i>Anabas</i> and <i>Clarias</i>	
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	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. SEMESTER VII
MJ-704T**

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.

WILD LIFE CONSERVATION AND MANAGEMENT

FM:60, PM: 24

TIME: 3 Hrs.

UNITS	TOPICS	CREDIT 3T
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.	8
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	8
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, Pugmarks and census method.	7
Unit 5: Management planning of wild life	Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbation.	6
Unit 6: Management of excess population	Bio- telemetry; Care of injured and diseased animal; Quarantine; Common diseases of wild animal	5
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.	6

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.

PRACTICALS
MJ-704P: WILDLIFE CONSERVATION AND MANAGEMENT

FM: 25, PM:10

TIME: 3 Hrs.

S.N.	TOPIC- EXPERIMENTS/LAB WOK	CREDITS 1P
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	
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

B.Sc. Zoology Semester VIII**MJ-801 T**

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.

EXPLORING THE BRAIN: STRUCTURE AND FUNCTION**FM:60, PM: 24****TIME: 3 Hrs.**

UNITS	TOPICS	CREDIT 3T
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.	6
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.	6
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.	6
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;	6
Unit 7: Rhythms of the Brain:	Electroencephalogram; Sleep – why do we sleep, Non-REM and REM sleep, neural mechanisms of sleep; Circadian rhythms.	6
Unit 8: Mental illness and the Brain:	Psychosocial and biological approaches to mental illness; anxiety disorders; Mood disorders; Schizophrenia.	5

Suggested Readings:

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

PRACTICALS
MJ-801P: EXPLORING THE BRAIN

FM: 25, PM:10

TIME: 2 Hrs.

S.NO.	TOPIC- EXPERIMENTS/LAB WOK	CREDITS 1P
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.

ADVANCED MAJOR COURSES/PAPERS

B.Sc. Zoology Semester VIII

AMJ-801T

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.

BASICS OF NEUROSCIENCE

FM:60, PM:24

TIME: 3Hrs.

UNITS	TOPICS	CREDIT 3T
GROUP: A		
Unit 1: Introduction to Neuroscience	Origins of Neuroscience; Neuroanatomy, Neurophysiology, and Systems Neurobiology	10
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.	10
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,	8
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.	7

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.

PRACTICALS
AMJ-801P: BASICS OF NEUROSCIENCE
FM:25, PM:10 **TIME: 2 Hrs**

S.N.	TOPIC- EXPERIMENTS/LAB WOK	CREDIT 1P
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	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

Suggested Readings:

- 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
- Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates, Inc.-2004

**B.Sc. Zoology Semester VIII
AMJ-802T**

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.

COMPUTATIONAL BIOLOGY

FM:60, PM:24

TIME:3Hrs

Units	Topics	CREDIT 3T
GROUP: A		No of Lectures
Unit 1: Introduction to Bioinformatics	Importance, Goal, Scope; Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics, Molecular Phylogeny; Applications and Limitations of Bioinformatics.	8
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, DrugBank, ZINC, CSD), journal databases (Pub Med).	10
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).	9
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.	9
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).	9

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.

PRACTICALS
AMJ- 802P: COMPUTATIONAL BIOLOGY

FM:25, PM:10

TIME: 2 Hrs.

S.N.	TOPIC- EXPERIMENTS/LAB WORK	CREDIT 1P
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 readingframe 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 (MS Excel).	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

B.Sc. Zoology Semester VIII
AMJ-803T

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.

BIOCHEMISTRY OF METABOLIC PROCESSES

FM:60, PM: 24

TIME: 3 Hrs.

UNITS	TOPICS	CREDIT: 3T
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.	11
GROUP: B		
Unit 3: Protein Metabolism	Catabolism of amino acids: Transamination, Deamination, Urea cycle.	11
Unit 4: Oxidative Phosphorylation	Redox systems; Review of mitochondrial respiratory chain, Inhibitors and uncouplers of Electron Transport System.	11

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.

PRACTICALS

AMJ-803 P: BIOCHEMISTRY OF METABOLIC PROCESSES

FM:25, PM:10

TIME: 2 Hrs.

S.N.	TOPIC- EXPERIMENTS/LAB WOK	CREDIT 1P
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	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.

SKILL ENHANCEMENT COURSES

B.Sc. Zoology Semester I

SEC-101T

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group.

AQUARIUM FISH KEEPING

FM:75, PM:30

TIME: 3Hrs

UNITS	TOPICS	CREDITS: 3T
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	11
Unit2: 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.	12
GROUP: B		
Unit 3: Food and feeding of Aquarium fishes	Use of live fish feed organisms, Preparation and composition of formulated fish feeds	10
Unit 4: Fish Transportation	Live fish transport - Fish handling, packing and forwarding techniques.	10
Unit 5: Maintenance of Aquarium	General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry.	12

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

PRACTICALS
SEC101P: AQUARIUM FISH KEEPING

FM: 25, PM:10

TIME: 3Hrs.

S.N.	TOPICS	CREDIT: 1P
1.	Water quality requirement: maintenance and temperature control	
2.	Live fish transport= Factors and principles associated with live fish transport	
3.	Aquarium maintenance/Ornamental fish farm	
4.	a) Fresh Water Ornamental Fishes= Gold Fish, Guppy and Angel Fish b) Brackish Ornamental Fishes= Ray Fish c) Marine Ornamental Fishes= Butterfly Fish	
5.	Aquarium Fish Disease= Parasitic, Bacterial, Viral, Protozoan, Fungal, And Deficiency Diseases.	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

Suggested Readings:

- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House
- Pandey & Shukla, Fish and Fisheries. Rastogi Publications
- Fish Biology and Indian Fisheries, R P Parihar, Central Publishing House Allahabad
- V. G. Jhingran, (1983), Fish and Fisheries of India, Hindustan Publishing Corp. Delhi. 1997., 2002 new enlarged edition)

B.Sc. Zoology Semester II

SEC-201T

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group.

SERICULTURE

FM-75, PM: 30

TIME: 3 Hrs.

UNITS	TOPICS	CREDIT 3T
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	9
Unit 2: Biology of Silkworm	Life cycle of <i>Bombyx mori</i> Structure of silk gland and secretion of Silk.	8
Unit 3: Rearing of Silkworms	Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances disinfectants: Formalin, bleaching powder, RKO, Silkworm rearing technology: Early age rearing, Types of mountages harvesting and storage of cocoons.	9
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	9
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 centers.	10

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.

PRACTICALS
SEC-201P: SERICULTURE

FM:25, PM: 10

TIME: 2 Hrs.

S.N.	TOPICS	CREDIT 1P
1.	Morphology of silk moth	
2.	Life cycle of Silk moth	
3.	Structure of silk gland	
4.	Rearing house and appliances	
5.	Morphology of Uzi Fly and Dermestid Beetles- Study of silkworm pests	
6.	Sericulture Centres in India	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 arks

Suggested Readings:

- Dr. Amardev Singh Dr Ravinder Kumar, Sericulture Handbook Vol. 2013, Biotech Publication
- Ganga G, 2020, An Introduction to Sericulture 2nd ED CBS Publishers & Distributors Pvt. Ltd.

**B.Sc. Zoology Semester III
SEC-301T**

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group.

MEDICAL DIAGNOSTIC

FM:75, PM:30

TIME: 3 Hrs.

UNITS	TOPICS	CREDIT: 2T
GROUP: A		No. of Lectures
Unit 1: Introduction	Introduction to Medical Diagnostics and its Importance.	7
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.)	8
Unit 3: Diagnostic Methods	Urine Analysis: Physical characteristics; Abnormal constituents	7
GROUP: B		
Unit 4: infectious Diseases	Non- 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.	8
Unit 5: Infectious Diseases	Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis	8
Unit 6: Tumours	Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT-Scan (using photographs).	7

SUGGESTED READINGS

- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
- Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology, 2nd 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.

PRACTICALS
SEC-301P: MEDICAL DIAGNOSTIC

FM:25, PM:10

TIME: 2Hrs

S.N.	TOPICS	CREDIT 1P
1.	Preparation of blood smear	
2.	Study of two normal and two abnormal constituents in urine	
3.	Testing of blood glucose level using Haemocytometer	
4.	MRI & CT SCAN	
5.	X-ray of Bone structure	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

MINOR COURSES (TRADITIONAL)

**B.Sc. Zoology Semester I
MN-101 T (TRADITIONAL)**

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group

ANIMAL DIVERSITY

FM:75, PM: 30

TIME: 3 Hrs.

GROUP A (INVERTEBRATES)

UNITS	TOPIC	CREDIT 3T
Unit 1: Kingdom Protista	General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa.	2
Unit 2: Phylum Porifera	General characters and classification up to classes: Canal System in Sycon	3
Unit 3: Phylum Cnidaria	General characters and classification up to classes; Polymorphism in Hydrozoa	2
Unit 4: Phylum Platyhelminthes	General characters and classification up to classes; Life history of <i>Taenia solium</i>	2
Unit 5: Phylum Nematelminths	General characters and classification up to classes; Life history of <i>Ascaris lumbricoides</i> and its parasitic adaptations.	3
Unit 6: Phylum Annelida	General characters and classification up to classes: Metamerism in Annelida	3
Unit 7: Phylum Arthropoda	General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects.	3
Unit 8: Phylum Mollusca	General characters and classification up to classes; Torsion in gastropods	3
Unit 9: Phylum Echinodermata	General characters and classification up to classes;	3
	GROUP B (VERTEBRATES)	

Unit 10: Protochordates	General features and Phylogeny of Protochordates	3
Unit 11: Agnatha	General features of Agnatha and classification of cyclostomes up to 10 classes.	3
Unit 12: Pisces	General features and Classification up to orders: Osmoregulation in Fishes.	3
Unit 13: Amphibia	General features and Classification up to orders: Parental care	3
Unit 14: Reptiles	General features and Classification up to 10 orders: Poisonous and non-poisonous snakes, Biting mechanism in snakes	3
Unit 15: Aves	General features and Classification up to orders: Flight adaptations in birds	3
Unit 16: Mammals	Classification up to orders: Origin of mammals.	3

Suggested Reading:

1. Barnes. R.D. (1982). Invertebrate Zoology. V Edition. Holt Saunders International Edition.
2. Barnes, R.S.K. Calow. P., Olive. P.J.W. Golding. D.w. and Spicer, J.I. (2002). The Invertebrates: A Synthesis. Ill Edition. Blackwell Science
3. Barrington. E.J.W. (1979). Invertebrate and Functions. 11 Edition. E.L.B.S. and Nelson
4. Boradale, L.A. and Potts. E.A. (1961). A Manual for the use of students. Asia Publishing
5. Singh, S. Keshari S. and Abhishek, K.S. (2016). Medical Zoology and Parasitology, Jharkhand Jharokha, Classical Publishing Company.
6. Young. J. Z. (2004). The Life of Vertebrates. Ill Edition. Oxford university press.
7. Pough H. Vertebrate life. Vill Edition. Pearson International.
7. Darlington P.J. The Geographical Distribution of animals, R.E. Krieger Pub. Co,

PRACTICALS
MN-101P: ANIMAL DIVERSITY

FM:25, PM:10**TIME: 2Hrs.**

S.NO.	TOPIC- EXPERIMENT/LAB WORK	CREDITS: 1P
GROUP A		
1.	Study of the whole mount of Euglena, Amoeba, and Paramecium; Binary fission and Conjugation in	
2.	Paramecium. Sycon (including T.S. and L.S.). Obelia. Physalia Aurelia. Gorgonia, Metridium, Pennatula. Aphrodite, Nereis, Heteronereis. Pheretima, Hirudinaria. Sacculina. Cancer. Pila, Unio. Asterias. Antedon	
3.	Examination of pond water collected from different places for diversity in Protista	
4.	Study of adult <i>Fasciola hepatica</i> . <i>Taenia solium</i> and their life cycles (Slides/micro-photographs)	
5.	Study of adult <i>Ascaris lumbricoides</i> and their life stages (Slides/micro-photographs)	
6.	Mount of mouth parts and dissection of the digestive system and nervous system of <i>Periplaneta</i>	
7.	To submit a Project report on any related topic	
GROUP B		
1.	Study of Museum specimen: <i>Petromyzon</i> , <i>Myxine</i> , <i>Scoliodon</i> , <i>Heteropneustes</i> , <i>Labeo</i> , <i>Exocoetus</i> , <i>Hippocampus</i> , <i>Tetrodon</i> , <i>Bufo</i> , <i>Hyla</i> , <i>Alyes</i> , <i>Salamandra</i> , <i>Uromastrix</i> , <i>Vipera</i> , <i>Naja</i> . <i>Hydrophis</i> , <i>Columba</i> , <i>Bat</i>	
2.	Types of beaks and claws	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

**B.Sc. Zoology Semester III
MN- 301T**

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group

ENVIRONMENT STUDIES

FM:75, PM:30

TIME: 3hrs.

UNITS	TOPICS	CREDIT: 3T
GROUP A		No. of Lectures
Unit1: Introduction	Sources of Environmental hazards, hazards identification and accounting, the fate of toxic and persistent substances in the environment, dose Response Evaluation, and Exposure Assessment.	10
Unit2: Climate Change	Greenhouse gases and global warming, acid rain, Ozone layer destruction, Effect of climate change on public health	10
Unit3: Pollution	Air. Water, Noise pollution sources and effects, Pollution control	8
GROUP B		
Unit 4: 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 the Bhopal gas tragedy, Chornobyl disaster, Seveso disaster, and three-mile island accident and their aftermath.	11

Suggested Readings:

1. Cutter, S.L. Environmental Risk, and Hazards, Prentice- Hall of India Pvt.L1d. New Delhi, 1999.
- Kolluru Rao. Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook". Mc Graw Hill Inc., New York, 1996.
- Kofi Asante Duah "Risk Assessment in Environmental Management", Jhon Wiley and sons, Singapore, 1998.
- Kasperson. J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V.N. Univ. Press, New York, 2003.
- Joshep F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.

PRACTICALS
MN-301P: ENVIRONMENT STUDIES

FM:25, PM:10

TIME: 3Hrs.

S.N.	TOPIC	CREDIT:1P
1.	To determine pH, in soil and water samples from different locations.	
2.	To determine Cl, in soil and water samples from different locations.	
3.	To determine SO ₄ , in soil and water samples from different locations.	
4.	To determine NO ₃ , in soil and water samples from different locations.	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

Suggested Readings:

- Kasperson. J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V.N. Univ. Press, New York, 2003.
- Joshep F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.

**B.Sc. Zoology Semester V
MN-501T**

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 four (4X15 = 60 MARKS) are to be answered
selecting not more than two from ANY group

HUMAN PHYSIOLOGY

FM:75, PM:30

TIME: 3 Hrs

7	TOPICS	CREDIT 3T
GROUP: A		No. of Lecture
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.	8
GROUP: B		
Unit 4: Renal Physiology	Functional anatomy of kidney, Mechanism and regulation of urine formation,	7
Unit 5: Cardiovascular Physiology	Structure of heart, Coordination of heart beat, Cardiac cycle,	7
Unit 6: Endocrine Physiology	Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes),	7

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. □

PRACTICALS
MN-501P : HUMAN PHYSIOLOGY

FM:25, PM:10

TIME: 2 Hrs

S.N.	TOPIC- EXPERIMENTS/LAB WOK	CREDITS 1P
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 Widmaier, E.P., Raff, H. and Strang, K.T. (2008).
- Vander's Human Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Marieb, E. (1998).
- Human Anatomy and Physiology, IV Edition, Addison- Kesar, S. and Vashisht, N. (2007).
- Experimental Physiology, Heritage Prakash, G. (2012). Lab Manual on Blood Analysis and Medical Diagnostics S. Chand and Company Ltd.

**B.Sc. Zoology Semester V
MN-701T**

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group.

PUBLIC HEALTH & DISEASE

FM: 75, PM: 24

TIME: 3Hrs.

UNITS	TOPICS	CREDIT 3T+ 1P
GROUP A		No. of Lectures
Unit1: Evolution & Basic concepts of Public Health	History of Public Health & its milestones, Concepts and indicators of Health and wellbeing, Levels of Prevention, Globalisation & its Impact on Health, Roles & Responsibility of State, Community and Private Sector in Health Management.	15
GROUP B		
Unit 2: Health Problems	Communicable Disease- COVID-19, HIV-AIDS, Chicken Pox. Non- communicable Disease-Diabetes, Cancer. Food & water- Borne infections: Bacterial disease – Cholera, Typhoid. Viral Disease- Polio, Hepatitis. Protozoan disease- Amoebiasis, Giardiasis, Parasitic disease- Taeniasis, Ascariasis, their transmission, causative agent, sources of infection, symptoms and prevention.	20
Unit 3: National Health programmes	National health programmes, Vaccination- Corona, Polio, DPT, BCG.	10

SUGGESTED READINGS:

1. Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.

PRACTICALS
MN-701P: PUBLIC HEALTH & DISEASE

FM:25, PM:10

TIME: 2 Hrs

S.NO.	TOPICS	CREDIT 1P
1.	Study of life stages of <i>Giardia intestinalis</i> through permanent slides/ microphotographs.	
2.	Study of life stages of <i>Ascaris lumbricoides</i> through permanent slides/ microphotographs	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

SUGGESTED READINGS:

1. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger.
2. K.D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII edition, CBS Publishers & Distributors (P) Ltd.

MINOR COURSE(VOCATIONAL)

**B.Sc. Zoology Semester II
MVC-201T**

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group.

FOOD NUTRITION & HEALTH

FM-75, PM: 30

TIME: 3 Hrs

UNITS	TOPICS	CREDIT:3T
Unit 1: Nutrition and dietary nutrients	Basic concept of Food: Components and nutrients. Concept of a balanced diet. nutrient requirements and dietary patterns for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents, and elderly people.	15
Unit 2: Macronutrients and micronutrients	Nutritional Biochemistry: Macronutrients. Carbohydrates, Lipids, Protein- Definition, Classification. their dietary source and role. Micronutrients. Vitamins- Water-soluble and Fat-soluble vitamins- their sources and importance. Important minerals viz., Iron, Calcium, Phosphorus, Iodine, Selenium, and Zinc: their biological functions.	15
Unit 3: Malnutrition and nutrient deficiency diseases.	Definition and concept of health: Common nutritional deficiency diseases- Protein Malnutrition (e.g., Kwashiorkor and Marasmus), Vitamin A deficiency. Iron deficiency and Iodine deficiency disorders- their symptoms, treatment, prevention, and government initiatives, if any. Life style dependent diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention. Social health problems- smoking, alcoholism. narcotics. Acquired Immuno-Deficiency Syndrome (AIDS): causes, treatment, and prevention. Other ailments viz., cold, cough. and fever, their causes, and treatment.	15

Suggested Readings:

1. Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; New Age International Publishers
2. Srilakshmi, B. (2002). Nutrition Science; New Age International (P) Ltd.
3. Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.
4. Swaminathan. M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO.
5. Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd.
6. Wardlaw, G.M. and Hampl, J.S. (2007). Perspectives in Nutrition; Seventh Ed; McGraw Hill.
7. Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed; Academic Excellence.
8. Manay. M.S. and Shadaksharaswamy, M. (1998). Food Facts and Principles: New Age International (P) Ltd.
9. Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.

PRACTICALS

MVC-201P: FOOD NUTRITION & HEALTH

FM:25, PM:10

TIME:2Hrs

SL.NO.	TOPIC- EXPERIMENT/LAB WORK	CREDIT 1P
1.	Detecting adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric	
2.	Estimation of Lactose in milk	
3.	Study of the stored grain pests from slides/photographs (<i>Sitophilus oryzae</i> , <i>Trogoderma granarium</i> , <i>Callosobruchus chinensis</i> and <i>Tribolium castaneum</i>): their identification, habitat and food sources, damage caused, and control. Preparation of temporary mounts of the above-stored grain pests.	
4.	Project- Computer-aided diet analysis and nutrition counselling for different age groups.	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

B.Sc. Zoology Semester IV
MVC-401T

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group.

APICULTURE

FM-75, PM: 30

TIME: 3 Hrs

Units	Topics	Credit 3T+1P
Group A		No. of Lectures
Unit 1: Biology of Bees	History, Classification and Biology of Honey Bees, Social Organization of Bee Colony	10
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 & Modern).	10
Group B		
Unit 3: Disease and Enemies	Bee Diseases and enemies, control and Preventive Measures	05
Unit 4: Bee Economy	Products of Apiculture, Industry and its Uses (Honey, Bees wax, Propolis), Pollen etc.	10
Unit 5: Entrepreneurship in Apiculture	Bee keeping Industry- Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.	10

Suggested Readings:

1. Prost, P.J.(1962). Apiculture. Oxford and IBH, New Delhi
2. Bisht D.S., Apiculture , Icar

PRACTICALS
MVC-401P: APICULTURE

FM:25, PM: 10

TIME: 2 Hrs.

S.N.	TOPICS	CREDIT 1P
1.	Morphology of honey bee	
2.	Dissection of head to expose mouthparts of honey bee	
3.	Study And Collection of Beehive	
4.	Study of Bee keeping Instruments	
5.	Visit to Apiculture Centres in Jharkhand	
6.	Apiculture Centres in India	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	07 arks

B.Sc. Zoology Semester VI
MVC-601T

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group.

FM-75, PM: 30

TIME: 3 Hrs

LAC CULTURE

UNITS	TOPICS	CREDITS 3T+ 1P
GROUP A		No. of Lectures
Unit 1: Introduction	Introduction to Lac Culture, Historical review of Lac culture, Various products of lac and their commercial value, Extent of Lac culture in the world. Lac Producing places in India, Distribution of Lac in the global area.	8
Unit 2: Biology of Lac Insect	Systematic position of lac insect in animal kingdom, Morphology and Anatomy of lac insect, Difference between male and female lac insects, Life history various species of lac insect i.e., <i>Tachardia-lacca</i> (Laccifer)	10
GROUP B		
Unit 3: Rearing of Silkworm	Various Host Plants of lac insects, Common host plants of India and other countries, names of various Host plants of lac insects, Cultivation of lac, Inoculation period Type of inoculation, Swarming of lac insects. Harvesting of lac, Harvesting period and types of harvesting Lac cultivation and Recent plant of lac cultivation. Lac Industry and Properties of Lac. Physical and chemical composition of Lac.	15
Unit 4: Pests and Diseases	Pests of lac insect, Protozoan, Viral and bacterial disease, their control and prevention.	6
Unit 5: Entrepreneurship in Lac culture	Prospectus of Sericulture in India, Lac Industry in different States of India, Employment, Economic Importance.	6

SUGGESTED READINGS:

1. Text Book of Applied Zoology by Jabde, P.V.
2. Insects by Mani, M.S.
3. Lac-Culture in India by N Ghorai
4. Lac Cultivation in India by Patrick Moore Glover

PRACTICALS
MVC-601P: LAC CULTURE

FM:25, PM: 10

TIME: 2 Hrs.

S.N.	TOPICS	CREDIT 1P
1.	Morphology of Lac insect	
2.	Life cycle of Lac insect	
3.	Products of lac	
4.	Disease and pest of Lac insect	
5.	A project report on Visit to Lac Culture centres in Jharkhand	
6.	Lac culture Centres in India	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	08 marks

B.Sc. Zoology Semester VIII
MVC-801T

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group.

FM-75, PM: 30

TIME: 3 Hrs

AQUATIC BIOLOGY

UNITS	TOPICS	CREDIT 3T+1P
GROUP A		No. of Lectures
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.	12
UNIT 2: Freshwater Biology	Lakes: classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide) Nutrient Cycles in Lakes- Nitrogen, Sulphur and Phosphorous. Streams: Different stages of development, Physico-chemical environment, Adaptation of hill-stream fishes.	15
GROUP B		
UNIT 3: Marine Biology	Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.	10
UNIT4: 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.	8

SUGGESTED READINGS

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

PRACTICALS
MVC-801P: AQUATIC BIOLOGY

FM:25, PM: 10

TIME: 2 Hrs.

S.N	TOPICS	CREDIT 1P
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.	Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	08 marks

SUGGESTED READINGS

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

MULTI-DISCIPLINARY COURSE

B.Sc. Zoology Semester I
MDC-101T (Multidisciplinary course)

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 four (4X15 = 60 MARKS) are to be answered selecting not more than two from ANY group

FM:75, PM:30

TIME: 3 Hrs

UNITS	TOPICS	CREDIT 3T
GROUP A		No. of Lectures
Unit 1: General Introduction	General Introduction to Animal World, General idea of Classification and Taxonomy.	6
Unit 2: Cell	Structure, Difference between Eukaryotic and Prokaryotic cell, Cell theory.	7
Unit 3: Overview of various cell organelles	Overview of various cell organelles, their structure, and significant feature	7
GROUP B		
Unit 4: Human Physiology	A general introduction to Human physiology.	6
Unit 5: Mendel's Law	Principles of Inheritance and variation. (Mendel's Laws of Inheritance and Variation.	7
Unit 6: Lamarckism Inheritance	Lamarck's Inheritance theory, Darwin's natural selection theory.	6
Unit 7: Ecology	General concept of Ecology and Ecosystem and its various components	6

Suggested Readings:

1. Animal Diversity (Biology of Invertebrates): Pechnik
2. Cell Biology: De Robberies
3. Cell Biology: Ambrose
4. Cell Biology: Karp
5. The Cell: Cooper
6. The Cell: Brine Alberts
7. Physiology: Guyton
8. Review of Medical Physiology: Ganong W.F

PRACTICALS
MDC-101P: MULTIDICIPLINARY COURSE

FM:25, PM:10

TIME: 2 Hrs

S. N.	TOPIC – EXPERIMENT/LAB WORK	CREDITS 1P
1.	Study of Permanent slides of (Amoeba, Paramecium, Kidney (T.S Mammal) liver, Pancreas, Ovary, Testis).	
2.	Study of Museum specimens (Sponge, Ascaris, Starfish, Frog, Bat, Fish, Bird, Wall lizard).	
3.	Observation of Animal and Plant Cells.	
4.	Homologous and Analogous organs.	
5.	Project on any related topic	
	Full Marks	25
	One major experiment	10 marks
	Spotting	06 marks
	Practical records	03 marks
	Viva- Voce	06 marks

RESEARCH COURSE

B.Sc. Zoology Semester VIII
RESEARCH- RC 801T
RESEARCH METHODOLOGY

FM:100, PM:40

TIME: 3 Hrs

UNITS	TOPICS	CREDIT 4
GROUP: A		No. of Lectures
Unit 1: Foundations of Research	Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied	12
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	18
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	18
Unit 4: Ethical Issues	Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement	12

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 Publication.