

M.Sc Zoology Programme Structure

(For Candidates admitted from the academic year 2019 onwards)

SEM.	COURSE CODE	COURSE TITLE	Instr. Hours/ Week	Credit	Exam Hours	Marks		Total
						Int	Ext	
I	CC1 P19ZY1	Biology of Invertebrates and Chordates and Paleontology	6	5	3	25	75	100
	CC2 P19ZY2	Cell and Molecular Biology	6	5	3	25	75	100
	CC3 P19ZY3	Genetics	6	5	3	25	75	100
	CC4 P19ZY4P	Practical – I - Pertaining to CC1, CC2 & CC3	6	5	3	25	75	100
	EC1 P19ZY5E	Bioinstrumentation and Bioinformatics	6	4	3	25	75	100
TOTAL			30	24				500
II	CC5 P19ZY6	Animal Physiology	6	5	3	25	75	100
	CC6 P19ZY7	Biotechnology	6	5	3	25	75	100
	CC7 P19ZY8	Microbiology	6	5	3	25	75	100
	CC8 P19ZY9P	Practical – II - Pertaining to CC6, CC7 & CC8	6	5	3	25	75	100
	EC2 P19ZY10E	Entrepreneurial Zoology	6	4	3	25	75	100
TOTAL			30	24				500
III	CC9 P19ZY11	Developmental Biology and Evolution	6	5	3	25	75	100
	CC10 P19ZY12	Biochemistry & Biophysics	6	5	3	25	75	100
	CC11 P19ZY13P	Practical – III - Pertaining to CC11 and CC12.	6	5	3	25	75	100
	EC3 P19ZY14E	Biostatistics and Research Methodology	6	4	3	25	75	100
	EC4 P19ZY15E	Environmental Biology and Management	6	4	3	25	75	100
TOTAL			30	23				500
IV	CC12 P19ZY16	Immunology	6	5	3	25	75	100
	CC13 P19ZY17	General and Applied Entomology	6	5	3	25	75	100
	EC5 P19ZY18E	Wildlife Biology	6	4	3	25	75	100
	P19ZYP19	Project Work	12	5		75	25	100
TOTAL			30	19				400
GRAND TOTAL			120	90				1900

CC - CORE COURSE, CCE - CORE COURSE ELECTIVE

For the science program oral test will be conducted for the practical papers and 5 marks will be allotted and to be included in the external 75 marks i.e., 70 for the practical lab + 5 for the oral test = 75 marks.

CLASS	I – M.Sc., Zoology	
Semester	I	
Course & Code	Core Course – (CC1)	Code: P19ZY1
Course Title	BIOLOGY OF INVERTEBRATES AND CHORDATES AND PALEONTOLOGY	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

1. To understand the biology of invertebrates
2. To understand the respiration, circulation, excretion, and nervous system in invertebrates
3. To understand the biology of vertebrates
4. To understand the integumentary, respiratory, circulatory and excretory systems in vertebrates
5. To understand the paleontology

UNIT - I : Biology of Invertebrates

Introduction to levels and patterns of organization – Symmetry in animal organization – Coelom: Origin; Types and significance – Metamerism: Types; Evolution of Metamerism – Locomotion in Annelids (Nereis, Earthworm, Leech) – Nutrition: Filter feeding mechanism in Polychaetes – Larval forms of Echinodermata and their significance.

UNIT - II

Respiration: Gill respiration in prawn; Tracheal respiration in cockroach; Ctenidial and pulmonary respiration in snail (Pila) – Circulation: Earthworm; Prawn; Snail (Pila) – Excretion: Contractile vacuole in Paramecium; Flame cells in Planaria; Green glands in prawn – Nervous systems: Diffused type in hydra; Segmental type in earthworm, Nervous system in prawn.

UNIT - III : Biology of Chordates

Locomotion in fishes – Migration in Fishes – Parental care in fishes – Adaptive radiation in deep sea fishes – Origin of amphibians – Evolutionary significance of crocodiles – Flight adaptations in birds – Adaptive radiation in birds – Dentition in Mammals – Adaptive radiation in mammals and their Phylogenetic relationships.

UNIT - IV

Structure of skin – Skin derivatives – Accessory respiratory organs in fishes – Pulmonary respiration in birds – Evolution of vertebrate hearts – Types and evolution of kidneys – Comparison of brain in chordates – Principal reproductive organs (testis and ovary) and their accessory glands in human.

Unit - V: Paleontology and Minor phyla

The evolutionary time scale: Eras, periods and epoch; Major events – Formation and classification of fossils – Dating of fossils – Fossil records – Invertebrate fossils – Vertebrate fossils and their importance – Phylogenetic importance of fossils – Minor Phyla: Rotifera, Phoronida and Cheatognatha.

Course Outcomes:

1. Familiar with the biology of invertebrates
2. Familiar with the respiration, circulation, excretion, and nervous system in invertebrates
3. Familiar with the biology of vertebrates
4. Familiar with the integumentary, respiratory, circulatory and excretory systems in vertebrates
5. Familiar with paleontology

Textbooks

Barnes, R.D. (1982) – Invertebrate Zoology, IV Ed., Holt Saunders – International Edition.

Waterman, A.J. (1971), Chordate Structure and Function, The Macmillan Company.

References

Mc Neill Alexander. 1981. The Chordates. CUP.

Ayyar, E.K., and Ananthakrishnan, T.N. (1992). A Manual of Zoology. Vol. II (Chordata). Visvanathan Publishers.

Barrington, E.J.W.(1979) Invertebrate Structure and Function, II Ed., ELBS and Nelson.

Hyman, G.H., The Invertebrates, Vols. I to VII, Mc Graw Hill Book Co Inc., New York.

Kent, G.C. (1976), Comparative Anatomy of the Vertebrates, McGraw Hill Book Co Inc., New York.

CLASS	I – M.Sc., Zoology	
Semester	I	
Course & Code	Core Course – (CC2)	Code: P19ZY2
Course Title	CELL AND MOLECULAR BIOLOGY	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

1. To understand plasma membrane
2. To understand the structure and function of mitochondria, Golgi complex, lysosome and endoplasmic reticulum
3. To understand the structure and function of DNA and RNA
4. To understand the cancer biology
5. To understand the cytological techniques

UNIT – I: Membrane structure & function and Cellular communication

Ultrastructure of plasma membrane – Functions of plasma membrane – Ultrastructure & composition of nucleus – Functions of nuclear pore complex – Nucleolus: Ultrastructure and functions – General principles of cell communication – Cell adhesion and roles of different adhesion molecules.

UNIT – II: Structural organization & function of intracellular organelles and cell cycle

Mitochondria: Ultrastructure; Electron transport system; Oxidative phosphorylation – Endoplasmic reticulum: Ultrastructure; Function in protein secretion – Golgi complex: Ultrastructure; Function in protein sorting and transport from Golgi – Lysosome: Morphology; Chemistry; Functions – Cytoskeleton: Structure and its role in motility – Steps in cell cycle – Regulation and control of cell cycle.

UNIT – III: Fundamental Processes of cell

Meselson and Stahl's experiment – DNA replication – Enzymes involved (Nucleases, Polymerases, Ligases) – DNA damage and repair mechanisms – DNA recombination (homologous and site-specific recombination) – Types of RNA – Mechanism of protein synthesis.

UNIT – IV: Cancer Biology

Characteristics of cancer cells – Genetic rearrangements in progenitor cells - Types of tumors – Carcinogens – Cellular oncogenes – Tumor suppressor genes (RB and P53). Metastasis (interaction of cancer cells with normal cells) – Apoptosis. Virus-induced cancer – Cancer and the cell cycle – Therapeutic interventions of molecular biology to uncontrolled cell growth and treatment.

UNIT – V: Cytological Techniques

Collection & preservation of animal tissue – Fixation, embedding, Sectioning – Cytochemical staining and detection methods of Carbohydrates, Protein, Lipids, DNA and RNA – Cell fractionation – Autoradiography – In situ hybridisation-by FISH.

Course Outcomes:

- Familiar with plasma membrane
- Familiar with the structure and function of mitochondria, Golgi complex, lysosome and endoplasmic reticulum
- Familiar with the structure and function of DNA and RNA
- Familiar with cancer biology
- Familiar with cytological techniques

Textbooks

De Robertis, E.D.P. and De Robertis, E.M.F. (1987), Cell and Molecular Biology, VIII Ed. Lea and Febiger, Philadelphia.

Cooper, J.M., Hausman, R.E. 2009. The Cell. Sinauer Associates, Inc., USA.

References

Bruce Alberts and Dennis Brey, (1994), Molecular Biology of the Cell. 3rd Edition. Garland Publishing, Inc. New York and London.

Becker and Deamer, (1991), The World of the Cell. 2nd Edition. The Benjamin and Cumming Publishing Company, Inc. California.

Alberts, B., Johnson, A., Lewis, J. Raff, M. Robertis, K., Walter, P. 2002. Molecular Biology of Cell. Garland Science (Taylor & Francis Group), New York.

Lodish H., Berr, A. and Paul, M. 2003. Molecular Cell Biology, New York: W.H. Freeman.

Karp, G. 2008. Cell and Molecular Biology, G. John Wiley & Sons.

CLASS	I – M.Sc., Zoology	
Semester	I	
Course & Code	Core Course – (CC3)	Code: P19ZY3
Course Title	GENETICS	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To understand linkage and crossing over
- To understand gene concept and gene expression
- To understand mutation
- To understand quantitative genetics
- To understand human genetics

UNIT – I: Genetic interaction, Linkage & Crossing over

Gene interaction and types (Complementary genes, supplementary genes, Duplicate genes, Lethal genes, and Epistasis) – Mechanism of crossing over and its theories (Chiasma, Breakage, Contact-first, Strain, and differential contraction theories) – Kinds of linkage (Complete and incomplete) – Gene Mapping in Chromosome by crossing over method – Somatic Cell Hybridization.

UNIT – II: Gene concept and regulation of gene expression

Chromatin structure (heterochromatin & euchromatin) – Split genes – Overlapping genes – Interrupted genes – Pseudogenes – Fine structure of gene – Characteristics of genetic code – Wobble hypothesis – Gene Regulation in Prokaryotes: Lac operon, trp operon and ara operon system in bacteria – Gene regulation in eukaryotes: Short term and long term regulation.

UNIT – III: Mutation

Gene Mutations: Base substitutions; Insertions and deletions; Phenotypic effects of mutations; Suppressor mutations – Chromosome Mutations: Chromosome Rearrangements (Duplications, Deletions, Inversions, and Translocations); Aneuploidy (nullisomy, monosomy, trisomy, and tetrasomy); Polyploidy (Autopolyploidy and Allopolyploidy) – Causes of mutation: Spontaneous Replication Errors; Spontaneous Chemical Changes; Chemically Induced Mutations; Radiation – Ames Test.

UNIT – IV: Microbial, Quantitative genetics & Extra chromosomal inheritance

Transposon – Types and mechanism of transposition – Methods of genetic transfers: Transformation; Conjugation; Transduction; Sex-duction – Mapping genes by interrupted conjugation mating – Polygenic inheritance – Types of heritability – Mapping QTLs – Maternal inheritance.

UNIT – V: Human Genetics

Inborn errors of metabolism: Phenylketonuria; alkaptonuria; albinism; Lesh-Nyhan syndrome; ADA deficiency; galactosemia; G6PD deficiency; Tay Sach's disease and Gaucher's disease – Preparation and analysis of human karyotype – Cytogenetic banding nomenclature – Chromosomal syndromes in man: Klinefelter; Turner; Down. Monogenetic disorders: Sickle cell anemia; Cystic fibrosis. Genetic counseling – Prenatal diagnosis (Aminocentosis, CVS).

Course Outcomes:

- Familiar with linkage and crossing over
- Familiar with gene concept and gene expression
- Familiar with mutation
- Familiar with quantitative genetics
- Familiar with human genetics

Textbooks

Pierce, B.A. 2012. Genetics A Conceptual Approach. Fourth edition. W. H. Freeman and Company.

Griffiths, A.J.F., Susan R. Wessler, Sean B. Carroll, John Doebley. 2015. Introduction to Genetic Analysis. Eleventh edition. W. H. Freeman and Company.

References

Daniel L.Hartl (1996) Genetics, III Ed., Jones Barlett Publishers. Boston.

David Friefelder (1998) Microbial Genetics, Narosa Publishing House, New Delhi.

Jenkins, J.B. (1983) Human genetics, The Benjamin Cummings Publishing Co.

Strickberger Monroe, W. (1996) Genetics, Prentice Hall of India Pvt. Ltd., New Delhi.

Watson J D et al (1987) Molecular Biology of gene, IV Ed., The Benjamin Publishing Company Inc., UK.

CLASS	I – M.Sc., Zoology	
Semester	I	
Course & Code	Core Course – (CC4)	Code: P19ZY4P
Course Title	Practical - I (Pertaining to Biology of Invertebrates and Chordates and Palaeontology, Cell and Molecular Biology and Genetics).	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To gain knowledge on identification and classification of invertebrates and vertebrates
- To understand various fossil forms.
- To understand the concepts of microscopy
- To understand histochemical and cytochemical techniques.
- To understand blood group identification, differential cell counting in blood, human karyotype, and calculation of gene frequency

BIOLOGY OF INVERTEBRATES AND CHORDATES AND PALAEONTOLOGY

1. Mounting of Teleost fish scales.
2. Study of frog nervous system and brain using virtual laboratory.
3. Study of frog circulatory system and heart using virtual laboratory.

Spotters:

4. Radial symmetry (Sea anemone).
5. Bilateral symmetry (Cockroach).
6. Acoelomates (Planeria).
7. Pseudocoelomates (Round worm).
8. Eucoelomates (Earthworm).
9. Fossils (Nautiloid, Ammonoid, & Trilobite).

CELL AND MOLECULAR BIOLOGY

10. Measurements using ocular and stage micrometers.
11. Histochemical technique (Micrometry).
12. Differential cell counting in human blood.

Spotters:

13. Ocular micrometer.
14. Stage micrometer.
15. Microtome.
16. Mitosis: Prophase, metaphase, anaphase, and telophase.

GENETICS

17. Blood group identification and Rh factor in human blood.

Spotters:

18. Human karyotype - Male, Female, Klinefelter, Turner, Down syndromes.

19. Mutation: Duplications, Deletions, Inversions, and Translocations.

Reference Books:

P.S. Verma and P.C. Srivastava. 2007. Advanced Practical in Zoology. S. Chand & Co.

Lal. 2004. Practical Zoology : Chordates. Rastogi Publications.

Course Outcomes:

- Familiar with identification and classification of invertebrates and vertebrates
- Familiar with various fossil forms.
- Familiar with the concepts of microscopy
- Familiar with histochemical and cytochemical techniques.
- Familiar with blood group identification, differential cell counting in blood, human karyotype, and calculation of gene frequency

CLASS	I – M.Sc., Zoology	
Semester	I	
Course & Code	Core Course Elective – (EC1)	Code: P19ZY5E
Course Title	BIOINSTRUMENTATION AND BIOINFORMATICS	
Hours: 6	Credits : 4	Max Marks : 75

Course Educational Objectives:

- To understand the principles and applications of various analytical instruments used in biological sciences.
- To gain knowledge about various separation techniques, and physiological measuring instruments.
- To understand the pharmacological techniques
- To understand basic concepts of bioinformatics
- To understand the sequence alignment and prediction

BIOINSTRUMENTATION

UNIT – I: Analytical instruments

Analytical Balance: Methods of weighing (weighing by difference & taring the balance) – pH meter: Sorensen’s pH scale, principle (Combined electrode), operation & applications – Microscopy: Light, Fluorescence, Phase contrast, Dark field microscopes – Radioactive counters (Geiger Muller and Scintillation counters).

UNIT – II: Separation techniques

Centrifugation: Types of rotors – Types of centrifugation (Analytical and Preparatory). Density and Differential centrifugation – Electrophoresis: Principle, structural components and applications of electrophoresis (AGAROSE, PAGE, SDS-PAGE) – Chromatography: Principle and applications of Column – Adsorption – Ion exchange – Gel permeation – HPLC).

UNIT – III: Pharmacological techniques

Positron Emission Tomography (PET) – Magnetic Resonance Imaging (MRI) – Functional Magnetic Resonance Imaging (fMRI) – Computed Axial Tomography (CAT) – Electrocardiogram (ECG) – Electroretinogram (ERG) – Electromyography (EMG) – Hemodialyser.

BIOINFORMATICS

UNIT – IV: Databases, Tools, and Phylogenetics

Applications of bioinformatics: Molecular medicine, Personalized medicine, Preventive medicine, Gene therapy, Drug development, Evolutionary studies – Biological database and its properties – Nucleotide sequence database – Protein sequence database – SwissProt, NCBI, GENBANK, BLAST – Phylogeny and Structure of phylogenetic tree – Construction of a phylogenetic tree – Steps in molecular phylogenetic analysis.

UNIT – V: Sequence alignment and Prediction

Components of Bioinformatics – Sequence Alignment: Pair-wise sequence alignment (Dot matrix method), Dynamic programming (Optimal global alignment and optimal local alignment) – Word method – Multiple sequence alignment (dynamic programming, progressive method, and iterative method) – Prediction of Protein Structure and Function.

Course Outcomes:

- Familiar with the principles and applications of various analytical instruments used in biological sciences.
- Familiar with various separation techniques, and physiological measuring instruments.
- Familiar with the pharmacological techniques
- Familiar with basic concepts of bioinformatics
- Familiar with sequence alignment and prediction

Textbooks

Veerakumari, L. 2015. Bioinstrumentation. MJP Publisher.

Webster, J.G. 2004. Bioinstrumentation. Wiley, India.

References

Andrzej Polanski and Marek Kimmel. 2007. Bioinformatics. Springer-Verlag Berlin Heidelberg.

N Arumugam and V Kumaresan. 2015. Biophysics and Bioinstrumentation. Saras.

Irfan Ali Khan and Atiya Khanum 2003, Fundamentals of Bioinformatics, Ukaaz Publications Hyderabad, India.

Murthy, C.S.V. 2003, Bioinformatics, Himalaya Publishing House, Mumbai, Delhi, Nagpur, Bangalore- India.

Subramanian, C. 2004, A Text Book of Bioinformatics, Dominant Publishers and Distributors, New Delhi, India.

CLASS	I – M.Sc., Zoology	
Semester	II	
Course & Code	Core Course – (CC5)	Code: P19ZY6
Course Title	ANIMAL PHYSIOLOGY	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To understand thermoregulation and osmoregulation
- To understand nervous coordination and excretion
- To understand muscular system and sense organs
- To understand bioluminescence and chronobiology
- To understand the biology of reproduction

UNIT - I: Thermoregulation and Osmoregulation

Homeostasis – Classification of animals based on thermoregulation – Temperature compensation in poikilotherms (aquatic and terrestrial animals) – Temperature regulation in homeotherms (Response to cold and heat) – Acclimatization – Mechanism of osmoregulation in freshwater animals – Mechanism of osmoregulation in marine animals.

UNIT – II: Nervous coordination and Excretion

Structure and types of nerve cells – Ionic basis of excitability – Resting membrane potential – Propagation of action potential – Interneuron transmission – Electrical synapses – Chemical synapses – Neurotransmitters. Electric Organs and electro-receptors in fishes & functional significance. Ammonia toxicity – Detoxification pathways – Elimination of excretory products in relation to habitat (Urea cycle, Uric acid).

UNIT - III: Sense organs, Muscular system, and Respiratory system

Photoreceptor – Chemoreceptor (Olfactory System) – Mechanoreceptors: Phonoreceptors; Tactile receptors – Muscular system: Structure of muscle; Mechanism of muscle contraction – Respiratory system: exchange of gases; transport of gases; control of breathing.

UNIT - IV: Bioluminescence and Chronobiology

Bioluminescence: Occurrence; Structure of bioluminescent organs; Chemistry of light production; Functional significance – Animal behaviour: Taxis, Kinesis, Reflexes, physiological basis of learning and memory – Biological rhythms: Circadian, Lunar, Circannual rhythms – Biological clock.

UNIT - V: Physiology of Reproduction

Mammalian reproductive physiology – Reproductive cycles (Menstrual & Oestrous cycle) – Molecular mechanism of hormone action – Prostaglandins, Reproductive disorders – Birth control methods.

Course Outcomes:

- Familiar with thermoregulation and osmoregulation
- Familiar with nervous coordination and excretion
- Familiar with muscular system and sense organs
- Familiar with bioluminescence and chronobiology
- Familiar with the biology of reproduction

Textbooks

Agarwal, R A. 2013. Animal Physiology and Biochemistry. S. Chand and Company, New Delhi.

Ian Kay. 1998. Introduction to Animal Physiology. BIOS Publishers.

References

Moyes, C.D. and Schulte, P.M. 2007. Principles of Animal Physiology. Pearson Education, Dorling Kindersley Publication. New Delhi.

Sherwood, L., Klandorf, H, and Yancey, P.H. 2008. Text Book of Animal Physiology. Cengage Learning, India.

Guyton, A.C. 2000. Textbook of Medical Physiology. W.B. Saunders Company, Philadelphia, London, Toronto and Igaku Shoin/Saunders (Tokyo).

Hill R.W., Wyse, G.A. and Anderson, M. 2008. Animal Physiology., 2 nd Ed., Sinauer Associates, Inc Publisher, Massachusetts,.

Prosser, C.L. 1973. Comparative Animal Physiology. 3 rd Ed., W.B. Saunders & Co. Philadelphia.

CLASS	I – M.Sc., Zoology	
Semester	II	
Course & Code	Core Course – (CC6)	Code: P19ZY7
Course Title	BIOTECHNOLOGY	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To understand the recombinant DNA technology and genomics.
- To understand enzyme biotechnology
- To understand pharmaceutical biotechnology.
- To understand molecular markers and gene therapy.
- To understand basics of nanobiotechnology

UNIT - I: Introduction to Biotechnology

Scope – Strategies of Recombinant DNA technology (Preparation of desired DNA, Preparation of desired vector, types of vectors – Plasmid (PBR322 & M13 Phage) – Bacteriophage (Cosmid – Transgenic animals) and its applications – Genomics – Human Genome Project – Methods of gene sequencing (Random shotgun, Whole genome Shotgun sequencing).

UNIT - II: Enzyme Biotechnology

Microorganisms producing enzymes, Enzyme: Properties – Methods of enzyme production – Immobilization – Application. Production of secondary metabolites (Bacterial and fungal toxins) – Product recovery and purification – Production of vitamins and single cell proteins.

UNIT - III: Pharmaceutical Biotechnology

Monoclonal Antibodies Production (Hybridoma Technology) – Pharmaceutical products of DNA Technology – Insulin, Human Growth hormone, Interferon. Recombinant vaccines (Subunit, DNA and Attenuated vaccines).

UNIT - IV: Molecular Markers and Gene Therapy

RFLP, RAPD, AFLP, PCR, and Northern, Southern and Western Blotting techniques – Gene Therapy: Ex vivo (Bone marrow transplantation) and in vivo gene therapy – Gene silencing.

UNIT - V: Nanobiotechnology

Introduction to Nanobiotechnology – Nanobiotechnological devices – Types and applications of Nanobiosensors – Drug delivery technologies – Cancer diagnosis and therapy – Preparation and uses of DNA microarrays.

Course Outcomes:

- Familiar with the recombinant DNA technology and genomics.
- Familiar with enzyme biotechnology
- Familiar with pharmaceutical biotechnology.
- Familiar with molecular markers and gene therapy.
- Familiar with the basics of nanobiotechnology

Textbooks:

Satyanarayana, U. 2007. Biotechnology. Books and Allied (P) Ltd.

Shanmugam, S. 2011. Nanobiotechnology. MJP Publishers, Chennai.

References

Brown, C.M., Campbell, I and Priest, F.G. (1988) Introduction to Biotechnology, Blackwell Scientific Publications, U.K.

Higgins, I.J., Best, D.J. and Jones, J. (1988) Biotechnology-Principles and Applications. Blackwell Scientific Publications, Oxford, London, Edinburgh.

Keshav Trehan (1996), Biotechnology, New Age International Pvt. Ltd. Publishers, New Delhi.

Primrose, S.B.(1989) Modern Biotechnology. Blackwell Scientific Publications, Oxford, London, Edinburgh.

Watson, J.D., Gilman, M., Witkowski, J. and Zoller, M. 1992. Recombinant DNA. 2 nd Ed., W. H. Freeman, New York.

CLASS	I – M.Sc., Zoology	
Semester	II	
Course & Code	Core Course – (CC7)	Code: P19ZY8
Course Title	MICROBIOLOGY	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To understand classification of microorganisms
- To understand the culture techniques
- To understand food microbiology
- To understand industrial microbiology
- To understand medical microbiology

UNIT - I: Characteristics of Microorganisms

General Features and Classification of bacteria, virus, fungi, and protozoa.

Structure of Bacteria (E. coli) – Structure of Virus: T4 Bacteriophage, Adenovirus.

UNIT - II: Culture Techniques

Bacterial growth and nutritional requirements – Types of culture media – preparation of culture media – methods of maintenance of culture – culture characteristics of bacteria : Gram's staining techniques.

UNIT - III: Food Microbiology

Microbial examination of food – Food Spoilage intrinsic & extrinsic factors (Meat, Fish, milk, egg, and bread) – Food Poisoning (Botulism, Staphylococcal poisoning, and Mycotoxicosis) – Food Preservation – Bacteriology of Milk – Bacteriological examination of Milk – Pasteurization of Milk.

UNIT - IV: Industrial and Agricultural Microbiology

Fermentation technology – Stages of fermentation – Fermentation products (alcohol, vinegar, pharmaceuticals, organic acids, amino acids, and fuels).

Biological nitrogen fixation; Nif genes, Nitrogen fixers – Bio fertilizers (Rhizobium, Azotobacter, Azospirillum, VAM) – Bio pesticides (Bacterial, Fungal, Viral).

UNIT - V: Medicinal Microbiology

Pathogenicity, Infection, Virulence, Causative agents, Modes of transmission, control measures: Bacterial diseases (Diphtheria, Tuberculosis, Tetanus, Typhoid, Cholera); Viral diseases (Polio, Viral Hepatitis A & B); Sexually transmitted diseases (AIDS, Gonorrhoea, Syphilis, Urethritis); Protozoan diseases (Malaria, Leishmaniasis, Trypanosomiasis).

Course Outcomes:

- Familiar with classification of microorganisms
- Familiar with culture techniques
- Familiar with food microbiology
- Familiar with industrial microbiology
- Familiar with medical microbiology

Textbooks

Pelczar, Chan and Kreig, 1993. Microbiology, Tata Mc Graw Hill Pub. Co. Ltd., New Delhi.

Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton. 2017. Prescott's Microbiology. Tenth edition. McGraw-Hill.

References

Thomas, C.G.A, 1998, Medical Microbiology, ELBS Publications.

Ananthanarayanan, R. and Jayaram Panikar, C.K. 2000. Text Book of Microbiology, Orient Longman, Chennai and Hyderabad.

Powar, C.B. and Diginawala, H.F. 1987, General Microbiology-Vol.I & II. Himalaya Publishing House, Bombay.

Sharma, P.D. 1993, Microbiology – Rastogi Publications, Meerut.

Ananthanarayanan, R. and Jayaram Panikar, C.K. 2013. Text Book of Microbiology. University Press, Hyderabad.

CLASS	I – M.Sc., Zoology	
Semester	II	
Course & Code	Core Course – (CC8)	Code: P19ZY9P
Course Title	PRACTICAL – II (Pertaining to Animal Physiology, Biotechnology and Microbiology).	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To obtain knowledge about the quantitative estimation of salivary amylase activity
- To obtain knowledge on quantitative estimation of ammonia and urea
- To understand physiological mechanism of various receptors.
- To gain knowledge on electrophoretic techniques
- To obtain knowledge on bacterial culture techniques

ANIMAL PHYSIOLOGY

1. Quantitative estimation of amylase activity.
2. Quantitative estimation of ammonia.
3. Quantitative estimation of urea.
4. Estimation of salinity in aquarium water samples.

Spotters:

5. Photoreceptor.
6. Phonoreceptor.
7. Bioluminescent organ (bait in deep sea fishes).

BIOTECHNOLOGY

8. Demonstration of DNA isolation.
9. Demonstration of Agarose gel electrophoresis.
10. Demonstration of SDS-PAGE.

Spotters :

11. pBR322 plasmid.
12. T₄ Bacteriophage.
13. Polymerase Chain Reaction.
14. DNA Microarray.

MICROBIOLOGY

15. Culturing of bacterial broth – Bacterial growth curve.
16. Preparation of culture media (Agar medium – slant, plating, streaking).

17. Serial Dilution technique
18. Antibiotic sensitivity for standard antibiotic.
19. Gram staining.

Spotters:

20. Inoculation loop.
21. Autoclave.
22. Incubator.
23. Hot air oven.
24. Laminar flow hood.

“Industrial-/Forest-/Zoo-visit (Educational Tour) report should be included in the practical record”

Course Outcomes:

- Familiar with the technique that quantitatively estimate salivary amylase activity
- Familiar with quantitative estimation of ammonia and urea
- Familiar with rate physiological mechanism of various receptors.
- Familiar with electrophoretic techniques
- Familiar with bacterial culture techniques

Reference Books:

Rajan, S and Selvi Christy. 2010. Experimental Procedures in Life Sciences. CBS Publishers, New Delhi.

Verma and P.C. Srivastava 2007. Advanced Practical in Zoology. S. Chand & Co.

CLASS	I – M.Sc., Zoology	
Semester	II	
Course & Code	Core Course Elective – (EC2)	Code: P19ZY10E
Course Title	ENTREPRENEURIAL ZOOLOGY	
Hours: 6	Credits : 4	Max Marks : 75

Course Educational Objectives:

- To understand vermiculture techniques
- To understand apiculture techniques
- To understand sericulture techniques
- To understand aquaculture techniques
- To understand poultry farming techniques

UNIT – I: Vermiculture

Ecological classification of earthworms (Epigeic, Endogeic and Anecic species) – Common species for culture – Life cycle of *Eudrilus eugeniae* and *Eisenia fetida* – Optimal conditions for vermiculture – Culture methods: Pit method; Windrow method – Predator and pathogen control in wormeries – Products of vermiculture – Medicinal importance – Quality control, packing, transport and marketing.

UNIT – II: Apiculture

Species of honey bees – Castes of honey bees – Life cycle of honey bee – Beekeeping equipments and their uses – Langstroth hive – Seasonal management of honeybee colonies – Diseases, pests, and predator management – Extraction, storage, bottling and packaging of honey – Products of apiculture – Indian beekeepers strategies for honey marketing.

UNIT – III: Sericulture

Types of silkworms: Mulberry, tasar, muga, eri – Life cycle of *Bombyx mori* – Disinfection of rearing houses and appliances – Tray and shelf rearing methods – Rearing environmental conditions – Steps involved in late age worm rearing – Mounting Methods – Disease and pest Management – Harvesting of cocoon – Transportation and Marketing of Cocoons.

UNIT – IV: Aquaculture

Scope of Aquaculture – Present state of aquaculture – Types of cultivable fishes – Types of aquaculture – Fish ponds – Construction of fish pond – Maintenance of fish pond – Seed collection – Fish feed – Control of Weeds, Pests and Predators – Disease control – Harvesting methods – Handling, preservation, and transport.

UNIT – V: Poultry Farming

Common Breeds of Poultry – Pre-requisites of a poultry house – Deep litter system – Cage system – Selection and incubation of eggs – Brooding of chick – Rearing of

growers – Rearing of broilers – Culling – Sexing – Poultry diseases: Infectious Coryza, Avian Influenza, Ranikhet, Coccidiosis, Fowl Pox.

Course Outcomes:

- Familiar with vermiculture techniques
- Familiar with apiculture techniques
- Familiar with sericulture techniques
- Familiar with aquaculture techniques
- Familiar with poultry farming techniques

Textbooks

Shukla, G.S. and V.B. Upadhyay 2003 Economic Zoology, Rastogi publications.

Ahsan, J. and S.P. Shiha 2005 A hand book of Economic Zoology, S. Chand & Co.

References

Sultan Ahmed Ismail, 2005. The Earthworm Book. Second Revised Edition. Other India Press, Goa, India.

Sardar Singh, 1962. Beekeeping in India. Indian Council of Agricultural Research.

Johnson, M. 2015. Sericulture. Nesamony Memorial Christian College, Kanyakumari.

Ganga, G. 1992. Introduction to Sericulture. Oxford & IBH, New Delhi.

Arumugam, N. 2008. Aquaculture. Saras Publications.

Ram P. Singh. 2012. Modern Livestock and Poultry Production. Biotech Publisher.

Rama Rao, V. 2004. Poultry Science. Mangal Deep Publications.

Arumugam, N., A. Thangamani, S. Prasanna kumar, L.M. Narayanan, N.C Nair, S. Leelavathy, N. Soundara Pandian, T. Murugan, J. Johnson Rajeswar, R. Ram Prabhu, Jayasurya. 2015. Economic Zoology. Saras Publication.

CLASS	II – M.Sc., Zoology	
Semester	III	
Course & Code	Core Course – (CC9)	Code: P19ZY11
Course Title	DEVELOPMENTAL BIOLOGY AND EVOLUTION	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To understand reproduction and assisted reproductive technologies
- To understand the metamorphosis and regeneration
- To understand cell differentiation
- To understand the concepts of evolution
- To understand the adaptive pattern and speciation concepts.

UNIT – I: Reproduction and Assisted Reproductive Technologies

Gametogenesis (Spermatogenesis & Oogenesis) – cell surface molecules in sperm-egg recognition in animals – Ultrastructure of human sperm and egg – Fertilization – Activation of egg cytoplasm – Infertility (Male and Female) – Super ovulation – Artificial Insemination – Intracytoplasmic Sperm Injection – Gamete Intrafallopian tube Transfer – In-Vitro Fertilization.

UNIT – II: Metamorphosis and Regeneration

Hormonal control on growth and metamorphosis of insects and amphibians – Formation of limb bud in amphibian – Induction of early limb bud – Mechanism of cell death and ageing – Regeneration in various Invertebrates and Vertebrates – Mechanism and factors influencing regeneration.

UNIT – III: Cell Differentiation

Differentiation, commitment, specification, and determination – Embryonic stem cell – Stem cell differentiation – Significance of Stem cells – Drosophila: Early embryonic development (Cleavage, Gastrulation) – Early anterior-posterior axis specification (Maternal effect genes) – Segmentation genes – Homeotic selector genes – Organizer and its function – Induction – Spemann and Mangold experiments.

UNIT – IV: Origin of Life and Mechanism of evolution

Origin of Life: Theories of origin of life – Molecular origin of life – Chemical evolution of life – Populations, Gene pool, Gene frequency – Hardy-Weinberg Law – Factors affecting Hardy-Weinberg equilibrium.

UNIT – V: Adaptive patterns and Speciation

Races to species – Adaptive radiation – Behavioral adaptations and strategies – Sexual competition and Selection – Isolating mechanisms – Mode of speciation: Allopatricity and Sympatricity – Stages in primate evolution including Homo.

Course Outcomes:

- Familiar with the knowledge of reproduction and assisted reproductive technologies
- Familiar with metamorphosis and regeneration
- Familiar with cell differentiation
- Familiar with the concepts of evolution
- Familiar with the adaptive pattern and speciation concepts.

Textbooks

Gilbert, S.F. 2010. Developmental Biology, 9th Edn. Sinauer Associates Inc. Publishers. Massachusetts, USA.

Strickberger, M.W. 1996. Evolution: Jones and Barlett Pub.Inc., London.

References

Balinsky, B.L. 1981. An introduction to Embryology V Ed. Saunders Co. Philadelphia.

Berrill, N.J. 1986. Developmental Biology, Tata McGraw Hill, New Delhi.

Gurubachan. S. Miglani, 2006. Developmental Genetics. I.K. International Publishing House Pvt.Ltd.

Dobzhansky, T., Ayala, F.J., Stebbins, G.L. and Nalentine, J.W. 1975. Evolution. Surjeet Pub. and Co., New York.

Chattopadhyay, S. 2008. LIFE: Evolution, Adaptation & Ethology. Arunabha Sen Books and Allieded, Pvt., LTD., Kolkata.

CLASS	II – M.Sc., Zoology	
Semester	III	
Course & Code	Core Course – (CC10)	Code: P19ZY12
Course Title	BIOCHEMISTRY AND BIOPHYSICS	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To acquire knowledge about the structure, classification, and metabolism of biomolecules.
- To gain knowledge about enzymes, hormones and their functions.
- To understand the thermodynamics.
- To gain knowledge about radiation and its impacts on biological system.
- To study the principles and applications of various microscopes and Spectroscopies.

UNIT – I: Proteins and Lipids

Proteins: Structure and classification, Physicochemical properties of amino acids, Essential amino acids, Glycogenic and Ketogenic amino acids, Metabolism of tyrosine, Functions of proteins and amino acids.

Lipids : Classification, Fatty acids, Triglycerides, Compound lipids, Phospholipids, Sphingolipids, Glycolipids, Steroids, Prostaglandins, Oxidation of fatty acids and Ketosis.

UNIT – II: Carbohydrates

Classification – Structure and Properties of monosaccharides, disaccharides (Maltose, Lactose, Sucrose), and polysaccharides (Starch, Glycogen, Chitin, Proteoglycan, Glycoproteins) – Acid Mucopolysaccharides – Biosynthesis of Glycogen – Glycolysis – Kreb’s cycle – HMP pathway – Gluconeogenesis.

UNIT – III: Enzymes and Hormones

Enzymes: Classification of enzymes – Properties of enzymes – Enzyme activation – Mechanism of enzyme action – Enzyme kinetics – Enzyme Inhibition (Competitive, Non-competitive, Allosteric inhibition).

Hormones: Hypothalamic releasing hormones and function, Mechanism of hormone action, Peptide hormones, Adenylate cyclase, cyclic AMP mechanism- Ca⁺⁺, Phosphoinositol, Steroid hormones and Transcriptional control.

UNIT – IV: Thermodynamics and Radiation Biology

Concept of free energy: Laws of Thermodynamics, Biological energy transducers. Scope of Radiation Biology – Sources of natural radiation (Terrestrial and cosmic) – Types of radiation (Alpha, Beta & Gamma) – Properties of Radiation (external emitters and internal emitters) – Man made radiation: Medical (occupational, diagnostic) – Nuclear fuel cycle – Radiation Units: Becquerel, RAD, Gray & Curie.

UNIT – V: Electron Microscopy and Spectroscopy

Electron Microscopy: Principle & applications of SEM, TEM, AFM & STM.

Spectroscopy: Principle and applications of UV-VIS Spectrophotometer – Flame Photometry – Circular dichroism – Principle and application of X-ray diffraction, FTIR, Atomic Absorption, NMR and ESR Spectroscopes.

Course Outcomes:

- Familiar with the structure, classification, and metabolism of biomolecules.
- Familiar with enzymes, hormones and their functions.
- Familiar with the laws of thermodynamics.
- Familiar with radiation and its impacts on biological system.
- Familiar with the principles and applications of various microscopes and Spectroscopies.

Textbooks

Veerakumari, L. 2005. Biochemistry. MJP Publishers.

Daniel, M. 1992. Basic Biophysics for Biologists, Wiley International, New Delhi.

References

Lehninger, A. L., Nelson D.K and Cox, M.M., 1993. Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.

Stryer, L., 1988. Biochemistry, W.H. Freeman and Company, New York.

Narayanan, P. 2007. Essentials of Biophysics. II Edn. New Age International Pub.

Shan, V.C. (1985) Elements of Radiation Biology, Today's & Tomorrow's Printers & Publishers, New Delhi.

Grosh, D.S. (1965) Biological Effects of Radiation, Blaisdell Publishing Co. Sharma, A.K. (1998) Guest Editor Preservation of Food by Ionising Radiation, IANCAS Bulletin, 14(1).

CLASS	II – M.Sc., Zoology	
Semester	III	
Course & Code	Core Course – (CC11)	Code: P19ZY13P
Course Title	PRACTICAL – III (Pertaining to Developmental Biology & Evolution, Biochemistry & Biophysics).	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To understand Hardy Weinberg law and calculation of gene frequency
- To understand solution preparation
- To understand buffer preparation
- To understand quantitative estimation of total sugar in animal tissues
- To understand Beer and Lambert’s law

DEVELOPMENTAL BIOLOGY AND EVOLUTION

1. Study of fertilization through a model diagram
2. Hardy – Weinberg Law and calculation of gene frequency.

Spotters:

3. Female infertility: PCOS, Endometriosis.
4. Intracytoplasmic Sperm Injection Technique.
5. Gamete Intrafallopian tube Transfer Technique.
6. In-Vitro Fertilization Technique.

BIOCHEMISTRY AND BIOPHYSICS

7. Calculation of normality, molarity, and percentage.
8. Determination of pH of water samples.
9. Quantitative estimation of protein.
10. Quantitative estimation of total carbohydrate.
11. Quantitative estimation of lipids.
12. Beer and Lambert’s law verification.

Spotters:

13. Mortar & Pestle.
14. Centrifuge.
15. Spectrophotometer.

Reference Books:

- Rajan, S and Selvi Christy. 2010. Experimental Procedures in Life Sciences. CBS Publishers, New Delhi.
- Verma and P.C. Srivastava 2007. Advanced Practical in Zoology. S. Chand & Co.

Course Outcomes:

- Familiar with Hardy Weinberg law and calculation of gene frequency
- Familiar with solution preparation
- Familiar with buffer preparation
- Familiar with quantitative estimation of total sugar in animal tissues
- Familiar with Beer and Lambert's law

CLASS	II – M.Sc., Zoology	
Semester	III	
Course & Code	Core Course Elective – (EC3)	Code: P19ZY14E
Course Title	BIOSTATISTICS AND RESEARCH METHODOLOGY	
Hours: 6	Credits : 4	Max Marks : 75

Course Educational Objectives:

- To understand the descriptive statistics
- To understand the hypothesis testing methods
- To understand methods involved in research
- To understand various resources of journals
- To understand the methods in field biology

BIOSTATISTICS

UNIT – I: Descriptive statistics and Presentation of data

Measures of central tendency: Mean, median, and mode – Measures of dispersion: Range, variance, standard deviation, standard error – Probability distributions (Binomial, poisson and normal) – Graphic presentation of Data: Scatter diagram, Bar diagram, frequency polygon, line graphs and Pie charts – Frequency distribution – Frequency tables – Variables.

UNIT – II: Testing Hypothesis

Test of hypothesis (Null hypothesis and Alternative hypothesis) – Confidence Interval – Levels of significance – Student’s t test (paired and unpaired tests) – Chi square test – One way and two way analyses of variance (F-values) – Correlation.

RESEARCH METHODOLOGY

UNIT – III: Research Methodology

Research: Definition, Sources for Literature collection, Selection of research theories, Experimental Design, Components of research report (Introduction, Materials and Methods, Results and Discussion, Summary, References), Presentation of results (in the form of Tables, Figures), Evaluation of Data (Statistical Analysis).

UNIT – IV: Journals and Online browsing of research articles

Popular Magazines and periodicals (monthly, quarterly and half-yearly journals and reviews). Online browsing of research articles: infonet, inflibnet and Pubmed. Peer-reviewed journals, indexed and non-indexed journals.

UNIT - V: Methods in field biology

Primary and secondary data collection – Estimation of population density – Estimation of ranging patterns – Sampling methods to the study the animal behavior – Ground and remote sensing methods for habitat characterization.

Course Outcomes:

- Familiar with the descriptive statistics
- Familiar with the hypothesis testing methods
- Familiar with method involved in biological research
- Familiar with various resources for research articles
- Familiar with the methods in field biology

Textbooks

Gurumani, N. 2010. An Introduction to Biostatistics. MJP Publishers, Chennai.
Gurumani, N. 2006. Research Methodology for Biological Sciences MJP Publishers.

References

Sokal, R.R. and F.J. Rohlf 1981, Introduction to Biostatistics, WH Freeman & Co. USA.
Zar, J.H. 1984, Biostatistical analysis, Prentice Hall, New Jersey, USA.
Anderson, T.W. 1983, An Introduction to Multivariate Analysis, John Wiley.
Kothari, C.R. 2004. Research Methodology: Methods and Techniques. Second edition, New Age International Publishers, New Delhi.
Louis Cohen, Lawrence Manion, and Keith Morrison. 2007. Research Methods in Education. Sixth edition. Routledge, Taylor & Francis Group.

CLASS	II – M.Sc., Zoology	
Semester	III	
Course & Code	Core Course Elective – (EC4)	Code: P19ZY15E
Course Title	ENVIRONMENTAL BIOLOGY AND MANAGEMENT	
Hours: 6	Credits : 4	Max Marks : 75

Course Educational Objectives:

- To understand our immediate environment
- To understand the population ecology
- To understand community ecology
- To understand the concepts of ecosystem
- To understand the ecological resources

UNIT – I: Environment, Habitat, and Niche

Abiotic factors (Air, Water, Light, Temperature, and Soil) – Biotic factors – Biotic and abiotic interactions – Habitat and niche – Niche width and overlap – Fundamental and realized niche – Resource partitioning – Character displacement.

UNIT – II: Population Ecology

Characteristics of a population – Population density (Natality, Mortality) – Population growth curves – Population regulation – Life history strategies (r and K selection) – Concept of metapopulation – Demes and dispersal – Interdemic extinctions – Age structured populations.

UNIT – III: Species Interactions, Community Ecology and Ecological Succession

Types of species interactions (Positive, negative and passive), interspecific competition, herbivory, carnivory, pollination, symbiosis – Community structure and attributes – Levels of species diversity and its measurement – Edges and ecotones – Types and mechanisms of ecological succession – Concept of climax.

UNIT - IV: Ecosystem Ecology

Ecosystem: Concept, Structure – Food chain, Food web, Trophic levels, Energy Flow in grassland food chain – Primary production and decomposition – Biogeochemical cycle: Carbon, Nitrogen, Phosphorous – Structure and function of freshwater, marine, and estuarine ecosystems.

UNIT – V: Applied Ecology

Renewable and Non-Renewable natural resources – Bioremediation – Environmental pollution: Air, Water, Soil, Sound pollutions – Environmental Protection Act – Global environmental change – Major drivers of biodiversity change – Biodiversity management approaches.

Course Outcomes:

- Familiar with our immediate environment
- Familiar with the population ecology
- Familiar with the community ecology
- Familiar with the concepts of ecosystem
- Familiar with the ecological resources

Textbooks

Peter Stiling. 2001. Ecology: Theories and Applications. 4th edition. Pearson.

Odum, E.P and Barrett, G.W. 2005. Fundamentals of Ecology. Thompson Brooks Cole (EWP) 5th Ed.

References

Clarke, G.L. 1954, Elements of Ecology. John Wiley & Sons. NY.

Dash, M C. 1998. Fundamentals of Ecology. 5th edition. Mcgraw-Hill, New Delhi.

Kormondy, E.J. 1996. Concepts of Ecology, 4th edition. Pearson Education, Inc., USA.

Smith T.M. and Smith R.L. 2008. Elements of Ecology. Sixth edition, Pearson Education, New Delhi.

Turk A. and Turk J. 1993. Environmental Science. Fourth edition, Saunders.

CLASS	II – M.Sc., Zoology	
Semester	IV	
Course & Code	Core Course – (CC12)	Code: P19ZY16
Course Title	IMMUNOLOGY	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To understand the lymphoid organs
- To understand the antigens and immunoglobulins
- To understand immune response
- To understand immune disorders
- To understand immunotechniques

UNIT – I: Lymphoid organs

Immunity: Innate and adaptive immunity. Lymphoid organs: Primary and secondary – structure and functions. Cells of the immune system: Origin and fate of stem cells (lymphoid, myeloid & erythroid lineage), T & B Lymphocytes, Null cells, Natural Killer cells, Macrophages, Polymorphonuclear cells, Dendritic cells, Antigen presenting cells, Mast cells, Lymphokines and Cytokines.

UNIT – II: Antigens and Immunoglobulins

Antigen: Types of antigens – Antigenicity – B and T cell epitopes – haptens, adjuvants and carriers. Antibody: Monoclonal and polyclonal antibodies, Ultra structure & types of immunoglobulin; paratopes (characteristics and functions) – Immunogenicity – Antibody receptors (T cell receptors – TCR), Genes for TCR and diversity – Complement: Nomenclature, complement activation and function (Classical and Alternate pathway).

UNIT – III: Immune response

Antigen processing and presentation – Activation and differentiation of B and T cells – B and T cell receptors – Immune response: Primary and secondary immune response – Mechanism of humoral and cell mediated immune response – Immunity to infections: Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections – Immunoprophylaxis: Vaccines (antigen, subunit, recombinant, anti idiotypic antibodies & toxoids as vaccines) – Immunization schedule for children.

UNIT – IV: Immune Disorders

Major Histocompatibility Complex: Functions; Structure and Pathway of class I and class II MHC Molecules – Hypersensitivity: Types – I, II, III, IV and V – Autoimmune disorders – Immunodeficiency diseases – Tumor immunity: Tumour antigens; Immune response to tumours – Transplantation immunity: Host versus Graft reaction; Graft versus Host reaction.

UNIT – V: Immunological Techniques

Salient features of Antigen-Antibody reactions: Specificity, Binding site, Strength & Properties (Affinity, Avidity, Cross reaction of Antibody) – Immunoprecipitation reaction: Double, Radial immunodiffusion & Immunoelectrophoresis – Agglutination reaction: ABO blood typing – Brucella agglutination test – Widal test – Immunofluorescence – Binder – Ligand assays: Radioimmunoassay (RIA), Enzyme Linked Immunosorbant Assay (ELISA).

Course Outcomes:

- Familiarize with the lymphoid organs
- Familiarize with the antigens and immunoglobulins
- Gain knowledge on immune response
- Gain knowledge on immune disorders
- Familiar with immunotechniques

Textbooks

Kindt, T.J., Goldsby, R.A., Osborne, B.A. 2007. Kuby Immunology. W.H. Freeman & Co., New York.

Roitt, (3rd Edition) 2002. Immunology Crover Medical Publishing Company, London.

References

Barret, J. T., 1983, A text book of Immunology. (5th Edition) The C.V. Mosly Company.

Weinn, D.M. and Steward, L. 1993. Immunology. Singapore Publishers Private Ltd.

Kannan, R. 2011. Immunology. Oxford University Press, New Delhi.

Lal, S.S., Kumar, S. 2012. Immunology. Rastogi Publication, Meerut.

Male, D., Brostoff, J., Roth, D.B., Roit, I. 2006. Immunology. Elsevier, Philadelphia.

CLASS	II – M.Sc., Zoology	
Semester	IV	
Course & Code	Core Course – (CC13)	Code: P19ZY17
Course Title	GENERAL AND APPLIED ENTOMOLOGY	
Hours: 6	Credits : 5	Max Marks : 75

Course Educational Objectives:

- To understand the classification of insects
- To understand the Digestive, respiratory and circulatory system of Insects
- To understand the excretory, nervous and reproductive system of insects
- To understand the insect pests and their management
- To understand the pest control methods

UNIT – I: Taxonomy and Morphology of Insects

Basis of insect classification – Key characteristics with common South Indian examples – Morphology of the insect – Head Sutures and Sclerites – Types of mouth parts – Thorax areas and sutures of tergum, sternum and pleuron – Wings: structure and modifications; venation – Leg structure and modifications – Abdominal segmentation with genitalia and their modifications.

UNIT – II: Physiology of Insects

Structure and chemistry of integumentary system – Structure and physiology of digestive system – Respiratory system: Aerial and Aquatic – Circulatory system: Structure of heart; Mechanism of haemolymph circulation; Haemolymph and its composition & Haemocytes and their functions.

UNIT – III: Physiology of Insects

Malpighian tubules and their functions – Nervous system: Structure; Neurotransmitters; Structure and function of compound eye – Male and female reproductive systems – Endocrine system: Neuroendocrine system of insects; Endocrine control of moulting and metamorphosis; Role of hormones in male and female reproduction.

UNIT – IV: Insect Pests

Biology, damage caused and control methods: Paddy (*Scirpophaga incerulas*, *Orseolia oryzae*, *Leptocorisa acuta*); Rice (*Sitophilus oryzae*) Sugarcane (*Chilo infuscatellus*, *Chilo Sacchariphagus indicus*, *Tryporyza nivella*); Cotton (*Earias insulana*, *Aphis gossypii*, *Thrips tabaci*); Coconut (*Rhyncophorus ferrugineus*, *Oryctes rhinoceros*); Brinjal (*Leucinodes orbanalis*); Tomato (*Spodoptera litura*); Lady's finger (*Earias fabia*).

UNIT – V: Pest Control Methods

Principles of Insect control: Prophylactic measures, Cultural, Mechanical, Physical and Biological methods – Parasites and predators – Chemical methods: Pesticides, Classification, Mode of action, Toxicity, Insecticide resistance to environmental safety

– Non conventional methods, Use of insect growth regulators (IGR), Repellents, Antifeedants, Pheromones and Chemosterilants. Integrated Pest Management.

Course Outcomes:

- Familiarize with the classification of insects
- Familiarize with the digestive, respiratory and circulatory system of Insects
- Familiarize with the excretory, nervous and reproductive system of insects
- Gain knowledge on the insect pests and their management
- Gain knowledge on the pest control methods

Textbooks

R. F. Chapman. 2013. The Insects: Structure and Function. Stephen J. Simpson, Angela E. Douglas. Cambridge University Press.
Nalina Sundari, M.S. 2011. Entomology. MJP Publishers, Chennai.

References

Wigglesworth, V.B. 1992, Physiology of Insects. IX Ed. Chapman and Hall London.
Nayar, K.K., Ananthakrishnan, T.N. and David, M., 1995. General and Applied Entomology. Tata McGraw Hill Pub. Co., Ltd., New York.
Arumugam, N., A. Thangamani, S. Prasanna kumar, L.M. Narayanan, N.C Nair, S. Leelavathy, N. Soundara Pandian, T. Murugan, J. Johnson Rajeswar, R. Ram Prabhu, Jayasurya. 2015. Economic Zoology. Saras Publication.
Rathinaswamy, T.K., 1986. Medical Entomology, S. Viswanathan and co., Madras.
Mani, M.S. 1982. General Entomology, Oxford and IBH Publishing Co. New Delhi.

CLASS	II – M.Sc., Zoology	
Semester	IV	
Course & Code	Core Course Elective – (EC5)	Code: P19ZY18E
Course Title	WILDLIFE BIOLOGY	
Hours: 6	Credits : 4	Max Marks : 75

Course Educational Objectives:

- To understand the Indian wildlife and its conservation
- To understand Ethology
- To understand the ecology selected endangered animals in India
- To learn the wildlife census techniques
- To understand human-animal conflicts

UNIT – I: Wildlife of India

Wildlife concept – Wildlife wealth of India – Threats to Indian wildlife (habitat loss, Mining activities, Forest fires, construction of road and railways, poaching and illegal wildlife trade) – Read Data Book and IUCN Red List of threatened animals – Aims and objectives of wildlife conservation – History of wildlife conservation in India – Necessity for wildlife conservation.

UNIT - II: Biome and Ethology of wildlife

Biome: Concept; Definition; Characteristic features; Types in India (Alpine Tundra, Grassland, Forest, Desert, Aquatic) – Communications and signaling: Modes of communications; Biological significance – Territory: Size; Defense strategies – Courtship displays: Stages involved in successful courtship; Biological significance – Mate selection: Influencing factors and benefits; Types.

UNIT – III: Corridors and Bio-Ecology

Wildlife corridors: Types; Problems associated.

Distinctive features, distribution, population, habitat, behaviour, breeding, threats to survival: Olive Ridley Turtles – Great Indian Bustard – White-Rumped vulture – Gray Slender Loris – Blackbuck – Greater One-Horned Rhinoceros – Asian Elephant – Fishing Cat – Indian Tiger – Asiatic Lion.

UNIT – IV: Wildlife census techniques

Objective of census – Estimation of abundance in wildlife studies – Direct count: Line transects, Point counts, Mark-recapture – Indirect count: pellet count, calls, sent mark, pug mark, camera trap, radio telemetry, remote sensing – Behavioural sampling: Events, States, Focal-sampling, Scan sampling.

UNIT – V: Human wildlife conflicts & Acts and convention

Human wildlife conflicts in India – Causes, consequences, and mitigation – Scenario, Mitigation strategies, and challenges: Human-Elephant conflict; Human-Tiger conflict; Human-Leopard conflict – Important acts related to wildlife conservation – Important

convention for wildlife conservation – Government organisations and institutes in conservation initiatives.

Course Outcomes:

- Gain knowledge about Indian wildlife and its conservation
- Familiarize with Ethology
- Gain knowledge about the ecology selected endangered animals in India
- Familiarize with the wildlife census techniques
- Gain knowledge about human-animal conflicts

Textbooks

Varadharajan Gokula. 2013. Elementary Wildlife Biology. Lap Lambert Academic Publishing.

Goutam Kumar Saha and Subhendu Mazumdar. 2017. Wildlife Biology: An Indian Perspective. PHI Learning Private Limited.

References

Sutherland W.J.2000. The conservation hand book: research, management and policy Blackwell Science Ltd

Andrawartha, H.C. and L.C. Birch. 1974. The distribution and abundance of animals. The University of Chicago press, London.

Agarwal, V.P. 1980. Forests in India. Oxford and IBH Publishing Co. New Delhi.

Giles, R.H. 1984. Wild life management techniques. The wild life society, Washington and Nataraj Publishers, Dehra Dun.

Saharia, V.B. 1982. Wild life in India. Nataraj Publishers, Dehra Dun.

CLASS	II – M.Sc., Zoology		
Semester	IV		
Project	Project Work	Code: P19ZYP19	
Title			
Hours: 12	Credits : 5	Max Marks : 100	

A dissertation should be submitted.

Extra credit papers (self study)

CLASS	For B.Sc and M.Sc., Zoology	
Semester	VI semester for UG and IV semester for PG	
Title		
Self Study	Credits : 4	Max Marks : 100

ORNITHOLOGY

Objective: To make the students understand the various aspects of Ornithology.

UNIT - I

Classification of Birds upto orders with examples – fossil birds – origin and evolution of birds.

Habitat ecology of Indian birds: Coastal birds – Inland water birds – Birds of high altitudes and deserts.

Status and Distribution: Distribution of birds in India – Endangered birds of India and their conservation.

UNIT - II

Methods: Morphometric measurements – methods used in food habit studies.

Feeding ecology: Insectivores – Frugivores – Nectarivores – Graminivores – Carnivores and Scavengers – Perch related variables and time activity budget studies with suitable example.

General Organization – digestive system – circulatory system – excretory system - respiratory system – sense organ, nervous system and coordination.

UNIT - III

Territory: Functions of Territory – Types of Territory – Sizes and shapes of Territory – Defense of Territory – Site Fidelity.

Songs and Calls: Functions of Voice (Reproductive, Social and Individual) – Birds Vocabularies – Nature of song – Non – Vocal sounds.

Nests: Functions of nests – Choice of nest sites – Colonial nesting – Forms of nest – Multiple nests – Nest materials – Nest building.

UNIT - IV

Reproduction: Breeding seasons – Factors influencing breeding seasons – Seasonal reproductive cycle – Photo periodism – Courtship and display – Sexual selection – Pair bond – Sexual dimorphism – Mating systems - Polyandry, Polygyny – Promiscuity – Co-operative breeding – Brood parasites.

Egg Laying: Timing of egg laying – Clutch size – Incubation patterns – Hatching.

Parental Care: Feeding – Nest sanitation – Brooding the young – Defense of young.

Feathers and Moulting: Types – Functions – Growth – Moulting.

UNIT - V

Migration: Theories of migration – Timing of migration – Physiology of migration– Orientation and navigation.

Population Regulation: Population densities – Predation – Competition – Climate and weather – Accidents – Parasites and diseases – Population fluctuations.

Economic values of birds: Food and other products from birds – Birds of agricultural Importance – Bird hazard in airports – Recreation – Esthetics – Hunting– Bird watching.

Text Books

1. Welty, J. 1982. The Life of Birds. Saunders College Publishing, New York.

Reference Books:

1. Ali, S., and S.D. Ripley. 1969. The Handbook of Birds of India and Pakistan. Oxford University Press – Delhi.
2. Farner D.S. and J.K. King. 1971-75. Avian Biology. 1-5 vols. Academy Press, Delhi.

CLASS	For B.Sc and M.Sc., Zoology	
Semester	VI semester for UG and IV semester for PG	
Title		
Self Study	Credits : 4	Max Marks : 100

PARASITOLOGY

Unit-I: Introduction to Parasites 1.1 Introduction to parasites of man, scope and definition of parasites/parasitology 1.2 Animal Association, Types of Parasites and Hosts 1.3 Interrelationship between Host and Parasites responses and hosts to parasitic infection 1.4 Mode of transmission of parasite, Host specificity and parasitic adaptation

Unit-II: Protozoa and Cestoda Classification, Geographical distribution, Morphology, Life-cycle, Transmission, Pathogenicity, Treatment and Prophylaxis of: 2.1 Protozoan parasites: Entamoeba Sps, Trypanosoma Sps., Leishmania Sps. 2.2 Intestinal flagellates Giardia Sps, Trichomonus Sps 2.3 Cestodes: Taenia Sps, Diphilabothrium Sps. 2.4 Classification of Parasitic Protozoans and parasitic cestodes

Unit-III: Trematoda and Nematoda Classification, Geographical distribution, Morphology, Life-cycle, Transmission, Pathogenicity, Treatment and Prophylaxis of: 3.1 Trematodes: Schistosomo Sps, Faciola Sps, Echinococcus Sps. 3.2 Nematodes: Wuchereria Sps, Ancylostoma Sps, Dracunculus Sps. 3.3 Plant & Soil nematodes: Cyst nematode, citrus nematode 3.4 Biodiversity & Taxonomic overview of Helminth Parasites

Unit-IV: Immunology, Genetics & Molecular Biology of Parasites 4.1 Trypanosoma: Diploid & Sexual stage, Molecular characteristics of surface coat, Variable surface glycoprotein (VSG) and VSG gene expression. 4.2 Plasmodium: Diploid & haploid stages, Chromosome polymorphism, gene encoding Circum sporozoite protein & merozoites S-antigens, surface antigen diversity. Resistance of Malaria to drugs, its mechanism & assessment. 4.3 Platyhelminthes: Inseminative behaviour, parthenogenesis and polyspermy, sex determination, sex linked inheritance in Schistosomes. 4.4 Nematoda: chromosome germ line limited DNA & chromatin diminution in Ascaris.

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6. Helminths, Arthropods and Protozoa of domesticated animals. ELBS and Bailliere Tindall. London. Soulsby, E. J. L. (1982).
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