

## M. Sc. ZOOLOGY Degree Course

### PG – SCHEME OF EXAMINATIONS: CBCS PATTERN

(For students admitted during the academic year 2018-2019 and onwards)

| Sub Code           | Title of the Paper   | Hrs (work) | Internal (CA) Marks | External Marks | Total Marks | Ext. – Min. | Total Pass Mark | Credits |
|--------------------|--|------------|---------------------|----------------|-------------|-------------|-----------------|---------|
| <b>Semester I</b>  |  |            |                     |                |             |             |                 |         |
| 18MZO11C           | <b>Core Paper I</b> – Biosystematics, Animal Diversity & Phylogeny             | 5          | 25                  | 75             | 100         | 38          | 50              | 4       |
| 18MZO12C           | <b>Core Paper II</b> – Environmental Biology                                   | 5          | 25                  | 75             | 100         | 38          | 50              | 4       |
| 18MZO13C           | <b>Core Paper III</b> - Genetics   | 5          | 25                  | 75             | 100         | 38          | 50              | 4       |
| 18MZO14E           | <b>Elective Paper I</b> – Fishery Science                                      | 5          | 25                  | 75             | 100         | 38          | 50              | 4       |
|                    | <b>Core Practical I</b> (Includes Core Papers I, II, III & Elective Paper I)   | 5          |                     |                |             |             |                 |         |
|                    | <b>Core Practical II</b> (Includes Core Papers IV, V, VI & Elective Paper II)  | 5          |                     |                |             |             |                 |         |
| <b>Semester II</b> |  |            |                     |                |             |             |                 |         |
| 18MZO21C           | <b>Core Paper IV</b> – Animal Physiology                                       | 5          | 25                  | 75             | 100         | 38          | 50              | 4       |
| 18MZO22C           | <b>Core Paper V</b> – Biochemistry   | 5          | 25                  | 75             | 100         | 38          | 50              | 4       |
| 18MZO23C           | <b>Core Paper VI</b> – Cell & Molecular Biology                                | 5          | 25                  | 75             | 100         | 38          | 50              | 4       |
| 18MZO24E           | <b>Elective Paper II</b> – Biostatistics, Biotechniques & Research Methodology | 5          | 25                  | 75             | 100         | 38          | 50              | 4       |
| 18MZO25P           | <b>Core Practical I</b> (Includes Core Papers I, II, III & Elective Paper I)   | 5          | 40                  | 60             | 100         | 30          | 50              | 4       |
| 18MZO26P           | <b>Core Practical II</b> (Includes Core Papers IV, V, VI & Elective Paper II)  | 5          | 40                  | 60             | 100         | 30          | 50              | 4       |

| <b>Sub Code</b>     | <b>Title of the Paper</b>   | <b>Hrs (work)</b> | <b>Internal (CA) Marks</b> | <b>External Marks</b> | <b>Total Marks</b> | <b>Ext. – Min.</b> | <b>Total Pass Mark</b> | <b>Credits</b> |
|---------------------|---|-------------------|----------------------------|-----------------------|--------------------|--------------------|------------------------|----------------|
| <b>Semester III</b> |   |                   |                            |                       |                    |                    |                        |                |
| 18MZO31C            | <b>Core Paper VII</b> – Developmental Biology                                 | 5                 | 25                         | 75                    | 100                | 38                 | 50                     | 4              |
| 18MZO32C            | <b>Core Paper VIII</b> – Immunology   | 5                 | 25                         | 75                    | 100                | 38                 | 50                     | 4              |
| 18MZO33C            | <b>Core Paper IX</b> – General Endocrinology                                  | 5                 | 25                         | 75                    | 100                | 38                 | 50                     | 4              |
| 18MZO34E            | <b>Elective Paper III</b> – General Entomology                                | 5                 | 25                         | 75                    | 100                | 38                 | 50                     | 4              |
|                     | <b>Core Practical III</b> (Includes Core Papers VII, VIII, IX, X & XII )      | 5                 |                            |                       |                    |                    |                        |                |
|                     | <b>Core Practical IV</b> (Includes Core Papers XI & Elective Papers III & IV) | 5                 |                            |                       |                    |                    |                        |                |
| <b>Semester IV</b>  |   |                   |                            |                       |                    |                    |                        |                |
| 18MZO41C            | <b>Core Paper X</b> – Microbiology  | 5                 | 25                         | 75                    | 100                | 38                 | 50                     | 4              |
| 18MZO42C            | <b>Core Paper XI</b> – Biotechnology & Genetic Engineering                    | 5                 | 25                         | 75                    | 100                | 38                 | 50                     | 4              |
| 18MZO43C            | <b>Core Paper XII</b> – Applied Endocrinology                                 | 5                 | 25                         | 75                    | 100                | 38                 | 50                     | 4              |
| 18MZO44E            | <b>Elective Paper IV</b> – Applied Entomology                                 | 5                 | 25                         | 75                    | 100                | 38                 | 50                     | 4              |
| 18MZO45P            | <b>Core Practical III</b> (Includes Core Papers VII, VIII, IX, X & XII )      | 5                 | 40                         | 60                    | 100                | 30                 | 50                     | 4              |
| 18MZO46P            | <b>Core Practical IV</b> (Includes Core Paper XI & Elective Papers III & IV)  | 5                 | 40                         | 60                    | 100                | 30                 | 50                     | 4              |
| 18MZO47V            | <b>Project &amp; Viva Voce</b>  |                   | 20                         | 80                    | 100                | 40                 | 50                     | 10             |
|                     | <b>Total Marks &amp; Credits</b>  |                   |                            |                       | <b>2100</b>        |                    |                        | <b>90</b>      |



## M.Sc., ZOOLOGY

| Year            | Paper Title   | Sem. | Subject code |
|-----------------|---|------|--------------|
| 2018-19 onwards | CORE PAPER I: BIOSYSTEMATICS, ANIMAL BIODIVERSITY AND PHYLOGENY | I    | 18MZO11C     |

### OBJECTIVES

- *To help the students to understand the status and mode of living of different forms of animals.*
- *To understand the principles of biosystematics, nomenclature and the species concept.*
- *To study some important aspects of invertebrate and vertebrate bio diversity.*
- *To enlighten the basic knowledge about the evolution of life.*

### UNIT I- Principles of Biosystematics

Basic concepts and applications of Classification, Taxonomy and Biosystematics, Nomenclature- History, Binomial, Trinomial, Homonymy and Synonymy  
International Code for Zoological Nomenclature (ICZN).  
The Three domains of life.  
Identification methods - Use of keys, kinds of keys, their merits and demerits.

### UNIT II - Species Concept

Speciation-species concepts,  
Category of species - typological, nominalistic, biological, evolutionary species.  
Kinds of species - polytypic species, subspecies, super species.  
Modes of speciation - allopatric, sympatric and parapatric speciation.  
Taxonomic hierarchies of species.

### UNIT III – Diversity of Invertebrates

Broad classification of Invertebrates.  
Significance of symmetry, coelom and metamerism.  
Ctenophore - Structural peculiarities and affinities.  
Trilobites - structure and significance.  
Larval forms of Arthropoda and Echinodermata.

### UNIT IV – Diversity of Chordates

Outline classification of phylum Chordata  
Systematic position and affinities of Cephalochordates and Cyclostomes.

Neoteny in Amphibia.

Evolutionary significance of Coelacanth, Sphenodon and Archaeopteryx.

Distribution and diversity of lemurs, tarsiers, lorises, gorillas and chimpanzees.

### **UNIT V - Phylogeny**

Chemical Evolution of life.

The Geological time scale.

Fossils -formation, types, dating and uses.

Rise and fall of dinosaurs.

Phylogenetic trees- history, types, construction, limitations.

### **TEXT BOOKS**

**Barnes., R.D.**, (1982), Invertebrate zoology, IV Ed., Holt Saunders International Edition.

**Young., J.Z.**, (1950), Life of Vertebrates, Clarendon Press, Oxford.

**Kotpal., R.L.**, Modern Text book of Zoology: Vertebrates, Rastogi Publications, Meerut.

### **REFERENCE BOOKS**

**David, M. H, Craig Moritz and Barbara, K. M.** (1996) Molecular Systematics.  
Sinauer Associates, Inc.

**Kapoor., V.C.**,(1998) Theory and practice of animal taxonomy. Oxford & IBH Publi.,  
Co. NewDelhi.

**Mayr., E.** (1969) Principles of Systematic Zoology . McGraw Hill Book Company Inc.,  
NewYork.

**Narendran., T.C.**,(2008) An Introduction to Taxonomy . Zoological Survey of India.

**Strikberger., M.W.**,(2005) Evolution, Jones and Bartett Publishers, London.

## M.Sc. ZOOLOGY

| Year               | Paper Title                          | Sem. | Subject code |
|--------------------|--------------------------------------|------|--------------|
| 2018-19<br>onwards | CORE PAPER II: ENVIRONMENTAL BIOLOGY | I    | 18MZO12C     |

### OBJECTIVES

- *To provide an understanding of the concepts and disciplines of ecology*
- *To study the structure, functions and types of ecosystem*
- *To gain a critical understanding of the impact of man on the environment*
- *To develop an appreciation of the resources of India and the conservation initiatives undertaken*

### UNIT I: Ecological Basics, Speciation and Biogeography

Definition, scope and division of ecology

Biotic environment, abiotic components, atmosphere – stratification; gases, wind and temperature

Concept of habitat and niche

Species interaction – types of interaction – intraspecific and interspecific.

Biogeography – Biogeographical zones in India.

### UNIT II: Ecosystem Types and Function

Ecosystem – structure and function, primary production, energy flow in ecosystem

Terrestrial ecosystem – desert and grassland

Aquatic ecosystem – fresh water – lentic and lotic

Marine – stratification, intertidal shores and deep sea

Estuarine ecosystem.

### UNIT III: Population ecology, Ecological succession and Natural Resources

Population ecology – characteristics, population growth curve, regulation, demes and dispersal

Ecological succession – types, mechanism, significance and climax concept

Community ecology – nature of community, structure, stratification

Natural resources – water and forest

Conventional and non-conventional energy resources.

### UNIT –IV: Pollution and Disaster management

Environmental pollution –air, water, land, radioactive pollution and e-pollution

Global warming and climate change  
Sustainable development, earth summit  
Disaster management.

#### **UNIT –V: Biodiversity, its Monitoring and Assessment**

Biodiversity in India  
Wildlife sanctuaries, national parks, biosphere reserves in India  
Endangered species and their conservation  
Environmental monitoring and impact assessment  
Western Ghats and its significance. Project Tiger

#### **TEXT BOOKS**

**Sharma P.D.** Ecology and Environment. Rastogi Publications., Meeraut  
**Odum EP**, Fundamentals of ecology, W.B. Saunders & Co.

#### **REFERENCE BOOKS**

**Agarwal KC.** Biodiversity. Agro Botanical publishers  
**Ananthakrishnan TN**, Bioresources Ecology, Oxford  
**Desanto Rs.** Concept of Applied ecology, Springer Varlag  
**Mani MS** (1974). Ecology and Bio-geography in India  
**Odum E.P.** Basic ecology, W.B. Saunders & Co.  
**Oliver and Owen.** Natural resources conservation. An ecological approach  
**Philipson J.** Ecological enegetics. St Martis

## M.Sc., ZOOLOGY

| Year            | Paper Title              | Sem. | Subject code |
|-----------------|--------------------------|------|--------------|
| 2018-19 onwards | CORE PAPER III: GENETICS | I    | 18MZO13C     |

### OBJECTIVES

- *To enlighten the students about the genetic materials, their functions.*
- *To know the chromosomal basis of inheritance, genetic engineering.*
- *To study the genetic disorders and genetic counselling.*

### UNIT-I: Genetic Material

Organization and functions of genetic material.

Molecular Structure of DNA and RNA.

Gene concept -Cistron, Muton, Recon, Exon, Intron, Operon, Overlapping genes, Split genes, Pseudogenes.

Regulation of gene expression in prokaryotes -Lac and tryptophan operon.

Regulation of gene expression in eukaryotes - Gene clustering.

### UNIT - II: Chromosomes and Inheritance

Mendelian principles.

Linkage and crossing over.

Chromosome mapping in prokaryotes (Virus, Bacteria) and eukaryotes (Neurospora and Man)

Ploidy, Sex chromosomes.

Extra chromosomal inheritance, Maternal inheritance.

### UNIT- III: Genetic Engineering

Protein synthesis, Genetic Code.

Isolation and purification of DNA/ genes.

DNA sequencing, Restriction endonucleases, Ligases, cDNA libraries, Genome project.

Use of DNA in forensics.

### UNIT-IV: Population Genetics and Mutation

Population and gene pool.

Hardy -Weinberg law and Genetic equilibrium.

Mutation and mutagens.



Molecular basis of mutation.

Evolutionary significance of mutations.

### **UNIT- V: Human Genetics and Counseling**

Normal human karyotype – banding technique.

Principles and methods of pedigree analysis.

Genetic disorders and syndromes.

Genetic counseling - Objectives, ethics and principles.

Methods of counselling for point mutation, structural and chromosomal disorders.

### **TEXT BOOK**

**Goodenough, U.** 1984. Genetics. Saunders College Publishing Co., London.

**Sinnot. E.W., Dunn. L.C., Dobzhansky, T.H.** 1973. Principles of Genetics.

McGraw Hill Co., New Delhi.

### **REFERENCE BOOKS**

**Daniel L. Hartl.** 1994. Genetics. Jones and Barflaff Publishing, Boston.

**Lewin, B. 2000.** Genes VII. Oxford University Press, New York.

**Ayala, F. I. and Kieger, J.A. Jr.,** 1980, Modern Genetics. The Benjamin Publishing Co. London,

**Jenking, J.B.** 1983. Human Genetics. The Benjamin Cummings Publishing & Co., London.

**Stickberger, M.W.** 1985. Genetics. Prentice - Hall of India, Pvt. Ltd., New Delhi.

**Watson. J.D. Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, .M.**  
1987. Molecular Biology of the Gene. W.A. Benjamin/Cummings Co., New York.

## M.SC., ZOOLOGY

| Year            | Paper Title                       | Sem. | Subject code |
|-----------------|-----------------------------------|------|--------------|
| 2018-19 onwards | ELECTIVE PAPER I: FISHERY SCIENCE | I    | 18MZO14E     |

### OBJECTIVES

- *To appreciate the scope of the study of and economics of Fishery Biology. To understand the structure and functioning of different organ systems.*
- *To gain a complete knowledge of equipments required for Culture Fisheries. .*
- *To obtain a thorough understanding of the production processes and uses of fish byproducts.*

### UNIT-I: Introduction, Fish Divisions and Government Programs

Introduction and scope of Fishery biology.

Government participation in aquaculture – ICAR, CMFRI, CIFRI, CIFA, CIBA (Brief account).

Salient features of Ostracoderms, Placoderms, Elasmobranchs, Holocephali, Dipnoi and Teleostoni.

Inland fisheries: Riverine fisheries, Estuarine fisheries.

### UNIT-II: Migration, Locomotion, Integumentation and Respiration

Locomotion in fishes - fins, role of muscle in locomotion, types of locomotion.

Migration in fishes- types of migratory fishes.

Integumentary system - Scales, types of scales.

Gill respiration - Types of Gills, structure, mechanism of Gill respiration.

Accessory respiratory organs - Air bladder.

Weberian ossicles- Structure, function.

### UNIT-III: Sense organs and Poison glands

Sense organs - Lateral line, Ampullae of Lorenzini, Pit organs, Vesicles of Savi.

Electric organs - Source of origin of electric organs, Location, Structure, Mechanism, Functions.

Poison glands -Difference between poisonous and Venomous fishes, Division of Poisonous fishes, Chemical nature of fish Toxin, and Venom apparatus.

Sound producing organs - Significance.

Bioluminescence- Significance of Bioluminescence.

### UNIT-IV: Fish feed, Edible fishes and Diseases

Nutritional requirement of fishes.

Fish feed - Live feed - Artemia culture, Daphnia culture, Spirulina culture. Artificial feed.

Feeding habits- Structure and modification of alimentary canal in relation to mode of feeding.

Edible fishes- fresh water – *Labeo rohita*, *Cirrhinus mirgala*, *Catla catla*.

Edible fishes - marine water – *Sardinalla longiceps*, *Chanos chanos*, *Scoliodon*.

Fish diseases: Protozoan diseases - White spot diseases, Costiasis; Bacterial diseases -

Gill rot, Vertical scale diseases; Viral diseases - Epizootic ulcerative syndrome (EUS),

Infectious pancreatic necrosis (IPN); Fungal diseases - Saprolegniasis, Erythroderma.

### **UNIT-V: Fisheries, Fishing crafts, nets, Preservation and Byproducts**

Fishing crafts: Coracle, Canoes, Kattumaram, Vallam, Trawlers- Bean trawlers, pair trawlers.

Fishing Nets: Cast net, Gill net, Fyke net, Dip net, Hook and line.

Methods of fish preservation: Curing, Drying, Salting, Smocking, Canning, Refrigeration.

Fish byproducts: Fish liver oil, Fish meal, Fish manure, Fish hydrolysed protein, Isinglass,

Fish glue, Fish leather.

### **TEXT BOOKS**

**Kamleshwar Pandey and Shukla J. P.** 2012. Fish and Fisheries. Rastogi publications.

**Khanna S. S and Singh H. R.** 2015. A Text book of Fish biology and Fisheries.

Narendra publishing house- Delhi.

### **REFERENCE BOOKS**

**DattaMunshi, J. S. and Shrivastava, M.P.** 1988. National History of Fishes and Systematic of Fresh water fish of India.

**Jhingran, V.G.** 1987 Fish and Fisheries of Indian, Hindustan Publishing Corporation Delhi – 7.

**Karl F Lagler, John E Bardach, Robert R Miller and Dorr Ra Mary Passiono,** 1970 'Ichthyology', John Willy and son New York.

**Khana** 1973. An introduction of Fishes. Central Book Depot, Allahabad.

**Ribelin W.E.** (ed.) 1975. Pathology of Fishes. Madison–Wiscosin University, Wiscosin Press, U.S.A.

**Robart, R. J.** (ed.) 1978. Fish Pathology, BallaireTindele London.

**Shunmugam K.** 1922. Fishery Biology and Aquaculture Leo Pathippagam, Madras 83

**Yadav** – Fish and Fisheries, Daya Publishing House, Delhi–110 035.

**Jayaraman, K.C.** The fresh water Fish of Indian Region. Narendra Publication House.1417, Kishab Duti Street, Madivara, Delhi – 110 006.

## M.SC ZOOLOGY

| Year            | Paper Title                      | Sem. | Subject code |
|-----------------|----------------------------------|------|--------------|
| 2018-19 onwards | CORE PAPER IV: ANIMAL PHYSIOLOGY | II   | 18MZO21C     |

### OBJECTIVES

- *To understand the functioning of different organ systems with reference to man/mammals.*
- *To compare the physiological processes of certain systems across the animal kingdom.*
- *To appreciate the chemical foundations of life processes.*

### UNIT I: Homeostasis and Nutrition

Homeostasis – Definition, body fluids and their significance.

Nutrition – Food requirements, Balanced diet and BMR.

Role of enzymes in digestion of carbohydrates, proteins and lipids. Physiology of Absorption.

Importance of Vitamins.

### UNIT II: Circulation and Respiration

Blood – Plasma proteins, Haemopoiesis, Physiology of clotting.

Circulation – Origin and Conduction of heart beat, Cardiac cycle and ECG, Control of heart beat.

Respiration – Physiology of respiration in man and Gaseous exchange.

Transport of Respiratory gases – O<sub>2</sub> Dissociation curve, Bohr's Effect and Hypoxia.

### UNIT III: Excretion and osmoregulation

Excretion – Types of excretory products, Patterns of excretion – Structure of Nephron, Mechanism of Urine formation

Juxta medullary Nephron – Counter- current exchange mechanism.

Juxta glomerular Apparatus – Renin- Angiotensin system.

Osmotic and ionic regulation in fishes and mammals.

### UNIT IV: Myology and Neurophysiology

Myology – Comparative molecular structure and function of skeletal, smooth and cardiac muscles.

Excitation – Contraction coupling of muscles.

Neurophysiology – Basis and significance of membrane potentials, Nerve impulse propagation.

Synaptic Transmission – Types, synaptic potentials and neurotransmitters.

#### **UNIT – V: Photo and Phono Receptors, Thermoregulation and Chronobiology**

Photoreceptors and Physiology of vision.

Phonoreceptors and Physiology of hearing.

Thermal Physiology – Thermoregulation in Homeotherms – Comfort zone – Heat Production, Heat loss, lethal temperature.

Chronobiology – Biological Rhythms – Circadian rhythm and biological clock.

#### **TEXT BOOKS**

**Parameswarn, R., Ananthasubramanian, K.S.** 1989. Outline of Animal Physiology. S. Viswanathan Pvt.

**Hoar, W.S.** 1983. General and comparative physiology. Prentice Hall of India. New Delhi.

#### **REFERENCE BOOKS**

**Harper, H.A. Rodwell, V.N. and Mayes, P.A.,** 1979. Review of physiological chemistry 17<sup>th</sup> edn. Large Medical Publication, Los Atlos, California.

**Prosser, C.L.** 1973. Comparative Animal Physiology. Vol I and Vol II. Saunder Philadelphia.

## M.Sc., ZOOLOGY

| Year            | Paper Title                | Sem. | Subject code |
|-----------------|----------------------------|------|--------------|
| 2018-19 onwards | CORE PAPER V: BIOCHEMISTRY | II   | 18MZO22C     |

### OBJECTIVES:

- *To enlighten the students about the various biological concepts.*
- *To understand the biochemical process and their relation to metabolism.*

### UNIT I-Basic concepts

Scope, atoms, molecules, water.

Chemical bonds of Biomolecules.

pH and acid - base balance.

Buffers -biological importance, acidosis, alkalosis.

### UNIT II -Carbohydrates

Classification and biological significance.

Structure of glucose, fructose, galactose, mannose, ribose, cellulose, starch,

Glycolysis, TCA cycle, HMP shunt pathway.

Glycogenesis, Glycogenolysis, Gluconeogenesis.

Electron transport system and oxidative phosphorylation.

### UNIT III-Proteins

Structure, classification and biological role.

Amino acids - structure, classification and functions.

Deamination, transamination, decarboxylation. ornithine cycle.

Biosynthesis of glutamic acid, phenyl alanine, methionine,histidine

Inborn errors of metabolism.

### UNIT IV-Lipids

Structure, classification and biological significance,

Fatty acids - structure, classification and functions.

Oxidation and biosynthesis of fatty acids, cholesterol.

Biosynthesis and degradation of purines and pyrimidines.

Lipids and Obesity disorders.

## **UNIT V-Enzymes**

Classification, nomenclature and properties.

Enzyme kinetics-Michaelis-Menten theory .

Factors influencing enzyme action..

Enzyme inhibition.

Vitamins as co-enzymes.

Free radicals and anti-oxidants.

## **TEXT BOOKS**

**Lehninger, A.L.** 2004. Principles of Biochemistry. CBS Publishers, New Delhi.

**Rama Rao, A.V.S.S.** 1986. Text Book of Biochemistry. L.K. & S Publishers.

## **REFERENCE BOOKS**

**Ambika, S.**1990. Fundamentals of Biochemistry for Medical Students,

**Deb, A.C.**2004. Fundamentals of biochemistry, New Central Book Agency

**Jain, J. L. Jain, S. and Jain N.** 2005. Fundamental of Biochemistry,

**Oser, B.L,** 1965. Hawk's Physiological Biochemistry, McGraw Hill Book.

**Robert Harper's** Biochemistry, 1996. 24th Edition,

**Vasudevan, D.M. and Sreekumar. S.** 2000. Text of Biochemistry for Medical students.

**Jaypee Brothers,** Medical Publishers (P) Ltd. New Delhi.

**Veerakumari** 2002. Biochemistry. MJP Publishers, Chennai.



## M.Sc. ZOOLOGY

| Year            | Paper Title                               | Sem. | Subject code |
|-----------------|---|------|--------------|
| 2018-19 onwards | CORE PAPER VI: CELL AND MOLECULAR BIOLOGY | II   | 18MZO23C     |

### OBJECTIVES

- To obtain an insight into the architecture and function of the cell organelles at the molecular level.
- To understand the structure and mechanisms that facilitate the constant engagement of the cell with its environment.
- To understand how the construction and regulation of genetic materials ensures the accurate copy, repair and interpretation of genomic information.

### UNIT - I: Cell Organization

**Plasma Membrane** – Structure – Bilayer Model (Fluid Mosaic Model), Micellar Model.

– Chemical Composition–Membrane Lipids, Membrane Carbohydrates, Membrane Proteins.

-- Movement of substances across cell membrane.

**Cytoskeleton** – Microtubules, Microfilaments, Intermediate Filaments – Structure and Function.

**Endoplasmic Reticulum** – Ultrastructure – SER, RER, Functions, Protein import.

**Ribosomes** – Structure and Function.

### UNIT - II: Cell Organization

**Golgi complex** – Ultrastructure, Polarisation (*cis* – *trans*), Compartmentalization, Chemical Composition, Functions.

**Mitochondria** – Structure– Mitochondrial membranes and Mitochondrial Matrix.

–Functions – Electron Transport System – Organization, Mechanism, Inhibitors. Electron Carriers. Oxidative Phosphorylation – Mechanism, Inhibitors, Translocation of ADP and ATP.

**Peroxisome** – Morphology and Function.

**Lysosome** – Morphology, Constituent Enzymes, Function.

### UNIT - III: Cell and its Environment

**Cell – Cell Signaling** – Signal transduction pathway (by GPCRs).

**Cell – Cell Adhesion** – Ca<sup>++</sup> - dependent and Ca<sup>++</sup> independent homophilic adhesions, Selectins.

- Cell – Junctions* – Occluding, Anchoring and Communicating Junctions.
- Cell Matrix Adhesion* – Focal adhesions, Hemidesmosomes and Integrins.
- Apoptosis* – Extrinsic pathway, Intrinsic pathway.
- Cancer Biology* – Genetics of Cancer - Oncogenes and Tumor suppressor genes.

#### **UNIT – IV: Genetic Organization and Mechanisms**

- DNA – Structure* (Watson – Crick model), Conformations (Z, A and B forms).
- DNA – Topology* – Supercoiling, Topoisomerases I & II.
- RNA – Structure* of mRNA, tRNA and rRNA.
- DNA – Replication* -Semi conservative mode.
- DNA – Repair* (Nucleotide excision repair, Base excision repair, Mismatch repair).

#### **UNIT – V: Genetic Mechanisms**

- Transcription in Prokaryotes* – Initiation - Recognition, Binding, Elongation and Termination.
- Transcription in Eukaryotes* – Promoters, Initiation with Polymerase I, II, III, Elongation, and Termination.
- Post – Transcriptional modifications in mRNA* – Mechanism - Capping, Splicing.
- Translation*
- Protein Folding* – Chaperone-mediated, Abnormal folding - CJD disease.
- Regulation of Gene Expression* – In Prokaryotes, In Eukaryotes.

#### **TEXT BOOKS**

- Verma P.S and V. K. Agarwal. 2016. Cell Biology. S. Chand & Co.
- Ajoy Paul, 2011. Textbook of Cell and Molecular Biology; 3<sup>rd</sup> Edition ; Books & Allied (P) Ltd. Kolkata.

#### **REFERENCE BOOKS**

- Bruce Alberts, A. Johnson, J. Lewis, d. morgan, M. Raff, K. Roberts and P. Walter (Eds.) 2014. Molecular Biology of the Cell, 5<sup>th</sup> Ed. Garland Science, new York.
- Harvey L, Arnold B, Chris. A K, Monty K, Anthony B, Hidde P, Angelika A and Kesley. C. M. 2016. Molecular Cell Biology 8<sup>th</sup> edition. Macmillan Learning.
- Gerald Karp, Cell and Molecular Biology; 5<sup>th</sup> Edition (2008); John Wiley & Sons (Asia) Pvt. Ltd.

## M.Sc. ZOOLOGY

| Year            | Paper Title   | Sem. | Subject code |
|-----------------|---|------|--------------|
| 2018-19 onwards | ELECTIVE PAPER II:<br>BIostatistics, BIOTECHNIQUES AND BIOPHYSICS | II   | 18MZO24E     |

### OBJECTIVES

- *To develop sorting, analytical, critical thinking and problem solving skills in data handling.*
- *To introduce the tools and techniques available for the study of the study of the biochemical and biophysical attributes of life.*

### BIostatistics

#### UNIT I: Data Collection, Sampling, Measures of Central tendency and Dispersion

Collection of data- Primary and secondary

Diagrammatic and Graphic representation of data

Tabulation of data, frequency distribution

Sampling distributions – difference between parametric and non-parametric

Measures of Central tendencies

Measures of dispersion – co-efficient of variation – standard error of sample and populations.

#### UNIT II: Probability and Tests of significance

Probability (Binomial, Poisson and Normal)

Correlation and regression

Test of significance – student's 't' test of samples – confidence limits

Analysis of variance (ANOVA), Chi-square test

DMRT, Multivariate statistics

### BIOTECHNIQUES

#### UNIT III: Molecules Detection, Quantification and Electrophoresis

ELISA, RIA, WESTERN BLOT

Detection of Molecules in Living cells, in situ – FISH and GISH

Principles and application of electrophoresis – paper and Gel (PAGE and SDS - PAGE)

#### UNIT IV: Microscopy, EMR and Biosensors

Microscopy – Phase contrast microscope - Electron microscope

Characteristics of Electromagnetic radiation – biological applications of X-rays, UV rays and lasers.

Biosensors.

## **BIOPHYSICS**

### **UNIT V: Bioinstrumentation**

Colorimetry, spectrophotometry- different types of mass spectrometry, UV visible and fluorescence flame photometry and GC-MS in biology – principles, applications and types

pH meter and their application in biology, construction of glass and calomel electrode  
NMR and ESR

Flow cytometry, X-ray diffraction and NMR

### **TEXT BOOKS**

**Gupta, C.B.** 1976. An introduction to statistics method. Vikas publishing. New Delhi.

**Jayaraman, J.** 197. Techniques in Biochemistry IBH, Oxford.

### **REFERENCE BOOKS**

**Gupta, S.P.** 1976. Statistical method. Sultan Chand and Sons, New delhi

**Bailey, N.J.** 1965. Statistic for Biological Sciences. Addition Wesley

**Campbell, R.D.** 1967. Statistics of biologist. Cambridge Uni.press

**Palanichamy, S and Manohar,** Statistics for Biologist, Palani Paramount Publications, Palani, Tamilnadu

**Vogal,** Inorganic Analysis, instrumental methods of analysis. Elbs

**Varley,** Practical clinical biochemistry, Ed. Alan H.Gowen Lock., Neinemann Medical Brooks.

**Smith, I, Seakins, J.W.J Eds.** 1976, Chromatographic and Electrophoretic Techniques Vol.1, William Heinemann Medical Books.

**.Palanichamy S and Shunmugavelu M.** Principles of Biophysics, 2002

## M.Sc. ZOOLOGY

| Year            | Paper Title      | Sem.   | Subject code |
|-----------------|------------------|--------|--------------|
| 2018-19 onwards | CORE PRACTICAL I | I & II | 18MZO25P     |

(Includes Paper I: Biosystematics, Animal Diversity and Animal Phylogeny, Paper II: Environmental Biology, Paper III: Genetics & Elective Paper I: Fishery Science)

### ANIMAL PHYLOGENY

Spotters limited to animal diversity and fossils.

### ENVIRONMENTAL BIOLOGY

- a. Determination of
  - i) Phosphate,
  - ii) Silicate,
  - iii) Nitrate,
  - iv) Nitrite ,
  - v) Calcium ,
  - vi) Iron in water samples
- b. Plankton collection and identification – quantitative and qualitative estimation of planktons.
- c. Study of Soil Fauna.
- d. Study of adaptive features in Amphibia, Reptiles, Aves and Mammalia.
- e. Animal association – i) Parasitism,ii) Mutualism.

### GENETICS

Culture of *Drosophila* sex identification, identification of mutants.

Mountings of Salivary glands of Chironomous larva.

Isolation of DNA from squamous epithelial cells.

Pedigree analysis.

Human karyotyping and chromosomal abnormalities.

Identification of Sex chromatin – Barr body.

### FISHERY SCIENCE

Identification of marine, brackish and inland fishes.

Morphometric and meristic characters of fish.

Analysis of gut contents.

Length - weight relationship in freshwater fish and marine fish- calculation 'K'  
(Condition Factor).

Study of fish blood (RBC, WBC, Hb).

Study of scales by temporary mounting.

Dissection of digestive system in relation to feeding habit.

Induced breeding techniques- Demonstration only.

## M.SC. ZOOLOGY

| Year            | Paper Title       | Sem.   | Subject code |
|-----------------|-------------------|--------|--------------|
| 2018-19 onwards | CORE PRACTICAL II | I & II | 18MZO26P     |

(Includes Paper IV: Animal Physiology, Paper V: Biochemistry, Paper VI: Cell & Molecular Biology and Elective Paper II: Biostatistics, Biotechniques and Biophysics)

### Animal Physiology:

- Osmoregulation by weight change of crab.
- Counting of blood cells – RBC, WBC, TC and DLC.
- Determination of Bleeding time and clotting time.
- Influence of temperature on oxygen consumption of fish.
- Identification of nitrogenous excretory products.
- Determination of ammonia excreted by fish.
- Determination of Na<sup>+</sup> and Cl<sup>-</sup> ions loss and gain in a freshwater fish.

### Biochemistry:

- Preparation of haemin crystals.
- Quantitative estimation of the following in blood samples.
  - Glucose
  - Urea
  - Cholesterol
  - Haemoglobin
  - SGOT
  - SGPT
- Quantitative estimation of glucose in urine.
- Quantitative estimation of tissue protein.
- Quantitative estimation of tissue carbohydrate.
- Quantitative estimation of tissue lipids.

### Cell & Molecular Biology - Spotters

- Dounce homogenizer
- Chromatography – HPLC
- Autoradiography

- d. Electrophoresis – SDS PAGE
- e. ELISA
- f. X-Ray Crystallography
- g. NMR
- h. Surface Plasmon Resonance (SPR)

**Biostatistics:**

Collection of data and construction of frequency distribution.

Diagrammatic representation.

Arithmetic mean.

Mean deviation.

Standard deviation and variance.

Co-efficient of variation.

Student's 't' test.

Chi-square test.

**Biotechniques: Demonstration only**

Electrophoretic separation of serum proteins.

Chromatography – 2 dimensional chromatography.

Paper Chromatography.

**Biophysics:**

Microphotography.



## M.Sc. ZOOLOGY

| Year            | Paper Title                           | Sem. | Subject code |
|-----------------|---------------------------------------|------|--------------|
| 2018-19 onwards | CORE PAPER VII: DEVELOPMENTAL BIOLOGY | III  | 18MZO31C     |

### OBJECTIVES

- To understand the basic concepts of Development Biology with reference to man.
- To study the experimental aspects of Developmental Biology.
- To acquire an in depth knowledge of the relationship between genes and development, environment and development.
- To appreciate the contribution of the subject to human welfare.

### UNIT I: Gametogenesis and Fertilization

Primordial Germ Cell (PGC) – Determination and Migration – in insects (*Drosophila*) and mammals.

Spermatogenesis in mammals.

Oogenesis in mammals.

External fertilization in Sea urchin.

Internal fertilization in mammals.

### UNIT II: Cleavage and Gastrulation

Patterns of embryonic cleavage.

Cleavage and blastula formation – *Caenorhabditis elegans*, amphibia and birds.

Gastrula -Morphogenetic movements.

Gastrulation and specification of germ layers- in *Caenorhabditis elegans*, amphibia and birds.

Axis and pattern formation – *Drosophila*, amphibia and birds.

### UNIT III: Tissue differentiation and Organogenesis

Neurulation and the formation of neurula.

The primary differentiation of mesoderm and endoderm.

The ectodermal derivation in Vertebrates – Development of the brain and differentiation of neurons.

The mesodermal derivatives in Vertebrates – Development of limbs.

The endodermal derivatives in Vertebrates – Development of the alimentary canal and its accessory organs.

#### **UNIT IV: Concepts**

Genomic equivalence – Concept and evidence (Cloning of sheep).

Genomic imprinting and DNA methylation.

Induction and Competence- Induction of lens in amphibians, Induction of vulva in *C. elegans*.

Levels of cell commitment – Specification (Autonomous conditional – Morphogen gradients, Syncytial), Determination and Differentiation.

Fate map (amphibia) and cell lineage.

#### **UNIT V: Ecology and Human Welfare**

Ecological regulation of development – Life cycle of *Dictyostelium discoideum*.

Ieratogenesis in human development – environmental and genetic.

Twins and chimeras.

Assisted reproductive technology (ART) in man – Artificial insemination (AI), *in vitro* Fertilization (IVF), Embryo Transfer (ET), Gamete Intra-fallopian Transfer (GIFT) and Zygote Intra-fallopian Transfer (ZIFT).

Cryopreservation of gametes and embryos.

#### **TEXT BOOKS:**

**P.S. Verma and V.K. Agarwal**, 2014. Chordate Embryology. S. Chand & Co.

**B.I. Balinsky**, 2012. An Introduction to Embryology. Centage Learning, India.

#### **REFERENCE BOOKS:**

**Scott F. Gilbert**, 2014. Developmental Biology, Tenth Edition, Sinauer Associates, Inc.

**Richard M. Twyman**, 2001. Instant Notes, Developmental Biology. BIOS Scientific.

**N.J. Berrill**, 1971. Developmental Biology. McGraw Hill Inc., USA.

| Year            | Paper Title                 | Sem. | Subject code |
|-----------------|-----------------------------|------|--------------|
| 2018-19 onwards | CORE PAPER VIII: IMMUNOLOGY | III  | 18MZO32C     |

### M. Sc. ZOOLOGY

#### OBJECTIVES

- *To understand the immune system with respect to origin, development and structure.*
- *To comprehensively study the cells and effector molecules of the immune system.*
- *To understand the underlying complexities and mechanisms of different immune reactions.*
- *To appreciate the clinical manifestations of immunological disorders.*
- *To study the techniques that are integral to immunological studies.*

#### UNIT I: Overview Of Immunology

Host parasite relationships. Microbial infections, virulence and host resistance.

Immunity - Innate immunity, Acquired immunity.

Structure, composition and functions of cells and organs involved in the immune system.

#### UNIT II: Antigens and Antibodies

Antigen Types, properties, Haptens, Adjuvants – vaccine types. Toxoids - antitoxins.

Immunoglobulin- structure, types and properties. Theories of antibody production.

Complement system- structure, properties, function of complement component and pathways.

#### UNIT III: Antigen and Antibody Reactions

*In vitro* methods - Agglutination, precipitation, complement fixation.

Immunofluorescence,

ELISA and RIA.

*In-vivo* methods - Skin tests, immune complex tissue demonstrations.

#### UNIT IV: Hypersensitivity reactions

Type I, II, III and IV hypersensitivity reactions.

B and T lymphocytes, maturation and selection of T and B cells, T cell and B cell interaction, Memory cells, Immune expression, Cytokines.

#### UNIT V: Transplantation immunology

Graft versus host reaction. Structure and function of Class I and Class II MHC molecules.

Major Histocompatibility Complex.

Tumour immunology. Immunodeficiency and Auto immune diseases.

**TEXTBOOKS:**

**S.S. Lal and S. Kumar**, 2015. Immunology. Rastogi Publications.

**FahimHalim Khan**, 2009. Elements of Immunology .Pearson Education.

**REFERENCE BOOKS:**

**Thomas J. Kindt and Barbara A. Osborne**, 2006. Kuby Immunology, 6<sup>th</sup> Edition.  
W.H. freeman & Co., New York.

**Peter J. Delves and Seamus J. Martin**, 2011. Roitt's Essential Immunology, 12<sup>th</sup>  
Edition. Wiley-Blackwell.

**Abul K. Abbas, Andrew H.H. Lichtman and Shiv Pillai**, 2017. Cellular and Molecular  
Immunology. Elsevier.

**Robert M. Coleman, Mary F. Lombard and Raymond F. Sicard**, 1992. Fundamental  
Immunology. Wm C Brown.

**Ian R. Tizard**, 1988. Immunology: An Introduction. Saunders College Publishing.

## M.Sc. ZOOLOGY

| Year            | Paper Title                          | Sem. | Subject code |
|-----------------|--------------------------------------|------|--------------|
| 2018-19 onwards | CORE PAPER IX: GENERAL ENDOCRINOLOGY | III  | 18MZO33C     |

### OBJECTIVES

- *To understand the significance of the integration of the neural and endocrine systems in Invertebrates.*
- *To obtain a comparative understanding of the origin and organization of the various endocrine glands across the Vertebrate Kingdom.*

### UNIT I: Invertebrate Endocrinology

Concept of neurosecretions.

Endocrine control of growth and reproduction in Annelids.

Endocrine mechanisms in Mollusca.

Endocrine control of moulting and metamorphosis in Crustaceans.

Neuroendocrine system in insects – moulting, metamorphosis and diapause.

### UNIT II: Hypothalamus, Pituitary and Pineal

Hypothalamic control of endocrine function.

Origin and structure of pituitary gland

Comparative anatomy of pituitary gland in fishes, amphibians, reptiles, birds and mammals.

Origin and structure of pineal gland

### UNIT III: Thyroid, Parathyroid and Ultimobranchial gland

Origin and Structure of thyroid gland

Comparative anatomy of thyroid gland in fishes, amphibians, reptiles, birds and mammals.

Origin and Structure of parathyroid gland.

Structure and biological significance of ultimobranchial gland.

### UNIT IV: Adrenal, Thymus and Islets of Langerhans

Origin and Structure of adrenal gland

Comparative anatomy of adrenal gland in fishes, amphibians, reptiles, birds and mammals.

Structure and biological significance of thymus gland.

Ultrastructure of Islets of Langerhans

**UNIT V: Testis, Ovary and Accessory Sex Organs**

Origin and Structure of testis in man.

Origin and Structure of ovary in man.

Structure of accessory sex organs - male and female.

Placenta.

**TEXT BOOKS:**

**A. Gorbman and H.A. Bern, 1962.** A Textbook of Comparative Endocrinology. Wiley, New York.

**K.V. Sastry, 2005.** Endocrinology and Reproductive Biology. Rastogi Publications.

**REFERENCE BOOKS:**

**K.C. Highnam and Leonard Hill** , 1977. Comparative Endocrinology of the Invertebrates. Edward Arnold.

**Chester-Jones I., P.M. Ingleton and J.G. Phillips** (Eds.), 1987. Fundamentals of Comparative Vertebrate Endocrinology. Springer.

**Peter J. Bentley**, 1998. Comparative Vertebrate Endocrinology. Cambridge University Press.

**U.S. von Euler and H. Heller** (Eds.), 1963. Comparative Endocrinology, Vol. I & II. Academic Press, London.

## M. Sc. ZOOLOGY

| Year            | Paper Title                            | Sem. | Subject code |
|-----------------|--|------|--------------|
| 2018-19 onwards | ELECTIVE PAPER III: GENERAL ENTOMOLOGY | III  | 18MZO34E     |

### OBJECTIVES

- *To appreciate the diversity of the Class Insecta and the scope of Entomology.*
- *To study the organization of the external structures that are characteristic of insects.*
- *To study the structure and function of the different systems.*

### UNIT I: Insect Classification, Collection and Preservation

Scope and branches of Entomology.

Methods of insect collection and preservation.

Outline classification of class Insecta up to order level.

Salient features with suitable examples of the following insect orders:Thysanura,

Odonata, Orthoptera, Coleoptera, Lepidoptera, Hymenoptera, Diptera.

### UNIT II: Morphology of Insects

Head – pre- and post- antennal appendages, antennae, mandibles, superlinguae, maxillae and labium.

Thorax - Structure of thorax - prothorax, pterothorax and thoracic muscles.

Thoracic Legs - Structure and mechanism of legs.

Wings- Structure of wings, wing movement and insect flight.

Abdomen - Structure of abdominal segments, musculature..

### UNIT III: Physiology of Insects

Digestive system - Structure and modification of gut, digestive enzymes, physiology of digestion.

Respiratory system - Structure of trachea, spiracles, air sacs, aquatic respiration.

Circulatory System – Organs of circulation, haemolymph, haemocytes and their functions.

Excretory System - Excretory organs, water regulation.

### UNIT IV: Muscular, Nervous and Endocrine systems

Muscular System - Skeletal muscles, visceral muscles, energetics of muscle contraction.

Nervous System – Structure and function of central nervous system,.

Sense Organs - Compound eyes, mechanoreceptors, chemoreceptors.

Endocrine glands and pheromone in insects.

#### **UNIT V: Reproduction and Metamorphosis**

Reproductive system – External genitalia - Reproductive organs in male insect.

Reproductive organs in female insect, types of ovaries, ovipositor and eggs.

Metamorphosis in insects.

#### **TEXTBOOKS:**

[B.V. David and T. Ananthkrishnan, 2004.](#) General and Applied Entomology. McGraw Hill Education.

**M. S. Mani**, 1982. General Entomology. Oxford & IBH Publishing Co.

#### **REFERENCE BOOKS:**

**R.F. Chapman**, 1998. The Insects: Structure and Function. Cambridge University Press.

[O.W. Richards and R.G. Davies, 2014.](#) Imms' General Textbook of Entomology. Springer.

**Franz Englemann**, 1970. The Physiology of Insect Reproduction. Pergamon.

**Robert E. Snodgrass**, 1935. Principles of Insect Morphology. McGraw Hill Book Co. Inc.

**Vincent B. Wigglesworth**, 1972. The Principles of Insect Physiology. Springer Netherlands.



## M.Sc. ZOOLOGY

| Year            | Paper Title                | Sem. | Subject code |
|-----------------|----------------------------|------|--------------|
| 2018-19 onwards | CORE PAPER X: MICROBIOLOGY | IV   | 18MZO41C     |

### OBJECTIVES

- *To appreciate the diversity and importance of the microbial kingdom.*
- *To understand the importance of the microorganisms that inhabit soil and water.*
- *To study the contribution of microbes in the fields of Food and Dairy Technology, Medicine, Industry and Agriculture.*

### UNIT I: Scope Of Microbiology, Classification, Fungi and Viruses

Scope of microbiology – Classification of microbes – Five kingdom concept.

Yeasts, Fungi and Viruses – Characteristics - Structure - Diseases caused - Economic importance.

Bacteriophages – Multiplication – Life cycle.

### UNIT II: Bacteria, Bacterial Growth and Control of Microbes

Bacteria – Classification – Structure – Reproduction – Economic importance.

Bacterial growth – Growth rate – Generation time – Growth curve – Culture techniques.

Control of microbes – Sterilization – Disinfection – Chemotherapy – Antisepsis – Mode of action of antimicrobial agents.

### UNIT III: Soil and Aquatic Microbiology

Soil microbiology – Soil microbes – Nitrogen fixation – *nif* genes – CO<sub>2</sub> fixation and regeneration – degradation of cellulose and lignin – Syntrophism – Soil improvement.

Microorganisms in sulfur, phosphorus and iron cycles.

Aquatic microbiology – Aquatic pollution and sources – Aquatic microbes – Importance – Microbiology of domestic and waste water – Purification methods – Waste water treatment – Water quality testing.

### UNIT IV: Food, Dairy and Medical Microbiology

Food microbiology – Food microbes and sources – Examination – Food spoilage – Food poisoning – Prevention of food poisoning – Food preservation.

Dairy microbiology – Microorganisms – Bacteriological examination – Milk borne diseases – Milk preservation – Pasteurization – Sterilization – Dehydration.

Medical microbiology – Normal microflora of human body – Pathogenesis, virulence, infection and epidemiology of Diphtheria, Tuberculosis, Cholera, Typhoid, Syphilis and Leprosy.

#### **UNIT V: Industrial and Agricultural Microbiology**

Industrial microbiology – Industrial microbes – Fermentation technology – Vinegar – Production of Lactic acid – Amino acids – Hormones – Antibiotics - Vaccines.

Agricultural microbiology – Microbes in soil formation and fertility – Biofertilizers – Rhizobium – Azotobacter – BGA – VAM fungi – Azolla – Biopesticides – Silage.

#### **TEXTBOOKS:**

**Ananthanarayan R. and C.K. JayaramPaniker**, 2009. Textbook of Microbiology, 8<sup>th</sup> Edition. Universities Press.

**Dubey R.C. and D.K. Maheswari**, 2004. Textbook of Microbiology. S. Chand & Co. Ltd., New Delhi.

[P.D. Sharma, 2010.](#) Microbiology. Rastogi Publications.

#### **REFERENCE BOOKS:**

[Bob A. Freeman and William Burrows](#), 1979. Burrows Textbook of Microbiology. Saunders.

**Michael J. Pelczar Jr.**, 1977. Microbiology, 5<sup>th</sup> Edition. E.C.S. Chan & Noel R. Krieg (Eds.). Tata Mc Graw-Hill Education Pvt. Ltd.

**Gerard J. Tortora, Berdell R. Funke and Christine L. Case**, 2016. Microbiology, 11<sup>th</sup> Edition. Pearson Education India.

[Cappuccino, 2014.](#) Microbiology: A Laboratory Manual, 10<sup>th</sup> Edition. Pearson Education India.

## M.Sc. ZOOLOGY

| Year            | Paper Title  | Sem. | Subject code |
|-----------------|--|------|--------------|
| 2018-19 onwards | CORE PAPER XI: BIOTECHNOLOGY AND GENETIC ENGINEERING | IV   | 18MZO42C     |

### OBJECTIVES

- *To provide a foundation on the tools and techniques employed in genetic engineering.*
- *To appreciate the contribution of biotechnology in disease diagnosis and advanced therapeutics.*
- *To understand the interface of modern biology and industrial bioprocess technology.*
- *To study the role of biotechnology in environmental protection.*

### UNIT I: Tools and Techniques of Genetic engineering

Enzymes – Restriction endonuclease, DNA ligase, alkaline phosphatase, terminal transferase, Polymerase – Klenow enzyme.

Vectors– Plasmids, bacteriophages, cosmids, artificial chromosome vectors, shuttle vectors.

Host Cells – Prokaryotic cells and eukaryotic cells (advantages and limitations).

Nucleic acid Purification– Cellular DNA, plasmid DNA, mRNA.

Methods of Gene Transfer– Transformation, transduction, electroporation, liposome-mediated gene transfer, microinjection, particle bombardment.

### UNIT II: Techniques in Genetic Engineering

Gene Synthesis – Chemical synthesis (Phosphoramidite method).

Gene Amplification – PCR technique, types and applications.

DNA Sequencing–Sanger Coulson method, chromosome walking.

Gene Libraries – cDNA library.

Site-directed mutagenesis.

### UNIT III: Medical Biotechnology and Animal Biotechnology

DNA in Disease Diagnosis –DNA probes, DNA chip –microarray.

Gene Therapy–*Ex vivo,invivo*, antigene therapy, antisense therapy.

DNA fingerprinting and DNA markers (RFLP, VNTR, STR, SNP).

Tissue engineering and embryonic stem cell engineering.

Pharmaceutical Products – Monoclonal antibodies, recombinant vaccines.

Transgenic Animals – Transgenic mouse.

### UNIT IV: Industrial Biotechnology

Microbial Production of Enzymes – Basic protocol and applications.

Immobilization of Enzymes – Methods and applications.

Biosensors - Types and Applications.

Microbial production of: Organic solvent (ethanol), organic acid (citric acid), antibiotic (Pencillin), amino acid (L – Lysine), vitamin (Vitamin B<sub>12</sub>), fermented food and beverage (cheese, wine).

#### **UNIT V: Environmental Biotechnology**

Bioremediation – Types, recalcitrant xenobiotics, Genetically Engineered

Microorganisms – applications.

Bioremediation of contaminated soil.

Biodegradation of hydrocarbons, pesticides, Polychlorinated Biphenyls (PCBs).

Waste water treatment and solid waste management.

Biotechnology – Risks, Ethics and Patenting.

#### **TEXTBOOKS:**

**Dubey, R.C.**, 2014. A Text book of Biotechnology. S.Chand & Co.

**Sathyanarayana, U.**, 2008. Biotechnology, 1<sup>st</sup> Edition. Books & Allied (P) Ltd., Kolkata.

**S.J. Ignacimuthu**, 2008. Biotechnology: An Introduction. Alpha Science International Ltd.

#### **REFERENCES:**

**S.B. Primrose and R.M Twyman**, 2006. Principles of Gene Manipulation, 7<sup>th</sup> Edition. Blackwell Scientific Publishers, Oxford.

**H.J. Peppler and D. Perlman**, 2004. Microbial Technology. Academic Press.

**Benjamin Lewin**, 1990. Genes-VII. Oxford University Press.

**P.D.Sharma**, 1994. Environmental Biology. Rastogi Publications.

**A.K. Chatterji**, 2002. Introduction to Environmental Biotechnology. Prentice Hall.

## M.Sc. ZOOLOGY

| Year            | Paper Title                      | Sem. | Subject code |
|-----------------|----------------------------------|------|--------------|
| 2018-19 onwards | CORE PAPER XII: ENDOCRINOLOGY II | IV   | 18MZO43C     |

### OBJECTIVES

- *To understand the regulatory mechanisms involved in the secretion of hormones and the mode of action of hormones.*
- *To obtain a thorough understanding of the biological functions of different hormones.*
- *To appreciate the significance of hypo and hyper secretion of endocrine glands.*

### UNIT I: Hormone action & Pituitary hormones

Mechanism of Hormone Action – Peptide and steroid hormone action mechanisms.

Second Messenger Hypothesis – cAMP, cGMP, Ca<sup>++</sup> mediated hormone action.

Neuro-endocrine reflex and feedback regulation.

Biological functions of adenohypophysis and neurohypophysis hormones.

Disorders due to hypo- and hyper- secretion of pituitary hormones and pituitary tumours.

### UNIT II: Thyroid & Parathyroid hormones

Synthesis and biological functions of thyroid hormones.

Disorders due to hypo- and hyper- secretion of thyroid hormones.

Biological functions of parathyroid hormones.

Effects of hypo- and hyper-parathyroidism.

Hormonal regulation of calcium and phosphate homeostasis.

### UNIT III: Adrenal hormones

Synthesis and chemistry of the adrenal cortex and medullary hormones.

Biological functions of cortical and medullary hormones.

Disorders due to hypo- and hyper- secretion of cortical hormones.

Disorders due to hypo- and hyper- secretion of medullary hormones.

Importance of adreno- cortical and medullary hormone interaction in stress.

### UNIT IV: Hormones of Digestion and Prostaglandins

Biological functions of insulin and glucagon.

Disorders due to hypo- and hyper-secretion of insulin and glucagon.

Sources and biological functions of gastro-intestinal hormones – gastrin, secretin, cholecystokinin, leptin and GIP.

Biological functions of prostaglandins.

Hormones and obesity.

#### **UNIT V: Hormones of Reproduction**

Synthesis of steroid hormones.

Biological functions of testosterone.

Disorders due to hypo- and hyper- secretion of testosterone.

Biological functions of oestrogen and progesterone.

Disorders due to hypo- and hyper- secretion of oestrogen and progesterone.

Placental hormones. Biological functions of Prolactin.

#### **TEXT BOOKS:**

**Shlomo Melmed, Kenneth S. Polonsky, P. Reed Larsen, Henry M. Kronenberg**, 2011.

Williams Textbook of Endocrinology. 12<sup>th</sup> Edition. W. Saunders.

**Mala Dharmalingam**, 2010. Textbook of Endocrinology. Jaypee Brothers Medical Publishers.

#### **REFERENCES:**

**David G. Gardner and Dolores M. Shoback**, 2007. Greenspan's Basic and Clinical Endocrinology. McGraw-Hill.

**H. Maurice Goodman**, 2012. Basic Medical Endocrinology. Academic Press, San Diego.

**Constance R. Martin**, 1976. Textbook of Endocrine Physiology. Williams & Wilkins.

**Earl Frieden and Harry Lipner**, 1971. Biochemical Endocrinology of the Vertebrates. Prentice-Hall Inc., New Jersey.

**Alexis Labhart**, 1974. Clinical Endocrinology: Theory and Practice. Springer-Verlag.

## M.Sc. ZOOLOGY

| Year            | Paper Title                           | Sem. | Subject code |
|-----------------|---------------------------------------|------|--------------|
| 2018-19 onwards | ELECTIVE PAPER IV: APPLIED ENTOMOLOGY | IV   | 18MZO44E     |

### OBJECTIVES

- *To study the biology and life cycle of economically beneficial insects.*
- *To understand the significance of insects that are of medical importance.*
- *To understand the biology and economic significance of household and agricultural insect pests.*
- *To appreciate the contribution of biological pest control methods.*

### UNIT I

Biology, Life Cycle and Economic Importance of: Honey bee (*Apis indica*), silk worm (*Bombyx mori*), lac insect (*Tachardia lacca*).

Helpful Insects – Pollinators, soil builders, scavengers, medicinal insects.

### UNIT II

Insect Pests- Definition, kinds of pests, pest outbreak.

Pest surveillance, forecasting and monitoring.

Insect vectors of various diseases like malaria, dengue, chickungunia, filariasis, yellow fever, and their control measures.

Pests of domestic animals - Cattle, fowl, dog.

Household Pests – Cockroach, ants, termites.

### UNIT III

Life history, nature of damage and control measures of any two major pests of:

Paddy, cotton.

Groundnut, coconut.

Brinjal, tomato.

Mango, banana.

Sugarcane, teak.

### UNIT IV

Pest Control Methods - Natural, topographic, climatic, legal methods.

Physical, mechanical, cultural methods.

Chemical control - Organic, inorganic, synthetic insecticides and mode of their action.

Fumigants in pest control.  
Pesticides and the environment.  
Physico-chemical adaptations in insects.

#### **UNIT V**

Biological Pest Control- Parasites, parasitoids, pathogens, predators.  
Insect Attractants, repellants, chemosterilants, antifeedants.  
Ionizing radiation, Electromagnetic energy, Genetic manipulation in insect control.  
Integrated Pest Management.  
Botanical insecticides - Neem, pyrethrum, nicotine.  
Nano pesticides and nano fertilizer.

#### **TEXTBOOKS:**

[B. Vasantharaj David and V.V. Ramamurthy, 2012.](#) Elements of Economic Entomology. Namrutha Publications.

**K.K. Nayar, T.N. Ananthkrishnan and B. Vasantharaj David**, 1976. General and Applied Entomology. Tata McGraw-Hill.

#### **REFERENCES:**

**Peter G. Fenemore and AlkaPrakash**, 1992. Applied Entomology. Wiley Eastern Limited.

**N.T. Krishnan**, 1993. Economic Entomology. JJ Publications, Madurai.

**Shyamsunderlal Pradhan**, 1969. Insect Pests of Crops. National Book Trust, India.

**Fletcher T. Bainbrigge**, 1914. Some South Indian Insects. Madras: Govt. Press.

**K.S. Subramanian (Ed.)**, 2015. Nanotechnology in Agriculture. New India Publishing Agency.



## M.Sc. ZOOLOGY

| Year            | Paper Title        | Sem.     | Subject code |
|-----------------|--------------------|----------|--------------|
| 2018-19 onwards | CORE PRACTICAL III | III & IV | 18MZO45P     |

(Includes Paper VII: Developmental Biology, Paper VIII: Immunology, Paper IX: Endocrinology I, Paper X: Microbiology and Paper XII: Endocrinology II)

### Developmental Biology

Regeneration of tail in amphibian tadpoles.

Vital staining and mounting of chick embryo at various stages.

A study of early stages of chick embryo development (96 hours).

### Immunology and Microbiology

Dissection to expose primary and secondary lymphoid organs of rat / mouse

Micro – measurement of yeast, *Paramecium*, RBC and WBC.

Gram's staining of bacteria.

Hanging drop method to observe live microorganisms.

Identification of bacteria in buccal smear.

Preparation of microbial culture media.

Types of micro-organism: Observation of the structural characteristics and economic importance of bacteria, algae and fungi.

### Endocrinology

Dissection of retro-cerebral complex (neuroendocrine system) in Insects - Cockroach.

Dissection of neurohaemal organ (endocrine system) in crustaceans - Prawn.

Dissection of endocrine system in vertebrates - fish.

Study of histological slides pertaining to mammalian endocrine glands- Pituitary, pineal, thyroid, pancreas, adrenal, testis, ovary.

Study of estrous cycle in rats.

Effect of eye stalk ablation on blood glucose levels in a crustacean.

Effect of thyroxine and thiourea (anti-thyroid agent) on oxygen consumption in fish.

Effect of adrenaline on respiration of fish.

Parabiosis in Insects.

## **Spotters**

Gram's stain

Autoclave

Laminar Air Flow chamber

Inoculation Loop

Inoculation Needle

Western Blot

ELISA

WIDAL kit

VDRL kit

Anti – A, B & D.

## M.Sc. ZOOLOGY

| Year            | Paper Title       | Sem. | Subject code |
|-----------------|-------------------|------|--------------|
| 2018-19 onwards | CORE PRACTICAL IV | IV   | 18MZO46P     |

(Includes Paper XI - Biotechnology and Genetic Engineering, Elective Paper III – General Entomology, and Elective Paper IV – Applied Entomology)

### Biotechnology

Isolation of DNA from rat liver by phenol extraction method.

Study of antigen-antibody reaction - Blood cells precipitation.

### Spotters

PCR

Gel Documentation Unit

Spectrophotometer

Centrifuge – ultra centrifuge

### Entomology

Identification of the following insect orders and their families using dichotomous keys:

Apterygota

Orthoptera

Lepidoptera

Coleoptera

Hemiptera

Diptera

Hymenoptera

Odonata

Dissections of common South Indian insects of the orders mentioned above (one or two representatives from each order):

Digestive system

Nervous system

Reproductive system

### Mountings

Mouth parts – Honey bee, bed bug, mosquito, house fly, cockroach.

Ovaries – Grasshopper and cockroach.

**Physiology**

- Qualitative study of digestive enzymes of an insect.
- Study of haemocytes in the haemolymph of cockroach.
- Qualitative estimation of protein in the haemolymph of an insect.
- Qualitative estimation of carbohydrate in the haemolymph of an insect.
- Qualitative estimation of fat in the haemolymph of an insect.
- Studies of different types of damage caused by insect pests.
- Periodic field collection, preservation and identification of insects.
- Slide preparation – minimum of 10 permanent mount slides.

**Submissions**

- Tour report
- Insect collection – Insect pests and damaged material.
- Slides – 10 nos. (Permanent mount).