

**a. Syllabus****M.Sc. ZOOLOGY****SEMESTER I****Core - ANIMAL DIVERSITY**

5 credits

**UNIT I:**

Broad classification of Animal Kingdom

Principles of Taxonomy: Nomenclature: Binomial, Trinomial nomenclature.

Suffix as for super family name (oidea), family name (idea). Use of suffixes 'T' 'Orum' 'ae' 'arum' 'iensis'.

Tautonyms, Synonyms, and Homonyms.

New trends in taxonomy: Ecological approach, Ethological approach, Cytological approach, Biochemical approach, Numerical Taxonomy and Phylocode.

Taxonomic keys: Indented, simple non - Bracket Grouped type, combination, Pictorial, Branching type, Circular and Box - type.

**UNIT II:**

Protozoa:

Polymorphism in Protozoa, Reproduction and feeding in Protozoa.

Origin and evolution of Metazoa - theories.

Porifera:

1. Interrelationship between different classes.

2. Phylum - Mesozoa.

Coelenterata:

Polymorphism in Coelenterates.

Ctenophora:

Structural peculiarities and affinities.

**UNIT III:**

**ORIGIN OF BILATERIA:**

Origin and evolution trends in coelom formation.

Theories on origin of metamerism.

Platyhelminthus: Functional morphology and adaptive biology for parasitic mode of life.

Annelida: Interrelationship between classes of annelida.

Phylogeny of Arthropoda Mollusca and Echinodermata.

#### **UNIT IV:**

##### **MINOR PHYLA:**

Structural peculiarities and affinities of:

Gastrotricha, Rotifera, Entoprocta, Phoronida, Ectoprocta and Branchiopoda.

#### **UNIT V:**

Prochordate phylogeny

Ostracoderms: Evolutionary position of the Ostracoderms.

Placoderms: Origin of jaws - Placoderms as ancient 'experiments' in the evolution of the jawed vertebrates.

Chondrichthyes: Tendencies in Elasmobranch evolution.

Actinopterygii: Origin and evolution, Adaptive radiation of bony fishes.

#### **UNIT VI:**

Amphibia: Evolution of Amphibia. Adaptive radiation in Amphibia.

Reptilia: Evolution of Reptilia. – Adaptive radiation of Reptiles.

Aves: Birds as glorified reptiles, Adaptive radiation in birds.

Mammals: Evolution of Mammals, Adaptive radiation in Mammal.

#### **UNIT VII:**

Comparative anatomy:

Origin and evolution of paired fins and limbs. Urinogenital system, heart and aortic arches and brain of vertebrates. Jaw suspension in vertebrates. Origin and evolution of middle ear and inner ear, Ear ossicles.

#### **REFERENCE / BOOKS**

1. Barnes R. D. (1982) Invertebrates Zoology 6th endn. Toppan International Co.,
2. Hyman L.H. (1940 - 1959). The Invertebrata, Vol. I to VI.
3. Carter, G. S. A. (1946) General Zoology of Invertebrates 2nd endn. (Wick and Jackson Ltd., London).
4. Borrardile, L.A. (1955) The Invertebrata.2nd endn. Cambridge University Press.

5. Barrington, E. J. W. (1969) Invertebrate Structure and functions. English Language. Book Society.
6. Kotpal, R.L. (1982) Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publications.
7. Moore, R. C. Lalicker, C. G. and Fisher, A. G. (1952) Invertebrate Fossils, Mc. Graw Hill Book Co., New York.
8. Gardinar, M. S. (1972) Biology of the invertebrates, Mc Graw Hill Book Co., New York.
9. Waterman, AJ. (1971) Chordate Structure and Function. Macmillan Co. London.
10. Jolie, M. (1968) Chordate Morphology. East West Press.
11. Romer, A.S. (1976) Vertebrate Body.
12. Young, J.Z. (1950) Life of Vertebrates. Clarendon Press Oxford.
13. Colbert, E.H. (1955) Evolution of the Vertebrates. John Wiley and Sons Inc. New York.
14. Kotpal, R. L. The Birds. Rastogi Publications.
15. Hobart M. Smith. Evolution of Chordate structure, Holt, Rinehart and Winston. Inc. New York.
16. Halstead, L.B. (1969). The Pattern of Vertebrate Evolution. Freeman and Co. San Francisco. U. S. A.
17. Kapoor, V.C. (1991) Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.

### **Core - CELL AND MOLECULAR BIOLOGY**

4 credits

#### **UNIT I: CELL STRUCTURE**

Structure of eukaryotic cell - Animal cell.

#### **UNIT II: STRUCTURE AND FUNCTIONS OF CELL ORGANELLES**

Plasma membrane: Composition and structure - Membrane associated receptors - Membrane transport - Membrane Potentials - Extracellular space - Cell adhesion Intracellular recognition - Intercellular junctions.

Lysosomes - Peroxisomes.

Mitochondria - energetics - Control of cellular .respiration - Biogenesis and mitochondrial replication.

**UNIT III: NUCLEI**

Nuclear - cytoplasmic Interactions.

Structure and function of Chromatin - Organization of Nucleosomes Euchromatin and heterochromatin - Unusual chromosomes (Polytene and lampbrush) - Mechanism of Chromosome formation.

Nuclear transplantation - Cell fusion: homokaryons and heterokaryons Cytoplasts and Karyoplasts.

**UNIT IV: CELL DIVISION AND CELL CYCLE**

Cell cycles- its components G<sub>0</sub> - G<sub>1</sub> transition - Spindle organization

Chromosome movements - Regulation of cell division in normal and malignant cell synchronization of cell division.

Cancer cell: Differences between normal and cancer cell - Membrane and biochemical changes in cancer cell - Nuclear and chromosome changes - Tumor Viruses - Oncogenes - Environmental factors inducing cancer - Hormones in relation to cancer - Characteristics of cancer cells. Theories of carcinogenesis

**UNIT V: INFORMATION TRANSFER**

Information transfer in Prokaryotes; Information transfer in Eukaryotes Transcription - Promoters - Initiators and terminators - Transduction RNA processing - Trimming of introns and splicing of exons.

**REFERENCE/BOOKS**

1. De Robertis, E. D.F. and De Robertis. E. M. F., (1981). Cells and Molecular Biology. Saunder International Edition.
2. Brachet, J. and Mirsky. A. E., (1967). The cell (all volumes). II Edition, Academic Press, New York.
3. Howland, J. L. (1973) Cell Physiology. Mac Millan Publishing Co.
4. De. Witt, (1977). Biology of the cell: An evolutionary approach. Saunders Company.
5. Wilson G. B. and Morrison. J. H., (1967). Cytology. II Edition. Reinhold Publishing Corporation, New York.
6. Avers, C. J., (1976). Cell Biology. D. Can Nostrand Company. New York.
7. Korenberg, A., (1974). DNA replication. W. H. Freeman and Company. San Francisco.

8. Ambrose, E. J; and Dorothy. M. E., (1979) Cell Biology. II edition. The English language. Book Society.
9. Albert. B and Watson. J. D., (1990) Molecular Biology of the Cell. Garland Publishing. London. Darrtell. J., Lodish, H. and Baltimore, D., 1992. Molecular Cell Biology. Scientific American Books.
10. Shanmugam, G., (1988) A Laboratory Manipulation in Fish. Madurai Kamaraj University.

### **Core - GENETICS**

4 Credits

#### **UNIT I:**

1. Molecular structure of DNA and RNA - Replication, Theories, Gene Concept Fine Structure of the gene - one gene one polypeptide concept.
2. Identification of DNA and RNA as the genetic material.
3. Microbial Genetics - Conjugation, transformation and transduction and sexduction.
4. Chromosome mapping in prokaryotes (Virus, . Bacteria) and eukaryotes (Neutospora, Drosophila and Man).

#### **UNIT-II:**

5. Enzyme regulation of gene action. Gene regulation of gene action-Operon concept - Gal and LAC Operon system. Evidence of regulation of gene action.
6. Genes and metabolism. Inborn errors of metabolism in Man

#### **UNIT III:**

7. Sex Determination. Evolution of sex chromosomes Dosage compensation - X inactivation. Geneomic imprinting.
8. Human Genetics - Normal human karyotype - Variations in Karotypes (Autosomal and sex chromosomal structural and numerical) with special Reference/Books to classical syndromes in Man. Principles and methods of pedigree analysis Statistical evaluation. Genetic Counseling - Objectives, ethics and principles. Methods of counseling for point mutation disorders, structural and numerical chromosomal disorders.

#### **UNIT IV:**

9. Genes in Development and differentiation.

Radiation Genetics. Mechanism of chromosomal breakage - physical, chemical and biological factors or agents, Mutagens and mutagenesis and carcinogenesis genetic changes in Neoplasia in man.

10. Population genetics - population and gene pool. Hardy Weinberg Law genetic equilibrium. Calculation of gene frequencies for Autosomal (Complete dominance, incomplete dominance and multiple alleles) and sex linked genes. Factors affecting Hardy Weinberg equilibrium.

**UNIT V:**

11. Genetic engineering - Restrictive enzymes - Recombinant DNA techniques. Applications of Recombinant DNA technology. Present status of genetic engineering.

12. Applied Genetics - Application of genetics in plant and animal breeding. Application of genetics in Crime and Law - DNA fingerprinting. Genetic basis of intelligence. Studies on Twins.

13. Genetics and society: Eugenics, Euphonis, Euthenics and eypsychics.

**REFERENCE / BOOKS:**

1. Watson. J.D. (1980) Molecular Biology of the Gene, W. A. Benjamin and, Company, New York.
2. Sinnot. E. W., Dunn. L. C., Dobzansky, T. H. (1958) Principles of Genetics, McGraw Hill Co., New York.
3. Burns, G. W. (1969). The Science of Genetics, the McMillan Company, New York.
4. Levine, R. P. (1968). The Science, Holt Reinhart & Winston, New York.
5. Ayala, F. J. & Kieger, J. A. Jr. (1980) Modern Genetics, The Benjamin Publishing Co., Inc.
6. Levine, L. (1970) Paper on Genetics, C. V. Mosby Co. St. Louis.
7. Curs Sten (1973) Principle of human genetics, W. H. Freeman and Co.,
8. Markert, C. L. Ed., (1974) Isozymes, Vol. I-IV, Academic Press, New York.
9. Markert, C.L. & Ursprung, (1973) Developmentgenetics, Prentice Hall.
10. Gardner, (1984) Principles of Genetics, 7th edn. Wiley private Limited, New Delhi.

**LAB COURSE I (INVERTEBRATES, CHORDATES, AND LAB COURSE II GENETICS  
& MOLECULAR BIOLOGY OF CELL)**

4 Credits

**INVERTEBRATES:**

**UNIT I:**

1. Identification and study of selected Protozoans and Helminthes of medical importance.
2. Identification and study of sections of certain animals from Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of coelom.
3. Identification and study of larval forms from all major phyla of Invertebrates.
4. Identification and study of types of minor phyla.
5. Identification and study of invertebrate fossils (slides and specimens).

**UNIT II:**

1. Dissection of digestive system of *Grylotalpa*, *Pila*, *Sepia/Loligo*.
2. Dissection of nervous system of Prawn, Crab, *Grylotalpa*, *Pila*, and *Sepia/Loligo*.
3. Dissection of reproductive system of *Grylotalpa* and *Pila*.

**UNIT III:**

1. Mounting of:
  - a) Appendages of Prawn
  - b) Gnathochilarium of Millipede
  - c) Sting of Honey bee.
  - d) Pedicellaria of Sea urchin.
  - e) Aristotle's lantern of Sea urchin.
2. Study of prepared slides of mouth parts of Honey bee, Housefly, Thrips, Mosquito, Bed bug and Butterfly to relate structure and type.

Practical record to be submitted during the University practical examination.

**CHORDATES**

**UNIT I:**

1. Study of the following specimens to bring out their affinities;
  - a) Amphioxus.
  - b) Balanoglossus
  - c) Ascidian

d) Peteromyzon

2. Study of the following specimens with Reference to their adaptive features for their respective modes of life:

a) Echeneis

b) Ichthyophis/Uraeotyphus

c) Hyla

d) Draco

e) Pigeon

f) Bat

3. Study of the following skull types with Reference/Books to jaw suspensions:

a) Fish

b) Frog

c) Calottes

d) Rat/Rabbit

#### **UNIT II:**

1. Dissection and mounting of internal ear of Frog.

2. Dissection and mounting of Weberian ossicles in Cat fish.

3. Dissection of aortic arches in Shark, Teleost, Frog and Calottes.

4. Demonstration of Aortic arches in Rat.

5. Dissection and display of portal system of Shark, Frog and Calottes.

6. Demonstration of portal system of Rat.

7. Dissection and display V<sup>th</sup>, VII<sup>th</sup>, IX<sup>th</sup> and X<sup>th</sup> cranial nerves of Shark and Frog.

8. Dissection and display of sympathetic nervous system of Frog.

9. Dissection and display of urinogenital system of Shark, Frog and Calottes.

10. Demonstration of urinogenital system of Rat. .

#### **GENETICS & MOLECULAR BIOLOGY OF CELL:**

1. Preparation of culture medium. Culture of Drosophila - Methods of maintenance. Sex identification of at least four mutants.

2. Identification of blood groups - A, b, AB, 0 and Rh and reasons for a particular blood group in child.



3. Mounting of salivary glands of *Drosophila* larva or Chironomous larva. Analysis of banding pattern.
4. Localization of Barr body in the Buccal smear - squamous epithelial cells. (Smear to be made and the presence or absence of Barr body to be reported giving reasons).
5. Karyotyping using human metaphase chromosome plates (Giemsa stained) - eye Karyotyping. Identification of syndromes (Down, Klinefelter and Turner) from karyotype photographs showing clinical features of each syndrome case.
6. Problems relating to the application of binominal theorem in population genetics with Reference to P. T. C. Earlobe attachment etc.
7. Observation of simple Mendelian traits in Man - Identification of color blindness using color charts. Population analysis of color blindness - Visit to primary school.

## **SEMESTER II**

### **Core - BIOCHEMISTRY AND BIOPHYSICS**

4 Credits

#### **UNIT I: WATER**

Water - Biological importance, pH and Acid - Base balance. Henderson Hasselbach equation. Buffers - biological importance, Acidosis, Alkalosis.

#### **UNIT II: ENZYMES**

Enzymes - general properties, function, classification, nomenclature. Enzyme kinetics - Factors affecting enzyme action.

#### **UNIT III: BIOENERGETICS CARBOHYDRATE AND LIPIDS AND METABOLISM OF CARBOHYDRATES AND LIPIDS**

Carbohydrate - structure, classification and biological significance.

#### **METABOLISM**

1. Glycogenesis, 2. Glycogenolysis, 3. Gluconeogenesis, 4. Glycolysis, 5. Kreb's cycle 6. Embden – Meyerhof pathway, 7. Hexose mono phosphate shunt.

Bioenergetics - Role of ATP, Biological Oxidation, Respiratory chain and Oxidative phosphorylation.

Lipids - structure and classification. Oxidation of Fatty acids. Energetics. Protein -

structure, classification of Proteins - Deamination, transamination, transmethylation.

#### **UNIT IV: HORMONES & VITAMINS**

General function, Classification - Steroid Hormones, Protein Hormones, Tissue hormones.

Vitamins - Water and Lipid soluble vitamins - structure, classification, sources and deficiency diseases in man.

#### **UNIT V: MICROSCOPY**

Principle and biological application of Light microscope, Electron Microscope, Polarising microscope, Fluorescent microscope, Phase contrast microscope, and X-ray microscope.

#### **UNIT VI: CHROMATOGRAPHY**

Principle and biological application of Chromatography - Paper, TLC, Column Gel filtration, ion-exchange and affinity chromatography.

#### **UNIT VII: PHOTOBIOPHYSICS**

Electromagnetic spectrum - visible and invisible region. Principles involved in Photoelectric colorimetry. Principle of Spectroscopy - UV & IR Spectroscopy in biological investigation. Effects of UV on biological systems.

Effects of radiation on macromolecules. Radioactive isotopes-measurement GM tubes, Liquid scintillation counters. Autoradiography.

#### **REFERENCE/BOOKS**

1. Murray, R. K., Granner, D. K., Maynes, P.A. and Rodwell, V.W. (1998) Harper's Biochemistry. 25th edition. McGraw Hill, New York.
2. Hames, B.D., Hoopa, N. M and Houghton, J. D. (1998) Instant notes in Biochemistry. Viva Books Pvt. Ltd. New Delhi.
3. Jain, J.L. (2001) Fundamentals of Biochemistry. 8, Chandra & CO. Pvt. Ltd. New Delhi.
4. Vasudevan, D.M and Sreekumar. 8. (2000) Text of Biochemistry for medical students. Jaypee Brothers, Medical Publishers (P) Ltd. New Delhi.
5. Rama Rao, A.V. 8.8. (1986)Text of biochemistry. L.K. & 8 Publishers. A. P.
6. Ambika, S. (1990) Fundamentals of Biochemistry for Medical Students. Published by the author.
7. Bose, S. (1982) Elementary Biophysics. Jyoth Books.

8. Bums, D.M. & MacDONald, S. G. G. (1979) Physics for Biology and Premedical students. Elbs and Addisson - Wesley Publishers Ltd., London.
9. Casey, E. J. (1962) Biophysics concepts and Mechanism. Affiliated East –West Press Pvt. Ltd., New Delhi.
10. Das, D. (1982) Biophysics and Biophysical Chemistry. Academic Publishers. New Delhi.
11. Epstein, H. T. (1963) Elementary Biophysics selected topics. Addisson – Wesley Publishing Company Inc London. .
12. Palanichamy, Sand Shanmugavelu, M. (1991) Principles of Biophysics. Palani Paramount Publication, T. N.
13. Pattabhi,V and N. Gautham (2001) Biophysics. Narosa publication, T.N.

### **Core - BIOTECHNOLOGY**

4 credits

#### **UNIT I: INTRODUCTION**

Biotechnology - Definition - Scope and importance - Historical background Global impact of biotechnology - Biotechnology in India - Achievements of biotechnology - Prevention and misuse of biotechnology - Bioinformatics.

#### **UNIT II: RECOMBINATION DNA TECHNOLOGY**

Gene cloning - the basic steps - various types of restriction enzymes - ligases linker and adaptors - DNA - transformation - Selection of recombination - Hybridization techniques - chemical synthesis of oligonucleotides.

Gene probe - molecular finger printing (DNA finger printing) - RFLP - the PCR techniques - Genomic library - Blotting techniques - Southern blotting - Northern & Western blotting. cDNA - Changing genes - Site directed mutagenesis and protein engineering.

#### **UNIT III: GENE CLONING VECTORS**

Plasmid biology - cloning vector based on E. coli PBR 322 and bacteriophage. Cloning vector for yeast. Cloning vector for Agro bacterium tumefaciens. Cloning vector for mammalian cells - Simian Virus 40 - Gene transfer technology - Particle bombardment - Micro injection techniques.

#### **UNIT IV: PLANT BIOTECHNOLOGY**

Plants tissue culture techniques - cell fusion - protoplast fusion - gene for disease resistance - salt tolerant varieties. Transgenic plants- Nitrogen fixation - Transfer of Nif genes to microorganisms - Biofertilizers - Cryobiology. Transposons and its applications.

#### **UNIT V: ANIMAL BIOTECHNOLOGY**

Cell culture - Organ culture - Whole embryo culture - Embryo transfer - In vitro fertilization (IVF) technology - Dolly - In vitro fertilization and embryo transfer in human. Transgenic animal. Human genome project- Human gene therapy.

#### **UNIT VI: MICROBIAL & ENVIRONMENTAL BIOTECHNOLOGY**

Fermentation - bioreactor - microbial products - primary & secondary metabolites antibiotics - enzymes technology - single cell protein (SCP).

Bioremediation - bioremediation of hydrocarbons - Industrial wastes - Heavy metals - Xenobiotics - bioleaching- biomining.

#### **UNIT VII: IMMUNOTECHNOLOGY**

Hybridoma technology - Monoclonal antibodies - Application in biotechnology. Genetically modified organism (GMO's) - GM foods. Biotechnology & biosafety bioethics IPR - IPP - WIPO.

#### **REFERENCE / BOOKS:**

1. Purohit, S. S. and S. K. Mathur, (1999), Biotechnology: Fundamentals and Application. Agro Botanica, New Delhi. ISBN. 81-87167-IO-b.
2. Alan scragg, (1999), Environmental Biotechnology; Long Mann Publication. ISBN. 0582 276829.
3. R. C. Dubey, (2001). A text book of biotechnology, Rajendra Printer. New Delhi. ISBN. 81-219-09 16-3.
4. T.A Brown Gene cloning and DNA analysis. (1996) Blackwell science, Osney Mead, Oxford, OX20EL.
5. Sathyanarayane,U. (2006) Biotechnology Books and Allied (p) Ltd, India.

**Core - ENVIRONMENTAL BIOLOGY & EVOLUTION**

4 Credits

**UNIT I: ECOSYSTEM**

Review of concept of ecosystem - Natural and Man-made ecosystem, with examples. Energy flow - Trophic structure and levels - Pyramids, food chain and food web - ecological efficiencies and productivity and its measurement.

**UNIT II: BIOLOGICAL CYCLES**

Complete and incomplete biogeochemical cycles - sedimentary cycle Recycle pathway of elements - Cycling of non-essential elements and organic nutrients.

**UNIT III: RESOURCES ECOLOGY**

Renewable and non-renewable resources – Animal resources. Conventional and non-conventional energy sources.

**UNIT IV: ENVIRONMENTAL CONSERVATION AND MANAGEMENT**

Principles of conservation - Rain water harvesting - Soil health and fauna - Inputs in agricultural Biosphere reserves - Wildlife conservation and management - biodiversity - Germplasm conservation and cryopreservation.

Environmental pollution and its biological effects. Air, water, soil and noise pollution. Biological indicators and their role in environmental monitoring.

Problems of urbanization - Sewage, soil waste and industrial waste disposal and management.

Social forestry - tribal welfare.

**UNIT V: EVIDENCES**

Evidences: The need for evidences for the fact of evolution Evidences from comparative anatomy, embryology, physiology and biochemistry - visual pigments, haemoglobin, protein sequences in phylogeny and evidences from paleontology.

**UNIT VI: MECHANISM OF EVOLUTION**

Mutationism - Views of De Vries and of R.B.Golschmid; hopeful monsters - Inadequacies of mutationism.

Lamarckism - Life of Lamarck - Lamarckian postulates - Inadequacies of Lamarckism.

Natural selection - Innature and laboratory - Creative aspects of natural selection - Modern understanding of selection, stabilizing and diversity and directional selection.

Adaptation - Nature and types of adaptation - Adaptive trends quantifying adaptation - Batesian and Mullerian mimicry Polymorphism and Evolutions.

The role of polyploidy, isolating mechanism - pre mating, Post mating - problems of the origin of isolating mechanism.

### **UNIT VII: SPECIATION**

Structure of species - clones, peripheral population and peripheral isolates.

Genetics and Ecology of speciations: Mayer's founder principle and genetic evolution in the peripheral isolates - Ecological opportunities for specification.

HUMAN EVOLUTION - Sociobiology: Definition and scope - selfish gene, altruism and kin selection - bioethics.

### **REFERENCE/BOOKS**

1. Odum, E. P. (1983). Basic Ecology, Saunders's College Publishing, New York.
2. Odum, E. P. (1959) System Ecology - An introduction in John Wiley and Son's, New York.
3. Berwer. A. (1988). The Science of Ecology. Saunders's College Publishing.
4. Bandopaghyay, J. (1985) India's. Environment Crisis and response – Natraj Publishers, Dehrappn.
5. Smith, R. L. (1986). Element of Ecology, Harper and Row Publishers, New York.
6. APHA, Soli, J. Archeivala - 1988 - Wastewater treatment for pollution control Second Ed. Tata McGraw hill Publication Company Ltd., New Delhi - ISBN-O-07-463002-4.
7. D. S. Bendall (ed) 1983). Evolution from Molecules to Men. Cambridge University Press.
8. M. Grene (ed) (1983). Dimension of Darwinism. Cambridge University Press.
9. E.C. Minkoff (1984). Evolutionary Biology. Addison-Wesley. London.
10. Montagu (ed) (1980). Sociobiology examined. Oxford University Press.

**LAB COURSE II: BIO CHEMISTRY, BIOPHYSICS, ENVIRONMENTAL BIOLOGY  
AND EVOLUTION.**

4 credits

**BIOCHEMISTRY AND BIOPHYSICS:**

1. Buffer preparation and determination of pH - Demonstration.
2. Enzyme kinetics – any one enzyme (Salivary amylase) Maltose standards, influence of enzyme concentration, time course, pH, Temperature, Substrate concentration – (Lineweaver Burk Plot) on enzyme activity.
3. Qualitative analysis of urine - protein, glucose, ketone and acetone bodies.
4. Chromatography: Determination of amino acid in body fluids and tissue of Frog.
5. Quantitative estimation of glucose, protein, cholesterol, urea and creatinine in the
6. Serum of chick/goat.
7. Principles and application of Spectrophotometry or Colorimetry, Electrophoresis, Centrifuge, Chromatography.

**ENVIRONMENTAL BIOLOGY**

1. Estimation of Aquatic - Primary productivity – Dark and Light bottle.
2. Estimation of Dissolved oxygen, Salinity, Nitrites, Phosphates, Calcium, Silicates and Alkalinity in water samples.
3. Analysis of industrial effluent - TDS, TSS, BOD, (COD - Demonstration).
4. Estimation of Earthworm population - Demonstration.
5. Collection, Isolation and identification of Plankton.
6. Study of sandy, muddy and rocky shore fauna with special Reference to their adaptation to the environment.
7. Animal Association - parasitism, mutualism and commensalisms.
8. Visit to treatment Plants
  - a) Drinking water treatment plant - Kilpauk water works.
  - b) Effluent Treatment - CETP - Pallavaram.
  - c) Sewage treatment - Koyembedu.

**EXTRA DISCIPLINARY - I**  
**BIOSTATISTICS**

3 Credits

**UNIT I: COLLECTION OF DATA**

Definition of statistical population and simple in biological studies.

Variables - qualitative and quantitative; discrete and continuous.

Derived variables - rates, ratios, percentages and indices.

Accuracy and precision of recorded data - implied limits numbers of significant digits - rounding of data.

Units of measurement - abbreviations of common units of measurements expression of very large or small number as an index of ten.

**UNIT II: CLASSIFICATION AND PRESENTATION OF DATA**

Types of classification: Qualitative and quantitative.

Qualitative classification - chronological, geographical etc. and continuous frequently distributions.

Diagrammatic and graphical representations of data - Bar diagrams (simple, multiple and subdivided) - Pie diagram – Cartogram.

Frequency diagram: histograms, frequency polygon and frequency curve line graphs.

**UNIT III: DESCRIPTIVE STATISTICS**

Measure of central tendency; Arithmetic mean - definition - computation for different types of data (ungrouped and discrete and continuous frequency distributions) - other measures such as median, mode, geometric mean, harmonic mean and weighted average may be defined - computation for different types of data (ungrouped and discrete and continuous frequency distributions) - Properties interpretation. Definition of other measures such as range, quartile deviation, decile range and mean deviation may be defined (Computation not required).

**UNIT IV: INFERENCE STATISTICS:**

Probability; basic principles - a priori and a posteriori probabilities - addition and multiplication rules of probability - conditional probability.

Patterns of probability distributions: definition – properties-uses - standard errors (standard error of the mean to be stressed) computation- properties - used estimation of population parameters from sample statistics - confidence intervals determination of sample size.



Hypothesis testing - null hypothesis - level of significance - degrees of freedom - types I and II errors.

Test of significance: Chi-square test for goodness of fit, homogeneity and association between attributes (problem relating to Genetics, patterns of distribution etc. to be worked out).

Test of significance for large sample - comparison of sample mean with population mean - comparison of two-sample mean.

## **UNIT V: CORRELATION AND REGRESSION**

Correlation: Definition and types - simple, multiple, partial, linear, nonlinear, mutual, cause and effect, etc.

Uses of scatter diagram and correlation graph in the study of correlation between two variables.

Computation of Karl Pearson's Co-efficient of correlation - testing its significance - Interpretation.

Regression analysis: derivation of regression equations between two variables regression coefficient - construction of regression lines - properties - applications.

## **UNIT VI: POPULATION STATISTICS**

Vital statistics - natality and mortality rates.

Population estimation - population growth

## **REFERENCE/BOOKS**

1. Gurumani, N. (2005) Biostatistics, 2nd edn. MJP publications, India.
2. Milton, J.S. (1992) Statistical method in Biological and Health Sciences. McGraw Hill Inc., New York.
3. Scheffler, W. C. (1968) Statistics for biological sciences, Addison- Wesley Publication Co., London.
4. Snedecor, G. W and Cochran, W.G. (1967) Statistical Methods. Oxford & IBH Publication co., New Delhi.
5. Spiegel, M.R (1981) Theory and problems of statistics, Schaum's Outline series McGraw-Hill International Book Co., Singapore.
6. Pillai, R.S.N and Bagawathi, V. (1989), Statistics. Theory and practice (For B.Com. and B.A., (Eco) classes) S. Chand & Co, Ltd., New Delhi.

7. Stansfield, W.D (1986) Theory and problems of genetics (including 600 problems). Schaum's outline series. McGraw-Hill Book Co., New York.
8. Sobl, R.R. and Rohlf, F. J (1969) Biometry. The principles and Practice of Statistics in Biological Research. W. H. Freeman and Co., San Francisco.
9. Pillai, R.S.N and Bagawathi, V. (1987) Practical Statistics (For B.Com. and B.A., Students) S.Chand & Co. (Pvt.) Ltd., New York.
10. Mahajan, B.K. (1984). Methods in Biostatistics for Medical students and Research works. Smt. Indu Mahajan, New Delhi.

### **SEMESTER - III**

#### **Core - DEVELOPMENTAL BIOLOGY**

4 Credits

#### **UNIT I: GAMETOGENESIS**

History of Embryology - Ovists Vs Animalculist Preformation and Epigenesis - Descriptive Embryology Experimental Embryology - Molecular Embryology gametogenesis: Growth of oocytes - Synthesis and storage of macromolecules in the oocytes - Nuclear activities during oocytes growth. Hormonal and nervous control of ovulation.

#### **UNIT II: FERTILIZATION**

Fertilization: polyspermy - Androgenesis - Egg activation - Electron microscopic and biochemical aspects - Fertility of sperm and its in vitro fertilization - artificial fertilization - Chemodifferentiation.

#### **UNIT III: EARLY DEVELOPMENT**

Gastrulation movements: role of egg cortex - Cell surface in morphogenesis - Cell adhesion and cell communication. Chemotactic induced aggregation - Aggregation in sponges. Early development stage of fish. Experimental analysis in the early development of Echinoderms, Amphibians and Birds.

#### **UNIT IV: ORGANOGENESIS**

Organogenesis - formation of organ. rudiments: Differentiation and development of limb, thymus, spleen, salivary glands, heart and kidney in a mammal. Organiser: Inductive tissue interactions in developments.

#### **UNIT V: GENES AND DEVELOPMENT**

Nuclear transplantation. Cellular differentiation and protein synthesis. Differential activation. Developmental genetic defects. Role of cell death in development. Teratogenesis - Ageing, transgenics.

#### **UNIT VI: REGULATION OF DEVELOPMENT**

Metamorphosis - morphological and biochemical changes during amphibian metamorphosis - Hormonal control of metamorphosis in amphibians - Neuro - endocrine control of insect metamorphosis - Biochemistry and mechanism of action of hormones during metamorphosis - Tissue reactivity in amphibian metamorphosis - Neoteny. Malignant growth - Neoplasia - Teratoma - Gene activation in neoplasia.

#### **UNIT VII: INVERTEBRATE EMBRYOLOGY**

Early development - larval metamorphosis and organogenesis in Nematelminthes, Platyhelminthes, Annelids, Crustaceans and Molluscs.

#### **REFERENCE/BOOKS**

1. Balinsky, B. L., 1981. An introduction to embryology, Saunders, Philadelphia.
2. Karp. G. and Berrill, N.J. 1981. Development, McGraw Hill, New York.
3. Eber, J.D., 1970. Interacting system in Development, Holt Rein chart and Winston, Inc. New York and Chicago.
4. Grant, P., 1978. Biology of developing systems, Hoit Rein chart and Winston, Inc. New York and Chicago.
5. Saunders, J. W. 1982. Developmental Biology. Macmillan Co., London.
6. Brachet J. 1974. Introduction to Molecular Embryology. The English Universities Press, London.
7. Nagabhushanam. R., and R. Sarojini. Invertebrate Embryology. Oxford and IBA Publishing Co.
8. Gilbert, Scott. F. 1985. Developmental Biology. Sinauer Association, Inc., Publishers.
9. Tyagi, Rajiv and AN. Shukla, 2002. Development of fishes, Jaya publishing house, New Delhi.
10. Raven, P. An outline of developmental physiology, Pergamon Press, New York.
11. Browder, W. 1984. Developmental Biology, Saunders College Publishing, Rinchert and Winston.

## **Core - IMMUNOLOGY**

4 Credits

### **UNIT I: BASIC OF IMMUNOLOGY**

Introduction - Historical perspective. Innate immunity (Non-specific), Adaptive immunity (Specific) - Humoral immunity, Cell Mediated immunity.

### **UNIT II: CELLS AND ORGANS OF IMMUNE SYSTEM**

Cells of Immune system - Haematopoiesis, Stem cells, Lymphoid cells, Mononuclear cells, Granulocytes, Mast cells, Dendritic cells. Organs of Immune system - Primary lymphoid organs and Secondary lymphoid organs.

### **UNIT III: ANTIGENS**

Antigens - Immunogenicity Vs Antigenicity, Haptens. Factors influencing Immunogenicity. Epitopes - B cell epitope and T cell epitope.

### **UNIT IV: ANTIBODIES**

Immunoglobulin - structure, isotypes and biological function. Immune response & theories. Antigenic determinant on immunoglobulin - isotype, allotype and idiotype. B-cell receptor, immunoglobulin superfamily, Monoclonal antibody, Polyclonal antibody. Organization and expression of immunoglobulin genes. Synthesis of immunoglobulin and disorders of immunoglobulin synthesis.

Antigen - Antibody interaction and immunodiagnostics. MHC - Restriction, Organization and inheritance of MHC, Antigen processing and presentation.

### **UNIT V: MEDIATORS OF IMMUNE SYSTEM**

T cell receptor, cytokine, adhesion molecules. Complement, Hypersensitive reaction, Transplantation immunology.

### **UNIT VI: VACCINES**

Vaccines - Principles and types of Vaccines - DNA Recombinant Vaccine, Serum therapy.

### **REFERENCE/BOOKS**

1. Roitt, I.M. 1994. Essential Immunology. Blackwell Scientific, Oxford ISBN.
2. Richard, A Golds, Thomas J. Kindt & Barbara A. Osborne. 2000. Kuby - Immunology. Freeman and Co. New York.

3. D.P. Stites, A.I. Terr and T.G. Parsloio. 1997. Medical Immunology. Prentice Hall, New Jersey.
4. Janeway, C.A. and P. Travers. 1997. Immunobiology. Current Biology Ltd. London.
5. Paul, W.E. 1989. Fundamentals of Immunology. Raver Press. New York.
6. Srivastava, R., Ram, B.P. and Tyle, P. 1991. Molecular mechanism of Immune regulation. VCH Publishers, New York.

### **LAB COURSE III: DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY**

4 Credits

1. Different stages in developmental- Crustaceans (Crab/Prawn)-Insects. (Drosophila) - Frog.
2. Demonstration: Experimental biology -Wound healing and cell aggregation in frog embryo.
3. Developmental of chick stage- observation of living chick embryo and vital staining demonstration only - slide showing C.S. of heart, kidney, lens and limb to demonstrated induction and organization.
4. Slides showing the uterus cycles in mammals (Rat).
5. Development of invertebrates- Eggs- cleavage- Gastrula- Study of larva forms Nauplius, Zoea, Veliger, Bipinnaria, Leptocephalus.
6. Developmental stage of fish.
7. Lymphoid organ anatomy - Rat Histology of lymphoid organs - Thymus, Spleen, Bone marrow, Lymph node.
8. Haernagglutination - Qualitative analysis "ABO" blood group. .
9. Haemagglutination -Quantitative analysis - haemagglutination titration.
10. Preparation of Antigen; RBC- Demonstration.
11. Immunoelctrphoresis - Demonstration.

**EXTRA DISCIPLINARY - II**  
**MICROBIOLOGY**

3 Credits

**UNIT I:**

History and scope of Microbiology - Milestones in Microbiology.

**UNIT II:**

Anatomy of Prokaryotes and Eukaryotes - Morphology - Ultra structure of bacteria, fungi and Viruses - Classification of microbes - Phenotypic and taxonomic characters - Principles of classification - taxonomic structure - DNA analysis, Ribosomal RNA analysis - Numerical Taxonomy - Molecular taxonomy - Methods of microbial identification.

**UNIT III:**

Sterilization: Principles - dry heat, moist heat, filtration, Tantilization, pasteurization, Radiation - disinfection - Antimicrobial chemotherapy - Antibiotics source - Classification - Mode of action Antimicrobial resistance - Tests for sensitivity to antimicrobial agents and its quality control.

**UNIT IV:**

Culture techniques - media preparation - preservation of cultures - Aerobic and anaerobic culture techniques- Wet mount - Hanging drop - staining methods - dyes simple - differential and special staining techniques - acid fast stain, spore stain, capsule stain, staining for pure and mixed cultures

**UNIT V:**

Environmental microbiology - Microbial ecology, role of microorganisms in the productivity of ecosystems - Interactions between microorganisms, and with plants and animals - microbes and biodegradation - microbes in waste treatment. Microbiology of soil, water and air.

**UNIT VI:**

Medical microbiology - Pathogenic microbes of bacteria, viral, fungal and protozoan diseases - cure, control and prevention.

**UNIT VII:**

Industrial microbiology - Industrial uses of microbes - fermentation products - bioconversions - bioremediation. Products of industrial microbiology - Penicillin, fuels, ethanol, vinegar, vitamin B12, citric acid, glutamic acid, protease etc. Food and Dairy microbiology -

Microbes in food - Role of microbes in food production; Dairy and non-dairy products - fermented foods and alcoholic beverages. Pharmaceuticals (antibodies, vaccines etc.).

#### **UNIT VIII:**

Biotechnology potentials of microbes - production of food (single cell protein), Biofertilizers (BOA), Biopesticides (*Bacillus thuringiensis*), Biopolymers, biosurfactants etc., Use of microbes in Biotechnology - Streptomyces, Yeasts (*Saccharomyces*, *Hansenella*), Spirulina and penicillium etc., Disposals of microbes and biosafety.

#### **REFERENCE / BOOKS**

1. Pelczer MJ, Chao ECS, King NR, Mc Graw-Hill, Inc. Ny. (1979) Microbiology Concepts and Applications,
2. Haley JO, Klecin DA. Microbiology, Prescott Lm., WCB Publishers, Sydney.
3. Davis BD, Dulbecco R, Eisen HN, Gihsercs HS, Harper & Row. (1990) Microbiology, 4th edn. Publishers, Singapore.
4. Principle of Microbiology, (1997). RM atlas, WBC Publishers.
5. Raymond Rodriguez and David T. Denhard. (1988) Vectors - A survey of Molecular cloning vectors and their uses.
6. Winnacker, E.L.(1987) From Genes of clones - Introduction to Gene Technology, VCH publishers, New York.

### **SEMESTER IV**

#### **ANIMAL PHYSIOLOGY**

5 credits

#### **UNIT I:**

Introduction, scope, significance of study and definitions & divisions.

#### **UNIT II:**

Nutrition – nutrients - digestion and adsorption of proteins, carbohydrates and lipids and role of gastrointestinal hormones hi digestion.

#### **UNIT III:**

Respiration in Invertebrates and Vertebrates - physiology of respiration in Man - respiratory pigments - BMR

#### **UNIT IV:**

Circulation - types of heart - physiology of cardiac muscle - heart beat and its regulation - composition of blood and coagulation.

#### **UNIT V:**

Excretion- excretion of metabolic waste products in relation to the environment - physiology of excretion in Man, and hormonal control.

#### **UNIT VI**

Osmoregulation - osmoregulation in Invertebrate (Protozoans, crustacean, insects) - osmoregulation in fishes, birds and terrestrial animals - hormonal control.

#### **UNIT VII**

Neuro muscular co-ordination - muscle physiology and structure and type of neurons - nervous system neurosecretions in insects, mollusks and crustaceans endocrine glands in vertebrates - endocrine control of reproduction in vertebrates with Reference to Man - endocrine related diseases and disorder in Man.

#### **UNIT VIII:**

Chemical co-ordination - neurosecretions in insects, mollusks and crustacean endocrine glands in vertebrates - endocrine control of reproduction in vertebrates with Reference to Man - endocrine related disease and disorder in Man.

#### **UNIT IX:**

Receptors - classification and function - mechanisms of hearing and physiology of vision, in Man.

#### **UNIT X:**

Behavioural physiology - chronobiology (circadian rhythm Lunar periodicity, circannual rhythm) Behaviour (types - tropism, taxis, kinesis, reflex, learning) Migration in birds and fishes - temperature regulation in poikilotherms, homeotherms and heterotherms - hibernation, aestivation - diapause.

#### **REFERENCE/BOOKS**

1. Hoar, W.S (1968): General and Comparative Physiology, Prentice Hall
2. Prosser, C.L. (1973): Comparative Animal Physiology, 3rd edn. W.B. Saunders & Co., Philadelphia.
3. Wood, D.W. (1968): Principles and Animal Physiology
4. Bentley, (1971): Endocrine and osmoregulation Springer verlag, N.Y.,



5. Palmen, J.D. Brown, J.R. and Hastirigs, J. W. (1970): Biological clocks, Academic Press, London.

### **Core - RESEARCH METHODOLOGY**

4 Credits

1. Concepts of Scientific research - Scope - Null Hypothesis.
2. a) Literature collection - Primary, Secondary and tertiary sources Bibliography.  
b) Use of internet facilities in literature collection - data bases.  
c) Reviews monographs - Text books - Reference / Books – Scientific journals - News letters - etc.,
3. Selection of Animals models - Maintenance - CPCSEA regulations.
4. Analytical tools: Microscopes (Light, Phase, Fluorescence), pH meter, O<sub>2</sub> Electrodes, Photometers: Colorimeter, Spectrophotometer (Single, Double beam and double array Spectrophotometric).
5. Chromatographic techniques - Paper - Gel matrices (gel filtration, Ion Exchange, affinity and HPLC) - Thin layer chromatography.
6. Enzyme kinetics - Lines weaver Burke plot - V<sub>max</sub> & K<sub>m</sub> determinations.
7. Histology & Histochemical Methods (Proteins, carbohydrates and lipids) Micrometry and photomicrography.
8. Population Estimation - concepts Density - (Soil Fauna, aquatic fauna or terrestrial fauna).
9. Presentation of Data- Preparation and Manuscript (Thesis & Publications)

### **LAB COURSE IV: BIOTECHNOLOGY & RESEARCH METHODOLOGY**

4 Credits

Visit to Biotechnology Laboratory to observe the demonstration of

1. Tissue culture.
2. Titration and preparation of virulent phage.
3. Isolation of DNA from the plasmids.
4. Restriction enzymes digestion of DNA.
5. DNA electrophoresis in Agarose gel.

Necessary book may be referred to learn the techniques and to be recorded in the Record Note books. Observation of photographs of different instrument used in Biotechnology, their principals and application.

6. Histological and Histochemical methods.
7. Electrophoresis.
8. Chromatography-Paper.

### **Practicals**

1. Determination of Sodium level in water samples
2. Determination of Potassium level in water samples.
3. Determination of Cadmium level in water samples
4. Determination of Mercury level in water samples
5. Estimation of SDH activity in liver tissue of normal and malathion treated fish
6. Estimation of total protein content in the muscle tissue of normal and endosulfan treated fish
7. Estimation of Glucose and Glycogen level in the liver tissue of normal and Lead treated fish
8. Estimation of AchE activity in brain tissues of normal and mercury treated mouse
9. Estimation of GSH level in liver tissue of normal and endrin treated mouse
10. Determination of cell volume in liver tissue of normal and copper treated fish
11. Histopathological observation of the following
  1. Liver, 2. Kidney, 3. Brain, 4. Intestine, 5. Muscle
12. Determination of LC<sub>50</sub> value of Zinc on fish.

## **ELECTIVE I: ENTOMOLOGY**

3 Credits

### **UNIT I:**

Biology of an insect with special reference to the following: Nutrition, Development, Reproduction and Endocrinology.

### **UNIT II:**

Insects and their interrelationships with environments (interspecific and intraspecific).

**UNIT III:**

Insects as pollinators, predators, parasitoids, scavengers, weedkillers, etc.,

**UNIT IV:**

Biology of honeybees, lac insects and their management.

**UNIT V:**

Prospects of sericulture, Biology of silkworm (Nutrition, Genetics, Endocrinology, Reproduction, Pest and Diseases).

**UNIT VI:**

Insects as crop pests: Types of injuries and loss caused to plants in general factors governing the outbreak of pests.

**UNIT VII:**

Vector borne diseases: Method of transmission of parasitic agents reference to mosquitoes and houseflies.

**UNIT VIII:**

Principles and methods of pest suppression: Conventional and Non-conventional, Biological and Integrated pest management.

**REFERENCES:**

1. The Science of Entomology. William S. Romoser and John G. Stoffolano. Wm. C. Brown Publishers, England. 1994.
2. The Silkworm. An important laboratory tool. By Yataro Tazima, Kodarsha, Scientific Book Ltd., Japan. 1978.
3. Sericulture Manual: FAD, Agril, Service Bulletin, Rome.
4. Applied Entomology: P. G. Fenemore, Allaprkash, Wiley Eastern Ltd., Delhi. 1992.
5. Park, J. E and K. Park. Textbook of social and preventive medicine. Publ. Mis. Banarasides Bharol. Jabalpur.
6. Nayar, K. K, Ananthkrishnan, T. Nand B. V. David. General and Applied Entomology. Tata McGraw Hill Publ., New Delhi. 1989.
7. Entomology and Pest M~agement. Larry, P. Pedigo Prentice Hall, New Jersey. 1989.

## **ELECTIVE II: ENDOCRINOLOGY**

3 Credits

### **Unit I: Pituitary Gland**

General characteristics of hormones - Pituitary gland - structural organization - Pituitary hormones functions hypothalamic control.

### **Unit II: Thyroid Gland**

Thyroid gland - structural organization - metabolic effects of thyroid hormone - effects of thyroid on reproduction - Parathyroid - structure - functions of parathyroid hormone.

### **Unit III: Pancreas and Adrenal Glands**

Structure of pancreas- function of Insulin and glucagon- Adrenals - structural organization. functions of cortical and medullary hormones.

### **Unit IV: Vertebrate Reproductive Endocrinology**

Structure of mammalian testis and ovary - male and female sex accessory organs - hormones of testis and ovary - estrus and menstrual cycle -, hormones of pregnancy - parturition - hormonal control of lactation.

### **Unit V: Insect and Crustacean Endocrinology**

The concepts of neurosecretion - Endocrine system in Crustacea - endocrine control of moulting and metamorphosis - Neuroendocrine system in insects endocrine control of moulting and metamorphosis.

### **Practicals**

- 1) Dissection of pituitary, adrenal and gonad in vertebrate animals.
- 2) Dissection of reproductive systems in vertebrate animals.
- 3) Histological study of pituitary, adrenal. teMis, ovary, corpus luteum, pancreas and thyroid gland.
- 4) Dissection of reproductive system neuroendocrine complex in insects.
- 5) Histology of ovary, accessory glands, corpus allatum, and brain in insects.
- 6) Parabiosis in cockroach.
- 7) Ovariectomy in cockroach.

### **Text Books**

1. Turner, C.D., 1966. "General Endocrinology", 4th Ed, W.B. Saunders Co., London.
2. Bentley, P.J., 1985. "Comparative Vertebrate Endocrinology", S.Chand and Co.,

3. Barrington, E.J.W., 1968. "An Introduction to General and Comparative Endocrinology", Academic Press, London.

### **Reference Books**

- 1) Harris, G.W. and B.T. Donovan, (Ed). 1968. "The Pituitary Gland", Vo1.3.
- 2) Williams, R.M., 1974. "Text Book of Endocrinology", 5th Ed.
- 3) Bentley, P.J., 1982. "Comparative Vertebrate Endocrinology", Cambridge University Press.
- 4) Michael. P., 1968. "Endocrinology and Human Behaviour", Oxford University Press, New York.

## **ELECTIVE III: FISHERY BIOLOGY**

3 Credits

### **UNIT I: BIONOMICS AND CLASSIFICATION**

Study of habit, food, feeding adaptations, growth, reproduction behaviour, fecundity and spawning of Indian major carps, three live fishes, three exotic fishes and six economically important marine fishes.

Classification of the above fishes as in Day's volumes, or in Munro's volume or in FAO Publications.

### **UNIT II: REPRODUCTION BIOLOGY**

Role of hormones in reproduction - maturity stages - morphological and histological observation of gonads – Cryopreservation.

### **UNIT III: GROWTH STUDY**

Age determination - length-weight relationship - factors influencing growth -condition factor - tagging methods.

### **UNIT IV: FISH GENETICS AND IMMUNOLOGY**

Sex determination in fish – monosex production - hormonal and chromosomal methods - hybridization techniques in aquaculture androgenesis and Gynogenesis fish immune system.

### **UNIT V: FISH AND PUBLIC HEALTH**

Diseases caused by fishes in man - prevention. Uses of fishes as biological control of diseases in man. Fish as food for human health.

### **UNIT VI: CAPTURE FISHERY OF INDIA**

Fishery zones of India and the type of fishery in these zones. At least six types of economically important marine pelagic, fishes to be studied with regards their fishery and the methods of capture. Reservoir fishery. Preservation and processing. By-products.

### **REFERENCE/BOOKS:**

1. Baluyut, E. A. (1989). Aquaculture systems and Practices. A selected review Publishing House, New Delhi.
2. Chondar, A (1970). Handbook of breeding of Indian major carps by pituitary hormone injection. Agra Satisdh Book Enterprise.
3. Das M. C. and Patnaik, P. N. (1994). Brackish water culture. Palani paramount Publications, Palani, T. N.
4. Day, F (1958). Fishes of Indiaa , Vol. I and Vol. II. William Sawson and Sons Ltd., London.
5. Jhingran, C. G. (1981). Fish and Fisheries of India. Hindustan Publilcating Co., India.
6. Maheswari. K. (1983) Common fish disease and their control. Institute of FIOsheries Education, Powarkads( M. P.)

### **ELECTIVE IV: TOXICOLOGY**

3 Credits

#### **Unit I: Absorption Distribution and Excretion of Toxicants**

Definition and scope of toxicology - Chemical interaction - Membrane permeability - Diffusion, filtration and engulfing by cells - Absorption distribution - excretion.

#### **Unit II: Bio-Transformation of Toxicants**

Definition - general principles - receptor site degradation reaction - conjugation - bio-activation - complex nature of bio--transformation - Antidotes - mechanism of antidotal action - assessment of antidotal efficacy.

#### **Unit III: Bio-chemical basis of Toxicology**

Mechanism of Toxicity - receptor mediated events disturbance of excitable membrane function, biochemical process - Ca<sup>+</sup> homeostasis - covalent binding genotoxicity - Tissue specificity - Target organs mechanism of action.

#### **Unit IV: Methods of Toxicology**

Bioassay test - single species test - multi species test - acute toxicity test - subacute

toxicity test - chronic toxicity test - determination of LC50 value - Pathological techniques - autopsy and histology - histopathology Histochemistry - cytochemistry - morphometric methods.

### **Unit V: Chemical and Immuno toxicology**

Toxic chemicals: Pesticides - automobile emission heavy metals - fertilizers - food additives - animal, plant and mushroom toxins.

Immunotoxicology - General concepts - lymphocytes Natural killer cells - macrophages - hypersensitivity reaction - immuno suppression - molecular immuno toxicology.

#### **Text Books**

1. Sharma, P.D., 1996. "Environmental Biology and Toxicology", Rastroggi Publication, Meerut, India.
2. LU, F.C., 1985. "Basic Toxicology", Hemisphere Publication, Corporation, Washington, N.Y., London.
3. Gupta, P.K. and Salunka, D.K. 1985. Modern Toxicology", Volume I and II, Metropolitan, New Delhi.
4. Sood, A., 1999. "Toxicology", Sarup & Sons, New Delhi

#### **Reference Books**

1. Butler, G.C. 1978. "The Principles of Ecotoxicology Scope, 12, ICSO Scope", John Wiley and Sons, Chichester.
2. Finney, D.J., 1971. "Probit Analysis", Cambridge University Press.
3. Adrien Albert, 1981. "Selective Toxicity", University Press Cambridge.
4. Gupta, P.K. and V. Raviprakash, 1988. "Advance in Toxicology and Environmental Health. Jagmandar Book Agency, New Delhi.

## **ELECTIVE V: AQUACULTURE**

3 Credits

### **UNIT I: FRESHWATER FISH AQUACULTURE**

Types of ponds in the intensive aquaculture, Culture pond - site selection - soil quality - layout - inlet and outlet - formation of dykes and construction neutralization of pH - reducing seepage.

Source of water - water quality management in aquaculture - temperature - pH DO levels - nutrients - trace elements.

Feed - formulated - conventional- artificial, Feed cost. Feeding methods.

Composite fish culture - paddy cum - fish culture - integrated fish culture sewage water fish culture - raceway culture.

Control of parasites, predators and weeds in culture ponds.

Procurement of seed, transport, stocking, harvesting and marketing.

Fish farm implements - Secchi disc - aerator - pH meter - tools for hypophysation - feeding trays - gears.

Freshwater prawn culture.

## **UNIT II: HATCHERY TECHNIQUES**

Hatching technology for major carps - common carp, silver carp - live fishes trout. Induced breeding methods. Live feed-*Artemia*, Rotifer, Diatoms and their culture. Prawn developmental stages - freshwater and marine prawn hatchery.

## **UNIT III: FISH DISEASE MANAGEMENT**

Non-parasitic diseases and parasitic diseases - symptoms - prevention – treatment.

## **UNIT IV: AQUARIUM AND ORNAMENTAL FISHES**

Aquarium tanks - maintenance - selection of ornamental fishes.

Ornamental fish culture as cottage industry and its export potential.

## **UNIT V: MARI CULTURE**

Types of seaweeds - species suitable for culture - methods of culture - by products.

Prawn culture - extensive culture methods semi- intensive - intensive culture methods - feeds and feeding management - disease managements.

Pearl oyster culture - pearl production crab culture. Economic importance of Lobster, sea urchin and sea cucumber - their bye products.

CMFRI, CIBA, CIFRI, CIF A and CIFE and its activities

Brackish water fish culture

## **REFERENCE/BOOKS**

1. Baluyut, E. A. (1989) Aquaculture systems and Practices. A selected review Publishing House, New Delhi.
2. Chondar, A (1970) Handbook of breeding of Indian major carps by pituitary. hormone injection. Agra Satisdh Book Enterprise.



3. Das M. C. and Patnaik, P. N. (1994) Brackish water culture. Palani Paramount Publications, Palani, T. N.
4. Day, F (1958). Fishes of India, Vol I and Vol. II. William Sawson and Sons Ltd., London.
5. Jhingran, C. G. (1981). Fish and Fisheries of India. Hindustan Publishing Co., India.
6. Maheswari. K. (1983) Common fish disease and their control. Institute of Fisheries Education, Powarkada (M. P.).
7. Michael, B. N. and Singholka, B. (1985). Freshwater Prawn Farming: A manual of culture of *Macrobrachium rosenbergii*. Daya Publishing House, New Delhi.
8. Paul Raj S. (Ed.) (1995). Shrimp farming Techniques, problems and solutions. Palani Paramount Publications, Palani, T. N.
9. Paul Raj S. (Ed.) (1996). Aquaculture for 2000 A. D. Publications, Palani, T. N. Palani Paramount.
10. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd.
11. Ponnuchamy, R. (1997). Practice guide to shrimp farming. Palani Paramount Publications, Palani, T. N.
12. Post, G. M. (1983). Text book of fish health. TFH Publication.
13. Santhanam, R. (1990). Fisheries Science. Daya Publishing House, New Delhi
14. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
15. Yadav, B. N. (1997). Fish and fisheries. Daya Publishing house, New Delhi.
16. FAO volumes for fish identification.