



# BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI – 620 024.

## M.Sc. Zoology - Course Structure under CBCS

(applicable to the candidates admitted from the academic year 2008-2009 onwards)

Sem ester	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total	
						Int.	Extn.		
I	Core Course – I (CC)	Functional Morphology & paleontology of Invertebrates & Chordates	6	5	3	25	75	100	
	Core Course – II (CC)	Genetics & Evolution	6	5	3	25	75	100	
	Core Course – III (CC)	Microbiology	6	5	3	25	75	100	
	Core Course – IV (CC)	Cell & Molecular Biology	6	5	3	25	75	100	
	Core Course – V (CC)	Practical I	6	4	3	40	60	100	
			Total	30	24				500
II	Core Course – VI (CC)	Biochemistry & Biophysics	6	5	3	25	75	100	
	Core Course – VII (CC)	Biostatistics & Computer Applications	6	5	3	25	75	100	
	Core Course – VIII (CC)	Introductory Biotechnology	6	5	3	25	75	100	
	Core Course – IX (CC)	Practical II	6	4	3	40	60	100	
	Elective – I	Open	6	4	3	25	75	100	
			Total	30	23				500
III	Core Course – X (CC)	Developmental Biology & Immunology	6	5	3	25	75	100	
	Core Course – XI (CC)	Animal Physiology	6	5	3	25	75	100	
	Core Course – XII (CC)	Practical III	6	4	3	40	60	100	
	Elective - II	Open	6	4	3	25	75	100	
	Elective – III	Open	6	4	3	25	75	100	
			Total	30	22				500
IV	Core Course – XIII (CC)	Environmental Biology	6	5	3	25	75	100	
	Core Course – XIV	Practical IV	4	4	3	40	60	100	
	Project Work	Dissertation - 80 Marks [2 reviews – 20+20=40 marks Report Valuation =40 marks] Viva 20 Marks	8	4	-	-	-	100	
	Elective - IV	Open	6	4	3	25	75	100	
	Elective - V	Open	6	4	3	25	75	100	
			Total	30	21				500
			Grand Total	120	90				2000

**The Department of Zoology will offer the following Major Elective Courses**

1. General and Applied Entomology
2. Environment and Health
3. Vermitechnology
4. Poultry Science
5. Coastal Geomorphology
6. Estuarine Biology
7. Fishery Biology

**The Department of Zoology will offer the following Non-Major Elective Courses**

1. Inherited Diseases and Genetic Counselling
2. Freshwater Fish culture
3. Bio resources
4. Ornamental Fish culture

**Note:**

Core Courses include Theory, Practicals & Project

No. of Courses	14 - 17
Credit per Course	4 - 5
Total Credits	70

**Elective Courses**

(Major based / Non Major / Internship)

No. of Courses	4 – 5
Credit per Course	4 – 6
Total Credits	20

	Internal	External
Theory	25	75
Practicals	40	60

**Project**

Dissertation	80 Marks	[2 reviews – 20+20 Report Valuation	=	40 marks
Viva	20 Marks		=	40 marks]
				20 marks

Passing Minimum in a Subject

CIA	40%	} Aggregate 50%
UE	40%	
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**CORE COURSE I - FUNCTIONAL MORPHOLOGY & PALAENTOLOGY OF  
INVERTEBRATES AND CHORDATES**

**A. INVERTEBRATES**

**Unit-I**

**Organization**

Symmetry in animal organization – Asymmetry, radial, biradial and bilateral symmetry – Significance.

Coelom – Evolution of coelom. Acoelomate, pseudocoelomate, coelomate groups (Schizocoel, Enterocoel, mesenchyme) – Significance.

Metamerism – Evolution of metamerism – Pseudometamerism, cyclo metamerism, corm theory, embryological theory – Significance.

**Locomotion**

Movement in Annelids, Molluscs and Echinoderms.

**Nutrition**

Filter feeding in Polychaetes, Molluscs and Prochordates.

**Respiration**

Gills and trachea in Arthropods – Respiration in Molluscs.

**Circulation**

Circulation in Arthropods and Molluscs.

**Unit-II**

**Excretion**

Different types of excretory organs in invertebrates – their structure and function.

**Nervous System**

Primitive types – Coelenterates and nerve net; Advanced types – Nervous system in Annelids, Molluscs and Arthropods.

**Chemical Co-ordination**

Endocrine glands in Crustaceans and Insects – Pheromones and allelochemicals.

## **Unit-III**

### **Reproduction**

Pattern of sexual and asexual reproduction – Invertebrate larval forms and their phylogenetic significance.

### **Invertebrate Fossils**

Evolutionary trends and phylogenetic importance of Trilobites, Ammonoids, Belemnoids, Nautiloids, Echinoderm fossils.

### **Minor Phyla**

Organisation and affinities of 1. Chaetognatha, 2. Rotifera, 3. Sipunculida, 4. Phoronida.

## **B. CHORDATES**

A. Comparative study functional Morphology of vertebrates.

## **Unit-IV**

### **Integumentary System**

Exoskeletal structures and their modifications.

### **Digestive System**

Alimentary canal and associated glands

### **Respiratory System**

Gill respiration in cyclostomes and fishes – Pulmonary respiration in tetrapods.

### **Circulatory System**

Types & evolution of heart and aortic arches.

### **Excretory System**

Types & evolution of kidneys.

## **Unit-V**

### **Nervous System**

Brain and spinal cord – cranial nerves, spinal nerves and visceral nerves – Autonomic nervous systems – Sympathetic – Parasympathetic.

## **Reproductive System**

Reproductive systems – Accessory reproductive glands.

## **Vertebrate Fossils**

Evolutionary significance of Ostracoderms, Placoderms, Crossopterygians, Labyrinthodonts, Dinosaurs, Archaeopteryx and Mesozoic mammals.

## **Recommended Text Books**

### **INVERTEBRATES**

1. BARNES, R.D. (1982), Invertebrate Zoology, IV Ed., Holt Saunders International Edition.
2. BARRINGTON, E.J.W. (1979), Invertebrate Structure and Functions, II Ed., ELBS and Nelson.
3. MOORE, R.C., LOLICKER and FISCHER, A.G. (1952), Invertebrate Paleontology, McGraw Hill Book Co., Inc., N.Y.

### **CHORDATES**

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

## **References**

### **INVERTEBRATES**

1. HIGHNAM, K.C. and HILL, L. (1979), The Comparative Endocrinology of Invertebrates, ELBS & Edward Arnold (Publishers) Ltd., London.
2. HYMAN, G.H., The Invertebrates, Vol. I to VII, McGraw Hill Book Co., Inc., N.Y.
3. VASANTIKA KASHYAP (1997), Life of Invertebrates, Vikas Publishing House Pvt. Ltd., New Delhi.
4. KOTPAL, R.L., Minor Phyla, Rastogi Publication, Meerut.

### **CHORDATES**

1. COLBERT, H. EDWIN (1989), Evolution of the Vertebrates, II Ed., Wiley Eastern Limited, New Delhi.
2. HARREY POUGH, JOHN B. HEISHER, WILLIAM N. McFARLAND (1990), Vertebrate Life, Macmillan Publishing Co., N.Y.
3. JOLLIE, M. (1962), Chordate Morphology, Reinholt Publishing Corporation, N.Y.
4. KENT, G.C. (1976), Comparative anatomy of the Vertebrates, McGraw Hill Book Co., Inc., New York.
5. ROMER, A.S. (1974), The Vertebrate Body, W.B. Saunders, London.
6. ROMER, A.S. (1979), HYMAN's Comparative Vertebrate Anatomy, III Ed., The University of Chicago Press, London.
7. WEICHERT, C.K. (1965), Anatomy of the Chordates, McGraw Hill Book Co., N.Y.
8. NEWMAN, N.H. (1961), Phylum Chordate, The University of Chicago Press, Chicago.

## CORE COURSE II - GENETICS AND EVOLUTION

### A. GENETICS

#### Unit-I

##### **Mechanism of Inheritance and Gene Regulation**

Phage – Genetic material, mechanism of recombination and concept of lysogeny.

Bacteria – Genetic material – chromosomal and extra- chromosomal - Mechanism of recombination by transduction, transformation and conjugation-Mapping of bacterial chromosomes.

Eukaryotes – Genetic fine structure – Cistron, muton, recon, exon, intron, Mechanism of homologous recombination. Role of recombinase and chromosome mapping.

Regulation of gene expression – *Lac* and tryphophan operon of bacteria. Short term and long term regulation of eukaryotic gene with reference to steroid hormone stimulation of gene, expression of globin gene family.

#### **Unit-II**

##### **Population, Mutation and Cancer Genetics**

Genes in populations – allelic and gene frequencies – implications of Hardy-Weinberg principle – Factors affecting Hardy-Weinberg equilibrium.

Gene mutations – Chromosomal and point mutations, spontaneous and inducible mutations, reversible and suppressor mutations. Mutagens – Physical, chemical and biological. Teratogens and induced birth defects.

Carcinogens – Genetic basis of cancer – Chromosomal translocations – Role of oncogenes and tumour suppressor genes – RB genes and P<sub>53</sub>.

#### Unit-III

##### **Human Genetics**

Inborn errors of metabolism: disorders of amino acid metabolism – PKU, alkaptonuria and albinism; disorders of purine metabolism – Lesh-Nhyan syndrome and ADA deficiency; disorders of carbohydrate metabolism – galactosemia and G<sub>6</sub>PD deficiency; disorders of lipid metabolism – Tay Sach's disease and Gaucher's disease.

Haemoglobin disorders – Sickle cell anemia and thalassemia.

Human Karyotype preparation and chromosomal syndromes in man – Down, Turner and Klinefelter syndromes.

## **B. EVOLUTION**

### **Unit IV**

Present status of the concept of natural selection – genetical theory of natural selection – evidences for the role of natural selection

Neo – Lamarckism – present concept of recapitulation – genetic and non-genetic variations – origin and evolutionary significance.

Polymorphism and selection – definitions, transient polymorphism, balanced polymorphism, genetic polymorphism, enzyme polymorphism and selection advantages.

### **Unit V**

Polyploidy and evolution – genetic assimilation – genetic speciation – species concept – evolutionary trends – canalization of selection – orthoselection.

Molecular evolution – gene evolution, evolution of gene families, molecular drive, assessment of molecular variation, punctuated equilibria and neutrality theory.

Molecular phylogenies and evolution – immunologic techniques, amino acid sequences, DNA sequences, nucleic acid phylogenies based on DNA-DNA hybridization and restriction enzymes, combined nucleic acid – amino acid phylogenies – rate of molecular change, molecular clock, regulatory genes and evolution.

Evolution of population – from races to species, adaptation pattern, behavioural adaptations and strategies, sexual competition and selection, isolating mechanisms, mode of speciation and evolutionary rate

### **Recommended Text Books**

#### **GENETICS**

1. JENKINS, J.B. (1983), Human Genetics, The Benjamin Cummings Publishing Co.
2. URSULA GOODENOUGH (1984), Genetics, Saunders College Publishing Co., London.

### **References**

#### **GENETICS**

1. BENJAMIN LEWIN (2000), Genes VII, Oxford University Press, New York.
2. DANIEL L. HARTL (1994), Genetics, III Ed., Jones and Bartlett Publishers, Boston.

3. JOHN D. HAWKINS (1996), Gene Structure and Expression, III Ed., Cambridge University Press.
4. ROBERT H. TAMARIN (1996), Principles of Genetics, WCB Publishers. Munro.W. Also,  
[www.catchword.com](http://www.catchword.com)  
[www.fruitfly.org](http://www.fruitfly.org)

## **Evolution**

### **Recommended Text Books**

#### **Evolution**

STRICKBERGER, M.W. (1996). Evolution. Jones and Barlett publishers Inc., London.

DOBZHANSKY, T., AYALA, F.J., STEBBINS, G.L. and VALENTINE, J.W. (1975). Evolution. Surjeet Publications.

#### **References**

DODSON, E.O. and DODSON, P. (1976). Evolution : Process and Product (II Edn), Van Nostrand Company, New York.

DOWDESWELL, W.H. (1963). The Mechanism of Evolution, Arnold-Heinmann India, Delhi.

JOHA, A.P. (1992). Gene and evolution, The Macmillan Co., New Delhi.

MERREL, D.P. (1962). Evolution and Genetics : The Modern theory of Evolution. Holt, Rinehart and Winston Inc., New York.

## **CORE COURSE III - MICROBIOLOGY**

### **Unit-I**

History and scope of Microbiology

General features of classification of bacteria, virus, Actinomycetes and fungi.

Structure and life cycle of DNA (T<sub>4</sub> Phage) and RNA virus (HIV)

### **Unit-II**

Bacterial growth and nutritional requirements

culture of bacteria , methods and maintenance of culture; types of culture media :

Gram staining

### **Unit-III**

Microbes of milk and food – Methods of detection, Pasturization and Food poisoning.

Food preservation.

Role of microbes in environmental management



## **Unit-IV**

Microbes in Fermentation –Production of alcohol, vinegar, antibiotics, enzymes and fuels  
Biology of Nitrogen fixation-nitrogen fixers.

## **Unit-V**

Causative agents, modes of transmission, symptoms, diagnosis and control of Polio, HIV, HBV  
A and B, Tuberculosis, Typhoid, Gonorrhoea.

## **Recommended Text Books**

1. PELCZER, M.J., REID, R.D. and CHAN, E.C.S. (1996), Microbiology, V Ed., Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. ANANTHANARAYANAN, T and JAYARAM PANIKER, C.K. (2000), Text Book of Microbiology, VI Ed., Orient Longman Ltd., Madras.

## **References**

1. DAVID FREIFELDER (1998), Microbial Genetics, Narosa Publishing House, New Delhi.
2. POWAR, C.B. and DIGINAWALA, H.F. (1982), General Microbiology Volume I & II, Himalaya Publishing House, Bombay.
3. MICHAEL T. MADIGAN, JOHN M. MARTINKL, JACK PARKER (1997), Biology of Microorganisms, VIII Ed., Prentice Hall International Inc., USA.

## **CORE COURSE IV - CELL & MOLECULAR BIOLOGY**

### **Unit-I**

#### **Cell Membrane**

Molecular organization – molecular models – cell permeability – cell surface differentiations and cell – cell communication – membrane receptors and signal transduction patahways

#### **Cytoskeleton and Cell Motility**

Microtubules, microfilaments and intermediate filaments – role in cell organization, division and motility.

#### **Methods of Cell Study**

Micrometry – cell culture methods – cell fractionation technique – cytochemical staining methods – cytophotometry – immunocytochemistry and autoradiography.

## **Unit-II**

### **Mitochondria and Energy Transduction**

Molecular organization of mitochondria and their role in oxidative phosphorylation.

### **Nucleus and Chromosomes**

Nuclear envelope – Nuclear pore – Nuclear proteins – Nucleosome – exons – introns – extrachromosomal DNA-overlapping genes-Transposable elements  
Gene amplifications

## **Unit III**

### **Nucleic Acids and Their Functions**

DNA and RNA – Structure, types and functions – Replication of DNA – DNA repair mechanism.

### **Ribosomes**

Morphology, ultrastructure, biochemistry and functions.

## **Unit-IV**

### **Cell Cycle**

Phases of cell cycle – role of cyclin and other molecules – molecular organization and functional significance of mitotic apparatus.

### **Protein Synthesis**

Mechanism of transcription – role of transcription factors – transcription regulators – Genetic code - Processing of mRNA – translation – post translational modifications and control mechanism.

## **Unit V**

### **Protein Transport**

Intracellular compartments and protein sorting

Vesicular traffic in secretory and endocytic pathways, transport from ER through Golgi to lysosome, endosome

## **Biology of Cancer Cells**

Characteristics of Cancer Cells, types of tumours. Apoptosis and its relevance in cancer biology.

### **Recommended Text Books**

#### **CELL AND MOLECULAR BIOLOGY**

1. De ROBERTIS, E.D.P. and De ROBERTIS, E.M.F. (1987), Cell and Molecular Biology, VIII Ed., Lea and Febiger, Philadelphia.
2. DAVID FREIFELDER (1998), Molecular Biology, II Ed., Narosa Publishing House, New Delhi.

### **References**

#### **CELL AND MOLECULAR BIOLOGY**

1. LEWIS, KELEINSMITH and VALERIS M. KISH (1988), Principles of Cell Biology, Harper and Row Publications, New York.
2. POWAR, C.B. (1983), Cell Biology, Himalaya Publishing House, Bombay.
3. WATSON et al., (1987), Molecular Biology of the Gene, The Benjamin Cummings Publishing Co., Inc., California.

### **CORE COURSE V - PRACTICAL – I**

#### **FUNCTIONAL MORPHOLOGY & PALAENTOLOGY OF INVERTEBRATES AND CHORDATES, GENETICS, MICROBIOLOGY AND CELL AND MOLECULAR BIOLOGY**

#### **A. INVERTEBRATES and CHORDATS**

##### **1. Taxonomy**

A list of atleast 50 representative animals belonging to major classes of eight invertebrate phyla and major orders of 5 classes of Chordata can be prepared by the college and the animals shown to the students. A student has to identify and describe the salient features and assign them to the order, class and phylum to which they belong.

##### **2. Mounting**

Nereis	–	Parapodium
Lepas	–	Mouthparts

Sea urchin	–	Pedicellaria
Teleost	–	Scales
Honeybee	–	Sting

### 3. Spotters

Invertebrate larval forms.

Invertebrate fossils – Ammonoids, Belemnoids, Nautiloids and Echinoclem fossils.

Minor Phyla – Chaetognatha, Rotifera, Phoronida and Sipunculida.

### 4. Dissections

Video clipping of dissection of shark, frog, calotes and rat can be shown to the students.

A student can make use of material available in any search web site for online dissection of shark, frog, calotes, rat using Apple quick time software.

### 5. Culturing of Animals

A visit to atleast any 2 of following: Vermiculture, apiculture, sericulture, ornamental fish culture, poultry or dairy farm or Biofertilizer or Biopesticide Industry in order to evoke interest in self employment.

## B. GENETICS

Drosophila culture – Identifications of mutants & sexes.

Blood groups ABO & Rh their genetic significance.

Pedigree analysis.

Human karyotyping & Chromosomal abnormalities.

Hardy Weinberg law & Calculation of gene frequencies for dominant, recessive & co-dominant traits and Multiple alleles.

## C. MICROBIOLOGY

Culture techniques – culture of bacteria. Bacterial growth curve – Counting and Antibiotic susceptibility test. Measurement of bacteria – Preparation of smears and simple staining. Specific staining – negative staining & Gram staining.

## D.CELL AND MOLECULAR BIOLOGY

Micrometry

Camera Lucida Drawings

Human Buccal Smear

Blood Smear – Cockroach, Man.

Cytochemical detection of Carbohydrates, Proteins, Lipids, DNA and RNA.

**Record of Laboratory work shall be submitted at the time of practical examination.**

## **References**

Biology course

[www.cleverrodgehog.com](http://www.cleverrodgehog.com).

# **CORE COURSE VI - BIOCHEMISTRY AND BIOPHYSICS**

## **A. BIOCHEMISTRY**

### **Unit-I**

Introduction to Biochemistry:

Scope of biochemistry – Physical and chemical processes of living systems – Water and its functions – Dissolved gases and their properties – pH and buffer.

### **Amino Acids**

Structure and classification – Ketogenic and glucogenic amino acids – Catabolism of Tyrosine and Tryptophan.

### **Proteins**

Classification – Globular and fibrous proteins – Structure and functions.

### **Enzymes**

Classification – Properties – 3D structure of an enzyme – Enzyme kinetics – Mechanism of action of enzymes – Active sites – Coenzymes – Activators and inhibitors – Isoenzymes – Allosteric enzymes – Regulation of enzymatic activity.

## **Unit-II**

### **Carbohydrates**

Mono, oligo and polysaccharides – Structure, properties and functions.

### **Lipids**

Classification, structure, properties and functions.

Prostaglandins – their classes, functions and Pharmacological uses.

### **Vitamins**

Structure of water soluble and fat soluble vitamins.

## **Unit-III**

### **Respiratory pigments**

Structure of Hemoglobin and Cytochrome

### **Biological Oxidation**

Nucleotides, Flavoproteins, Cytochromes – Redox potential – Oxidative phosphorylation.

Energy relation, energy rich compounds, their roles.

Hypothalamic and hypophyseal factors – Chemistry and function – Mechanism of hormone action – Peptide hormone – Adenylate cyclase – Cyclic AMP mechanism –  $Ca^{++}$  - Phosphoinositol, steroid hormone and transcriptional control.

## **B. BIOPHYSICS**

### **Unit-IV**

Scope of Biophysics in Biology – structure and properties of atoms and molecules – Formation of molecules from atoms – Bonds – types – properties – strength – atomic and molecular orbitals – X-ray diffraction – Polymerization of organic molecules.

Energy sources – Principle and application of thermodynamic laws – Free energy from electromagnetic waves.

Natural radiations – Properties of natural light. Photoelectric effect – Photodynamic sensitization – LASER – Concept of spectroscopy. Visible, NMR and ESR spectroscopy ;Atomic absorption and plasma emission spectroscopy.

Effect of UV light and ionizing radiations – Detection – Disintegration – Measurement of radio activity – Gieger Muller counter – Isotopes as tracers.

## **Unit-V**

Microscopy – principles of optics in light, phase contrast, polarizing, fluorescence, scanning and transmission electron microscopes.

Principles of Centrifuge – sedimentation velocity – sedimentation equilibrium and density gradient centrifugation.

Principles and application of chromatography – Paper – Thin layer – Column – Ion – exchange – Gel filtration – Gas liquid – HPLC and Affinity.

Principles and applications of electrophoresis – Paper electrophoresis – Ager gel electrophoresis – PAGE – SDS-PAGE – Immunoelectrophoresis – Isoelectric focussing.

## **Recommended Text Books**

### **BIOCHEMISTRY**

1. LEHNINGER L. ALBERT, DAVID. L. NELSON, MICHAEL M. COX. (1993), Principles of Biochemistry, CBS Publishers and Distributors, Delhi.
2. STRYER, L. (1988), Biochemistry, W.H. Freeman and Company, New York.
3. COOPER, T.G. (1977), The Tools of Biochemistry, Wiley Interscience Publication, John Wiley and Sons, New York.

### **BIOPHYSICS**

1. CASEY, E.J. (1962), Biophysics – Concepts and Mechanisms, East West Press Pvt. Ltd., New Delhi.

## **References**

### **BIOCHEMISTRY**

1. ROBERT K. MURAY, DARYL K. GRANNER, PETER A. NAYES, VICTOR W.RODWELL (1993), Harper's Biochemistry (24<sup>th</sup> Edition), Prentice Hall International Inc., London.
2. SMITH et al., (1985), Principles of Biochemistry, McGraw Hill (Mammalian Biochemistry).
3. VOET, D. and VOET, J. (1995), Biochemistry, John Wiley and Sons, New York.

### **BIOPHYSICS**

1. DANIEL, M. (1989), Basic Biophysics for Biologists, Agro-Botanical Publishers, Bikaner, India.

2. De ROBERTIS, E.D.P. and De ROBERTIS E.M.F. (1987), Cell and Molecular Biology, VIII Edition, Lea and Febiger, Philadelphia.
3. DOG, A., DOUGLAS and JAMES J. LEARY (1992), Principles of Instrumental Analysis, Under Golden Sunberst Series.

## **CORE COURSE VII - BIOSTATISTICS AND COMPUTER APPLICATIONS IN BIOLOGY**

### **A. BIOSTATISTICS**

#### **Unit-I**

Definition – development of Biostatistics, data in Biostatistics – samples and population, variables, accuracy and precision, derived variables, frequency distribution, handling of data.

#### **Unit-II**

Descriptive Statistics: arithmetic mean, other means, median, mode, range, standard deviation, practical methods for computing mean and standard deviation, coefficient of variations, probability distribution – binomial and Poisson distribution, estimation and hypothesis testing – Student's t, confidence limit, analysis of variance, single classification, two way analysis of variance, assumptions, regression, correlation, analysis of frequencies.

#### **Unit-III**

Multivariate analysis – Definition and derivation of Principal components, statistical properties of Principal components, Principal components using correlation matrix, Principal components with equal and/or zero variance.

### **B. COMPUTER APPLICATIONS**

#### **Unit-IV**

Graphical representation of data using simple statistics, univariate and multivariate analysis, spatial data representation, Statistical packages – BMDP, GENSTAT, MINITAB, SAS, SPSS, STATISTICA, EISPACK.



## Unit-V

MS Excel, MS Word for data entry, simple statistics with statistical packages, graphics and plotting using advanced packages (SIGMAPLOT), Advanced method of PCA using statistical packages.

### Statistical Packages

MINITAB,	: 215 Pond Laboratory University Park, Pennsylvania – 16802, USA.
SPSS	: SPSS INC, 444 n. Michigan Avenue, Chicago, Illinois 60611, USA
SAS	: SAS Software Ltd, 68, High Street, Waybridge, Surrey, KT138BL, UK.
GENSTAT	: The GENSTAT Co-ordinator, Numerical Algorithms Group 2, Banbury, Oxford, OX27DE, UK
BMDP	: BMDP Statistical Software Inc. 1964, Westwood Boulevard Suite 202 Los Angeles, CA, 90025, USA

### References

1. BAILEY, N.T.J. (1997), Statistical Methods in Biology, III Ed., Cam. University Press, N.Y.
2. SOKAL, R. and JAMES, F. (1973), Introduction to Biostatistics, W.H. Freeman and Company Ltd., Tokyo, Japan.

## CORE COURSE VIII- INTRODUCTORY BIOTECHNOLOGY

### Unit-I

History of Biotechnology

Sources and isolation of gene-methods, genomic and DNA Library

Vectors- plasmids – cosmids- phages – viruses-yeast.

Restriction endonucleases-types-functions, ligation-linkers and adaptors

### Unit II

Gene transfer techniques –physical and biological

Selection and screening – genetic complementation-colony hybridization

immunological screening and reporter gene

DNA sequencing – Sanger and Maxim Gilbert Method, & PCR

DNA finger printing

Human genome project-salient features

### **Unit III**

Production of recombinant insulin, growth hormone

Vaccine engineering, enzyme engineering and antibody engineering

Use of RFLP and DNA probes in detection of genetic diseases

Gene therapy-types-protocols-gene therapy against ADA-future and ethical issues

### **Unit IV**

Plant tissue culture and application

Gene transfer in plants-transgenic plants and application

Biopesticides, biofertilizers

Terminator gene

Single cell Protein

### **Unit V**

Ploidy induction – Production of Transgenic fish.

Biotechnology in Animal Husbandary- Embryo manipulation-embryo transfer-embryo cloning-

Transgenic farm animals and applications

Biosafety- implication of GMO

### **Recommended Text Books :**

1. Dubey R.C. (2008) A text Book of Biotechnology. S.Chand and Company, New Delhi

2. Sathyanarayana.U.(2005) Biotechnology. Books and Allied P.Ltd. Kolkata.

### **References**

1. BROWN, C.M., CAMPBELL, I. and PRIEST, F.G. (1988), Introduction to Biotechnology, Blackwell Scientific Publications, UK.
2. PRIMROSE, S.B. (2000), Modern Biotechnology, Blackwell Scientific Publications, Oxford, London.
3. KESHAV TREHAN (1996), Biotechnology, New Age International Pvt. Ltd. Publishers, New Delhi.
4. Watson et.al. (1999) Recombinant DNA. Freeman and Company, New York
5. IGNACIMUTHU, S. (1998), Basic Biotechnology, Tata McGraw Hill Publishing Co., New Delhi.
6. KUMAR, H.D. (1998), Modern Concepts of Biotechnology, Vikas Publishing House Pvt. Ltd., New Delhi.

**CORE COURSE IX – PRACTICAL II - BIOCHEMISTRY AND BIOPHYSICS,  
BIOTECHNOLOGY, BIostatISTICS AND COMPUTER APPLICATIONS**

**A. BIOCHEMISTRY**

Quantitative estimation of amino acids, protein, carbohydrate and lipids in tissue samples.  
Preparation of solutions – Molarity, Normality, Percentage.

Calculation of moles, millimoles, micromoles and nano moles.

Buffer preparation – determination of pH using pH meter.

**B. BIOPHYSICS**

**Colorimeter**

Determination of Optical Density of samples using Standards.

**Centrifuge**

Preparation of samples using low and high speed centrifuges.

**Chromatography**

Separation of free sugars in different samples (Paper).

Separation of neutral lipids (TLC).

**Electrophoresis**

Separation of human serum proteins (Demonstration only).

**C. BIOTECHNOLOGY**

Isolation of genomic DNA

Plasmid isolation

Agarose gel electrophoresis of DNA

DNA fragmentation using restriction enzymes (Demonstration)

Blotting technique (southern and western) Demonstration only

## E. BIOSTATISTICS

### Problems related to

Chi-square test

Student's t – test

Correlation

Regression

## F. COMPUTER APPLICATIONS

Analysis of Data using Excel software packages, univariate and multivariate analysis of data.

**A record of laboratory work shall be submitted at the time of practical examination.**

## CORE COURSE X - DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

### Developmental Biology

#### Unit I

Gametogenesis – Spermatogenesis – Biochemistry of semen, Sperm physiology – Oogenesis – Superovulation, ICSI, GIFT – Embryo cloning. Fertilization – *In Vitro* fertilization – vitellogenesis.

Morphogenetic gradients in egg-double gradient theory.  
Embryonic fields and their properties

Differentiation: Concept and nature of differentiation-selective action of genes in differentiation in *Drosophila* development, recognition of gene to signal molecules – time factor in progressive differentiation.

Differentiation at tissue level : Lactate dehydrogenase and alkaline phosphatase. Chemical substances as means of controlling differentiation. Role of *Hox* genes and *Hoxa* genes.

## **Unit II**

Embryonic induction-concepts-organizers-classical experiments on organizers-analysis of the nature of primary organizer-chemical nature of inducing substances – mechanism of induction-competence of organizer.

Influence of hormones on growth and metamorphosis of insects and amphibians.

Regenerative ability in various invertebrates and vertebrates-mechanism of regeneration in amphibians-blastema formation – Factors affecting regeneration.

Aging and alterations in development – Gene regulation of aging.

Immunology

## **Unit III**

Scope of Immunology – recognition of self and non self – types of Immunity – innate and acquired, passive and active.

Primary and secondary lymphoid structures and organs – structure and functions of bone marrow, thymus, spleen, bursa of Fabricius, GALT, BALT and Lymph nodes.

Cells of immune system – origin and differentiation of T,B cells and macrophage, antigens – class determinants – reactive sites and receptor sites. Vaccines and toxoids – types of vaccines – vaccination schedule vaccination and serotherapy.

## **Unit IV**

Antibody – immunoglobulin – primary structure – classes, functions, synthesis (cellular, subcellular and molecular). Monoclonal antibodies and their applications, Genetic mechanisms in generation of antibody diversity – Somatic mutation – class switching – allelic exclusion – regulation of antibody.

Complements – classical and alternatives pathways and immunological significance

## **Unit V**

Major histocompatibility complex (HLA) and its products in man.

Diseases and immune response – viral – bacterial diseases – parasitic infections – tumour immunology.

Immune deficiency diseases – AIDS.

Autoimmune diseases – examples, concept and mechanisms.

Types of hypersensitivity.

## **Recommended Text Books for Reference:**

### **Developmental Biology**

BALINSKY, B.L., (1981) An Introduction to Embryology, V Ed., Saunders Co., Philadelphia.

BERRILL, N.J., (1986) Developmental Biology, Tata McGraw Hill, New Delhi

### **Immunology**

Sells, S. (1987). Basic Immunology, Elsevier Science Publishing Co., New York.

TIZARD, I.R., (1995). Immunology – An Introduction, IV Ed., Saunders College Publications, Philadelphia.

## **Reference Books :**

### **Developmental Biology**

BERRILL, N.J., and KARP, G. (1976) Developmental Biology, McGraw Hill Inc. New York.

BROWDER, L.N. (1980) Developmental Biology, Saunders College, Philadelphia.

DEUCHAR, E.M., (1976) Cellular interaction in Animal Development, Chapman and Hall, London.

GILBERT, S.F. (1995) Developmental Biology, II Edn., Sinamer Associates Inc., Publishers, Saunderland, Massachusetts, USA.

SAUNDERS, A.W., (1982) Developmental Biology : Patterns / Principles / Problems. Macmillan Publishing Co., NewYork.

STEVAN, B. and OPPENHEIMER (1980) Introduction to Embryonic Development, Alley and Bern.

TIMIRAS, P.S. (1972) Developmental Physiology and Aging. The Macmillan Company, New York.

WILLER, B.H. and OPPENHEIMER, J.M., (1964) Fundamentals of Experimental Embryology, Prentice Hall.

### **Immunology**

ABBAS A.K., LICHMAN A.K., JORDAN S. POBER J.S. (1997). Cellular and Molecular Immunology, Harcourt Brace and Co., Asia Pvt. Ltd., Singapore.

CHAMPION, M.D., and COOKE, A. (1987) Advanced Immunology, J.B. Lippincott Philadelphia.

CLARK, W.R. (1983). The Experimental Foundations of Modern Immunology, John Wiley & Sons, New York.

COLEMAN, LOMBARD and SICARD (1992). Fundamentals Immunology, W.M.C. Brown Publishers.

STITES D.P. and ABBA I.TERR A.I. (1991). Basic and Clinical Immunology, Prentice Hall International Inc.,

KUBY, J. (1994). Immunology. W.H.Freeman and Co., New York.

NANDHINI SHETTY (1996). Immunology : Introductory Text Book. New age International Pvt. Ltd. New Delhi

PAUL, W.E.M. (1989). Fundamentals Immunology, Raven Press, New York.

RAMAKRISHNAN, S and RAJI SWAMY (1995). Text Book of Clinical Biochemistry and Immunology, T.R. Publications, Madras.

ROITT, M.I. (1994). Essential Immunology, Blackwell Science Ltd., U.K.

ROITT, M.I., BROSTOFF & D.K.MALE (1996). Immunology, IV Edn., Mosby, London.

SRIVASTAVA, R., RAM, B.P. and TYLE, P. (1991). Molecular Mechanisms of Immune Regulation, VCH Publishers Inc., New York.

## **CORE COURSE XI – ANIMAL PHYSIOLOGY**

### **Unit I**

Homeostatic mechanisms : ionic and osmoregulation in crustaceans and fishes – temperature and pH regulations in animals. Light – photobiological processes – pressure – acclimatization to high altitudes – Hydrostatic pressure – Buoyancy.

### **Unit II**

Carbohydrate metabolism – Glycogenesis, Glycogenolysis, Glycolysis, Krebs's cycle, HMP pathway, Gluconeogenesis.

Protein metabolism – Deamination, transamination and transmethylation of aminoacids. Lipid metabolism-Oxidation and biosynthesis of fatty acids.

Integrated metabolism – Mineral metabolism (with spl ref to Na<sup>+</sup>, K<sup>+</sup> and Ca<sup>2+</sup>).

### **Unit III**

Respiration : Respiratory pigments and their functions – Exchange of gases – Transport of oxygen and carbon-di-oxide – Regulatory mechanisms.

Circulation: Chemistry of blood – inorganic and organic components their regulations and functions -blood pigments and functions – Types of transport mechanisms – Cardiac cycle – Blood Pressure –ECG.

Excretion : Excretion in relation to different habitates – Detoxication pathways of ammonia – Regulation of nitrogen excretion.

#### **Unit IV**

Muscles : Mechanism of muscle contraction- Regulation and energetics of contraction – Electric organs.

Nervous co-ordination : Propagation and transmission of nerve impulse – Synaptic transmission.

Bioluminescence – Biological clocks.

#### **Unit V**

Endocrine glands in mammals – hypothalamus, Hypothalamus, Pineal, Thyroid, Parathyroid, Pancreas, Adrenal, Testis and Ovary-Location and structure – Hormones and functions.

Physiology of reproduction : Mammalian reproductive physiology – Reproductive cycles – Hormonal control. Molecular mechanism of hormone action.

#### **Recommended Text Books :**

HOAR W.S. (1987) General and Comparative Physiology, Prentice Hall.

TURNER, C.D. and BAGNARA, J.T. (1976) General Endocrinology, 6<sup>th</sup> Edn., WB Saunders Co., Philadelphia.

#### **Reference Books :**

BALDWIN, E. (1964) An Introduction to Comparative Biochemistry, CUP, London.

BECK, W.S. (1971). Human Design, Harcourt Brace Jorand Inc.,

DAWSON, H. (1964) General Physiology, Little Brown Co., Boston.

ECHERT, R. and RANDALL, D. (1987) Animal Physiology, CBS Publishers and Distributors

GIESE, A.C. (1979) Cell physiology and Biochemistry, Prentice Hall

GORDON, M.S., BARTHOLOMEW, G.A., GRILNELL, A.D., JORGENSEN, C.B., and WHITE.

F.N. (1971) Animal Function, Principles and Adaptation, Macmillan Co., London.

McFARLAND, D. (1986) Animal Behaviour – Psychobiology, Ethology and Evolution, English Language Book Society, Longman.



ROBERT M. BERINE and M.N. LEVY (1988) Physiology, - III Edn., St;Louis, Baltimore, Boston, Lodon.

SCHMIDT NEILSSEN, K. (1985) Animal Physiology – Adaptation and Environment, CUP, London.

TEDESCHI, H. (1993) Cell Physiology, Molecular Dynamics, II Edn., Won C. Brown publishers, Oxford, England.

WILSON, J.A. (1979) Principles of Animal Physiology

WOOD, W.S. (1968) Principles of Animal Physiology, Edward Arnold, London.

## **CORE COURSE XII**

### **PRACTICAL – III**

#### **DEVELOPMENTAL BIOLOGY, IMMUNOLOGY, ANIMAL PHYSIOLOGY AND MICROTECHNIQUE**

##### **Developmental Biology**

Preparation of sperm suspension in frog/bull and observation of the spermatozoa. Observation of live spermatozoa and study of rate of motility of sperm in frog /bull semen.

Effect of thyroxin or iodine on metamorphosis of frog.

Vaginal smear preparation in rat / mouse to study the stages of oestrous cycle.

##### **Immunology**

Identification of lymphoid organs in rat / mouse.

Preparation of antigen and raising of antibody – RBC and sperm proteins.

Determination of human blood group by haemagglutination test and assessment of specificity of antigen – antibody reactions.

Detection of the presence of precipitating antibody (IgG) with soluble antigen by precipitin ring test.

Detection of the specific reactivity of precipitating antibody (IgG) with soluble antigens by double immunodiffusion (Ouchterlony) test.

Detection of the specific reactivity of precipitating antibody (Igg) with fractionated antigens by immunoelectrophoresis.

##### **Animal Physiology**

Quantitative estimation of amylase activity.  
Quantitative estimation of ammonia and urea  
Rate of salt loss and salt gain in fish using different experimental media.  
Estimation of blood chloride.

### **Microtechnique**

Fixing, embedding, sectioning, spreading, staining, and mounting of tissues and embryos

Candidates are expected to study the ecology of chosen habitats and make observations of ecological interest during field studies. Visits to national laboratories and research institutes are recommended.

A record of field work and laboratory work and twenty five slides containing serial sections (Tissue – 10 slides; Embryos – 10 slides) shall be submitted at the time of practical examination.

## **CORE COURSE XIII : ENVIRONMENTAL BIOLOGY**

### **UNIT 1**

General components of environment-Hydrosphere, Lithosphere, Atmosphere and Biosphere  
Ecosystem dynamics- stability and complexity  
Primary Production and secondary production  
Biogeochemical cycles-nitrogen and carbon

### **Unit II**

Population dynamics- growth curve  
Trends in human population – urbanization

Natural resources – Renewable (food, water and forest) and non-renewable (land, energy and mineral) resources. Conservation of natural resources and biota-soil conservation.

### **Unit III**

Biodiversity –basic concepts, types, values, threats , methods of conservation- sustainable development and biodiversity indices.

Wildlife conservation-Wildlife sanctuaries and National Parks-Biosphere Reserves

Habitat Ecology- lake, marine, rocky, muddy and sandy shore, estuary, terrestrial-grassland,forest,desert

### **Unit IV**

Pollution – sources, effects, and control of air, water, organic pollutants, BOD, COD, pesticides, heavy metals, thermal, radiation, oil, land and noise pollution – indicator organisms – bioaccumulation – biomagnification and biomonitoring of pollutants.

Environmental impact assessment (EIA) – definition, steps in EIA, method of EIA, problems involved in EIA, reporting (EIS).

### **Unit V**

Remote sensing – aerial photography – satellite images – thermal, infra – red, radar images, ecological applications – resources exploration, understanding environmental factors, predicting natural hazards, ecosystem management.

GIS and its application

Law and Environmental Protection-National (Indian) and International –Earth summit

### **Recommended Text Books :**

ODUM, E.P. (1996) Fundamentals of Ecology (III Edn), Nataraj Publishers, Dehradun.

SHARMA, B.K. and KAUR, H. (1997) Environmental Chemistry, Goel Publishing House, Meerut.

TACCONI, L. (2000) Biodiversity and Ecological Economics : Participation, Values and Resource Management. Earthscan Publications Ltd., London.

CASTRI, F.D. and YOUNES, T. (1996). Biodiversity : Science and Development. CAB Int., Wallingford, U.K.

### **Reference Books :**

CHAPMAN, J.L., and REISS, M.J. (1997). Ecology – Principles and Applications, CAMBRIDGE University Press, U.K.

CLARK, G.L. (1963). Elements of Ecology, John Wiley and Sons, Inc., New York.

GHOSH, G.K. (1992). Environmental Pollution, Ashish Publishing house, New Delhi.

SHARMA, B.K. and KAUR, H. (1997). An Introduction to Environmental pollution, Goel Publishing House Meerut.

SIMMONS, I.G. (1981). The Ecology of Natural Resources (II Edn), Edward Arnold Publishers Ltd., Bedford Square, London.

KAPOOR, V.c. (1995). Theory and Practice of Animal Taxonomy (III Edn) Oxford and IBH Publishing Co., New Delhi

Global Biodiversity strategy (1992). Report by World Resources Institute (WRI). The World Conservation Union, and United Nations Environment Programme (UNEP).

SINHA, R.K. (1996) Biodiversity (Global Concerns), Commonwealth Publishers, New Delhi.

SOLBRIG, O.T., VAN EMDEN, H.M., and VAN OORDT, P.G.W.J. (1995). Biodiversity and Global change. CAB International, Wallingford, U.K.

STEAMS, S.C and HEKSTRA, R.F. (2000) Evolution – An Introduction, OUP, London.

MUNN, R.E. (1975) Environment Impact Assessment, Principles and Procedures, John Wiley and Sons, Toronto.

AHMAD, Y.J and SAMMY, G.K. (1985). Guidelines to Environmental Impact Assessment in Developing Countries. Hodder and Stoughton, London.

## **CORE COURSE XIV- PRACTICAL IV- ENVIRONMENTAL BIOLOGY**

### **Environmental Biology**

Report on ecological collection representing different habitats and their adaptations – sandy, muddy, rocky shores, Deep sea.

Hydrological studies of water samples with special reference to pollution :  
Chlorides, silicates, calcium, total hardness, phosphates and nitrates – pH, dissolved oxygen and BOD.

Water quality index(WQI) calculation using 9 parameters such as pH, Temperature, Turbidity, Conductivity, Total solids, Dissolved Oxygen, BOD, Nitrate and Phosphate

Quantitative and qualitative estimation of marine & freshwater plankton.

Effect of pollutants on primary productivity  
Determination of LC<sub>50</sub>

A record of laboratory work shall be submitted at the time of practical examination

## **MAJOR ELECTIVE COURSES**

### **ELECTIVE COURSE I - GENERAL AND APPLIED ENTOMOLOGY**

#### **Unit I**

Taxonomy : Basics of insect classification – Classification of insects upto super families – Key characteristics with common South Indian examples.

Morphology of a typical insect. Physiology : Integumentary system – structure and chemistry  
Neuroendocrine system in insects.- physiology of moulting – Endocrine control of moulting and metamorphosis.

#### **Unit II**

Physiology of Respiration – aerial respiration – aquatic respiration.

Circulatory system – structure of heart, mechanism of haemolymph circulation – haemolymph and its composition. Excretory system : Malpighian tubules and their functions – role of rectum in water and ionic regulation.

#### **Unit III**

Nervous system : Structure – Structure and function of compound eye. Stridulatory organ.

Reproductive system : Male ;and female reproductive systems – types of ovaries – vitellogenesis – accessory reproductive glands – their secretions and functions .  
Viviparity – Role of hormones in male and female reproduction.

#### **Unit IV**

Economic importance of Insects – Biology of Honey bee, Silk moth and Lac insect - Culture methods for honey bee and, silk worm – Appliances used and problems related to these cultures.

Helpful insects – Pollinators, predators, parasitoids - scavengers – weeds killers

Destructive insects: Biology, damage caused and control methods of any 3 major insect pests of agricultural importance : Pests of paddy, sugar cane, cotton – Pests of stored products.

## **Unit V**

Principles of Insect control – Prophylactic measures – cultural, mechanical, physical methods – Genetic control and quarantine.

Biological control : Parasites, Predators and Microbial agents.

Chemical methods : Pesticides, classification – types of formulation – mode of action – toxicity – insecticide resistance – environmental safety.

Non – conventional methods : Use of insect growth regulators (IGR), repellents, anti-feedants, pheromones, chemosterilants and irradiation .

Integrated Pest Management (IPM) – definition, Integration of methods – potential components – need for IPM and uses.

## **Recommended Text Books**

AMBROSE, DUNSTON P. (2004) The Insects: Structure, function and Biodiversity. Kalyani publishers, Ludhiana – New Delhi – Chennai.

NAYAR, K.K., T.N. ANANTHAKRISHNAN, and B.V. DAVID (1986) General and Applied Entomology, Tata McGraw Hill Publications, New Delhi.

VASANTHARAJ DAVID, B (2001) Elements of Economic Entomology, Popular Book Depot., Chennai – 15.

CHAPMAN R.F.(1998). The Insects structure and function Cambridge University Press

SNODGRASS, R.E. (1985) Principles of Insect Morphology, McGraw Hill and Co., New York.

WIGGLESWORTH, V.B. Principles of Insect Physiology IX Ed., Chapman and Hall, London.

## **ELECTIVE – II – ENVIRONMENT AND HEALTH**

1. **Man and Environment**: Ecosystems and natural balance – Resources ; Living and Non-living – Biodiversity : its importance and threats – Renewable and non-renewable energy – Future energy options : Solar energy, biogas – Sustainable development – EIA and its need.
2. **Pollution and health**: Effects of air pollutants and health of man – Acid rain, automobile and industrial pollution : effect of oxides of carbon, sulphur and Nitrogen on land and animals. Water pollution : Effect of fertilizers, pesticides, and heavy metals on

- human health – eutrophication – sewage and solid wastes problems – Disposal and treatment.
3. **Environment and disease** : Water and air borne disease : Tuberculosis and respiratory infections, skin infections, cholera, amoebiasis, helminthiasis – diagnosis, precautions and remedial measures (ORT) – disease related to dietary deficiency – stress related disorders.
  4. **Personal Health** : WHO definition of health – Psychosomatic diseases – Stress management – Emotional intelligence – Positive thinking – Body – mind relationship – Life style and health – Yoga: aim, asanas, disease concept, basics about meditation for wholistic health.
  5. **Population and Health** : Population explosion – Urbanization and its impacts – Occupational health hazards – Food contamination and additives – Measures to prevent manifestation of ill health : provision of clean drinking water, application of bio-pesticides and bio-fertilizers, proper diet with supplementation – Impact of GM food on human health and its manifestations.

#### **Reference:**

1. Turk and Turk (1995) Environmental Science, Saunders Company, USA
2. Part and Park (1985) Social and Preventive Medicine, East West Publications, New Delhi.
3. Publications of World Health Organization on Health and Diseases.

### **ELECTIVE III - VERMITECHNOLOGY**

#### **UNIT I**

Earthworms and their environment, diversity, distribution and biology.

The nature of earthworms- soil environment – basic environmental requirements.  
Food and digestive capabilities, respiratory requirements and adaptation.  
Systematic affinities and evolutionary descent.  
Families, genera and species.  
Geographical distribution.  
Life style, behaviour patterns, water relationships, regeneration and transpiration.

#### **UNIT 2**

Role of earthworms in soil structure, fertility and productivity

Earthworms burrows and casts.  
Effect earthworms in soil structure – carbon, nitrogen and phosphorous Transformations.  
Earthworms as bio-indicators of soil types.  
Effect of earthworms on plant productivity.

Earthworms in land amelioration and reclamation.  
Earthworms as indicators of environmental contamination.

### **UNIT 3**

Earthworms in organic waste management.

Management of sewage sludge by earthworms.  
Management of animal, vegetable and industrial organic waste by earthworms.  
Earthworm composts as plant growth media and its marketing.  
The use of earthworm as food protein source for animals  
Engineering of waste management.  
Role of earthworms in processing organic wastes applied to agricultural and  
Other land

### **UNIT 4**

Effects of agricultural practices and chemicals on earthworms.

The effects of cultivation.  
The effects of cropping.  
The effects of fertilizers.  
The effects of chemicals.  
The effects of radioisotopes.  
Heavy metals and acid deposition and earthworms.

### **UNIT 5**

Earthworms and microorganisms and field sampling methods.

The effects of earthworms on the number, biomass and activity of microorganisms.  
Importance of microorganisms as food for earthworms.  
Dispersal of microorganisms by earthworms.  
Role of intestinal microbes of earthworms on the decomposition of organic wastes.  
Field sampling – Passive methods, behavioural methods and Mark recapture methods.  
Counting of mass and biomass estimation.

### **References:**

1. Edwards, C.A & P.J Bohlen, 1996. Biology and ecology of earthworms III Edn. Chapman & Hall N.Y.U.S.A.
2. Edwards, C.A & J.R Lofty Vermicology – The Biology of earthworm, 1997 Chapman & Hall Publications N.Y.U.S.A.
3. Lee, K.E. 1985. Earthworms their ecology and relationships



## **Unit I**

Introduction to poultry science – Historical review and problems of poultry growing in India. Annual egg production in India.

Nomenclature of breeds of fowl, classification of fowls, selection of breed – Natural and artificial brooding.

Housing and equipment – General principles of building poultry sheds, deep litter system, laying cages.

## **Unit II**

Brooding and rearing – Methods of brooding brood temperature, space and duration; fed, water and space allowance, debeaking – vaccination.

Management of growers, layers, broilers – lighting of chicks, growers and layers. Summer and winter management.

Poultry manure – volume, composition, value and disposal.

## **Unit III**

Feed additives – Names, allowance and usage of Food additive – the impact on human health.

Food stuffs for poultry in relation to protein, amino acids, minerals (Ca and P), vitamins and fibre content.

Feed formulations for chicks, growers, phase I to phase III layers and broilers.

## **Unit IV**

Short account on cause symptoms, prevention, control and treatment of viral, bacterial, fungal, protozoan and worm infection, ticks, mites and lice affecting fowl.

## **Unit V**

Nutritive value of egg, factors affecting egg size, storage and preservation of egg, marketing, incubation and hatching of eggs.

Economics of poultry production units to examine first hand rearing and business operation.

### **Text Book:**

Sunil Kumar Das (1994) – Poultry production, CBC Publishers and Distributors, Delhi – 110032.

### **Reference Books:**

1. Banerjee G.C. (1992) A textbook of animal husbandary, Oxford and IBM Publishing Co., New Delhi.

2. Shukula, G.S. and Upadhyay V.B. (1997) Economic Zoology, Rakesh Rastogi Meenit.
3. Indian Poultry Industry year book 1975 – 76. By Sakuntbak B.Gupta, C-34, New Bactak Road, New Delhi – 110 005.
4. Intensive Poultry Management for egg production. Bulletin NO. 152, Her majesty stationery office, London.

## **ELECTIVE – V – COASTAL GEOMORPHOLOGY**

### **Unit I**

Coastal ecosystems, geomorphic classification of coastal systems – unconsolidated coastal materials, consolidated coastal components.

### **Unit II**

Physical basis of coastal environment – tides, tidal range, tidal currents, effects of tides on tidal flats, physical basis of wave movement, effects of waves, surf, Tsunamis.

### **Unit III**

Processes in coastal ecosystem : bars, beach drift and beach forms, Abrasion Platforms and cliffs, estuaries meandering.

### **Unit IV**

Coastal types (structurally controlled), coral reefs, seagrasses, mangroves, swamps, salt marshes, coastal islands, forms, types and processes.

### **Unit V**

Coastal ecosystem impacts : Climate and glacial impact, global change factor, man-induced – changes in coastal geomorphology, Impact of Development projects coastal ecosystems, protection of Marine Biosphere resources, coastal mining and sediment movements.

### **Reference:**

1. Ahnert, F.1998 Introduction to Geomorphology Arnold Publisher, London, 352 pp.
2. Oldale, R.1980 A geologic history of carp cod, U.S. Geological Survey, Washington, D.C.
3. Reed Wicander & James S.Monroe, 1999 Essentials of Geology Wadsworth Publishing Company, Tokyo 447 pp.
4. Sent, P.K. and Prasad, N.2002 Introduction to Geomorphology of India. Allied publishers private limited Mumbai 378 pp.

## **ELECTIVE COURSE VI – ESTUARINE BIOLOGY**

### **Unit I**

Estuarine environment : Classification, characteristics – physical, chemical and biological.

South Indian Estuaries : any three with their biota.

Mangrove swamps : Classification and ecology – their role in fishery potential.

## **Unit II**

Estuarine biota : Plankton – types – their collection and identification.

Fauna – types : Meiofauna, Macrofauna and Microfauna – Composition and characteristics.

Estuarine benthos – their ecology and adaptations.

## **Unit III**

Estuarine Biota : Nekton – fishes – food and feeding habits – growth, reproduction and larval cycle of fin fish, prawns, crabs and edible mollusks.

Estuarine animals and their adaptations.

## **Unit IV**

Estuarine fishery resources of South India – fin fish and shell fish – fishing methods – clarfs and greas.

## **Unit V**

Estuarine farming : Construction and maintenance of fish and prawn farms. Fish culture, Prawn culture, Oyster culture, Crab culture, Clam culture, Artemia culture.

### **Recommended Text Books :**

1. KENNEDY, (1982), Estuarine Perspectives, Academic Press, New York.
2. PERKINS, (1982), The Biology of Estuarine and Coastal Waters, Academic Press New York.

### **Reference Books :**

1. BARDACH, J.E., RYTHER, W.O. and McLARREY (1972) Aquaculture : The farming and Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York.
2. BISWAS, K.P. (1992) Prevention and Control of Fish and Prawn Diseases, Narendra Publishing House, Delhi.
3. BURTON-LIAS, (1982) Estuarine Chemistry, Academic Press, New York.
4. DONALD S. McLUSKY (1985) Ecology of Estuaries, Heinemann Educational Books, London.
5. CMFRI (1992) An Appraisal of the Marine Fisheries of Tamilnadu and Pondicherry, Special Bulletin No.34, Central Marine Fisheries Research Institute, Kochi.
6. DASH, M.C., and PATNAIK, P.N. (1994) Brackishwater Prawn Culture, Palani Paramount Publications, Palani.

7. HORNELL, J., (1995) Marine Fish Farming for India. Associate Publishing House, New Delhi.
8. MPEDA Handbook Aquafarming (1992) Sea Fishes, Marine Products Export Development Agency, Kochi.
9. SAMUEL PAUL RAJ (1995) Shrimp Farming Techniques : Problems and Solutions, Palani Paramount Publications, Palani.
10. SANTHANAM, R., RAMANATHAN, N., JAGATHEESAN, G., and VENGATARAMANUJAN, K. (1988) Phytoplankton of the Indian Seas. Daya Publishing House, New Delhi.
11. SANTHANAM R., and SRINIVASAN, A. (1994) A Manual of Marine Zooplankton. Oxford and IBH Publishing Co., Ltd., New Delhi.

## **ELECTIVE COURSE 7 – FISHERY BIOLOGY**

### **Unit I**

World and Indian Fisheries – Prospects and Problems – Plans, Policies and Current Status of Indian Fisheries.

### **Unit II**

Marine fisheries ; Sardines, Mackerels, Bombay duck, Sciaenids, Ribbonfish, Silver bellies, Pomfrets, Carangids, Sharks, Shrimps, Prawns, Crabs Lobsters, Oysters, Molluscs ; Mussels, Clams and Scallops.

### **Unit III**

Inland fisheries ; Freshwater – riverine, reservoir, pond and cold water fisheries – Spawning and breeding habits of fishes.

Estuarine and brackish water fisheries and their economics

Fish Gears and Crafts used in South Indian Fisheries.

Ornamental fish culture and economics.

### **Unit IV**

Assessment of fish stocks : Marking and recapture method, area sampling method, biostatistical method, egg count method, hydroacoustic method, remote sensing.

Age and Growth : Scale method, otolith method, other skeletal parts as age indicators, length – frequency method, length – weight relationship and condition factor.

Population studies : estimation of population size, marking, tagging, population dynamics, population models.

### **Unit V**

Culture fisheries : Integrated fish farming technology – rice – cum – brackish water fisheries, rice-cum-common carp culture, fish –cum-duck culture, Sewage – fed fisheries – monosex culture – polyculture.

Fish endocrinology – Induced breeding – techniques – examples.

Fish Processing and Preservation – fish by – products – brief account on transport and marketing. Effect of pollution of fisheries.

Fish Pathology : Parasites – Protozoan, fungal, bacterial, worms and arthropods.

### **Recommended Text Books :**

1. BISWAS, S.P., (1993) Manual of Methods in Fish Biology, International Book Co., Absecon Highlands, New Jersey.
2. JHINGRAN, V.G., (1991) Fish and Fisheries of India. Hindustan Publishing Copr., New Delhi.
3. PILLAI, T.V.R. (1993) Aquaculture : Principles and Practices. Fishing News Agency, London.

### **Reference Books :**

1. BOSE, A.N., YANG, C.T., and MISRA, A. (1991) Coastal Aquaculture Engineering. Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
2. CHAKRABARTI, N.M., (1994) Diseases of Cultivable Freshwater Fishes and Their Control. International Books and Periodicals Supply service, New Delhi.
3. DAY, F., (1986) The Fishes of India, Vols., I & II. Today and Tomorrow's Book Agency, New Delhi.
4. GOVINDAN, T.K. (1992) Fish processing Technology, Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
5. MPEDA Hand book of Aquafarming (1992) Freshwater Fishes, Marine Products Export Development Agency, Kochi.
6. NEW, M.B., TACON., A.G.J., and CSAVAS., I. (1993) Farm – made – Aqua feeds. Food and Agrilculture Organization of United nations, Rome.
7. SANTHANAM, R., (1990) Fisheries Science, Daya Publishing House, New Delhi.
8. SEGHAL, K.K. (1992) Recent Researches in Cold Water Fisheries, Today and Tomorrow's Pbulishers and Printers, New Delhi.
9. SINHA, V.R.P. (1993) A Compendium of Aquaculture Technologies for Developing Countries. Center for Science and Technology and Oxford and IBH Publishing Co., Pvt., Ltd., New Delhi.
10. SUBBHA RAO (1986) Economics of Fisheries, Daya Publishing House, New Delhi.
11. TRIVEDI, K.K. (186) Fisheries Development : 2000 A.D. Association of Indian Fishery Industries and Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
12. UMA SHARMA., AND GROVER, S.P., (1982), An Introduction to Indian Fisheries, Bishen Singh Mahendra Pal Singh, Dehra Dun.

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## NON MAJOR ELECTIVE COURSE

### COURSE I : INHERITED DISEASES AND GENETIC COUNSELLING

#### Unit I

Introduction : Basic principles of inheritance – chromosomes and genes – human chromosomes – karyotype - sex determination in man.

#### Unit II

Blood groups in man : Inheritance of ABO blood groups – MN blood group – Rh factor – ABO incompatibilities – Inherited diseases associated with blood – haemolytic anemia – Thalassemia and Cooley's anemia- Genetic counseling.

#### Unit III

Inborn errors of metabolism : amino acid metabolism – phenylketonuria, alkaptonuria, albinism, and genetic goitrous cretinism – sickle cell anemia – diabetes mellitus. Genetic counseling.

#### Unit IV

Sex linked inheritance : X-linked inheritance – haemophilia and colour blindness; Y-linked inheritance – ichthyosis hystrix; Y chromosome based problems in sex determinations and differentiations (introduction only). XY – linked genes – total colour blindness, xeroderma pigmentosum and retinitis pigmentosa.

Abnormal human karyotypes – autosomal abnormalities in man – Down syndrome (21<sup>st</sup> trisomy), Turner syndrome, Klinefelter syndrome and multiple sex chromosome syndrome. Genetic counselling.

#### Unit V

Inherited diseases in man : Dominantly inherited disease – Glaucoma, Alzheimer's diseases and manic depression. Recessively inherited diseases – retinoblastoma and haemolytic anemia.

Diagnosis of genetic disorders : prenatal screening – non-invasive types –ultrasonography; invasive testing methods – foetoscopy, amniocentesis and chorionic villi biopsy.

Management of genetic disorders-gene therapy

#### Reference:

1. Strikberger, M.W. (1985). Genetics, Prentice Hall of India, New Delhi.
2. Stine, C.J. (1989). The new human genetics. Wm.C.Brown Publishers, Iowa.
3. Sarin, C.Genetics (1985). Tata Mcgraw Hill publishing Co., New Delhi.
4. Verma, P.s. and Agarwal, V.K.(1998). Concept of genetics, human genetics and eugenics, S.Chand & Co., Ltd, New Delhi.

## NON MAJOR ELECTIVE II - FRESH WATER FISH CULTURE

#### Unit I

Historical background and present status of aquaculture; Purpose and importance of aqua culture; Categories of farm types and fish farming systems.

## **Unit II**

Types of culture systems – Traditional, extensive, semi-intensive, intensive and super intensive; Characteristic feature of freshwater cultivable species (Indian major carps, murels, cat fish and Tilapia)

## **Unit III**

Types of aquaculture – Freshwater aquaculture, brackish water aquaculture and mariculture-merits and demerits; Selection criteria for cultivable species; Construction of ponds – Types of fish ponds.

## **Unit IV**

Composite fish culture, monosex culture, culture of air-breathing fishes; sewage fed fish culture, Induced breeding of carps – Brood stock management – Management of farms.

## **Unit V**

Control of aquatic weeds and predators; Fish diseases (Parasitic, bacterial, fungal and viral) and control measures.

### **Reference Books:**

1. Jhingaran V.G.(1983) Fish and fisheries of India, Hindustan publishing corporation, New Delhi
2. Santhanam R, Sukumaran N and Natarajan P. (1990) A manual of freshwater aquaculture. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi
3. Shanmugam K. Fishery biology and aquaculture
4. Pillay T.V.R. Aquaculture – Theory and practice, Black well publishers
5. Rath R.K. Freshwater aquaculture, Scientific publishers
6. Shukla, G.S. and Upadhyay V.B. (1997) Economic zoology, Rakesh Rastogi, Meerut.

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## ***NON MAJOR ELECTIVE COURSE III- BIO RESOURCES***

### **Unit I**

Biodiversity – understanding biodiversity, value of biodiversity, threats, conserving biodiversity, biodiversity sustainability, natural and man included changes in Biodiversity – Applications of Biotechnology in Biodiversity.

### **Unit II**

Renewable energy – Sugar cane molasses to ethanol, Bagasse to ethanol, Biomass to renewable energy beneficial by products, biofuels.

### **Unit III**

Bio resources and biotechnology – Genetically modified organisms; benefits and risk generic conservation and sustainable use of bioresources.

## Unit IV

Conservation strategies, past, present and future; Managing land resources, Managing aquatic resources monitoring and the future prospects.

## Unit V

Patterns of resource use : Protected ecosystems, Biosphere reserves, National parks, Wild life sanctuaries, Forest Reserves. Agricultural land – ecological consequences of agriculture, Restoration of ecosystems.

### Reference Books:

1. Wilson, E.J. 1988 Biodiversity. National Academy Press, Washington, D.C., 521 pp.
2. Sen, P.K. and Prasad, N. 2002, Introduction to Geomorphology of India, Allied Publishers Private Limited, Mumbai, 378 pp.
3. Peter D. Stiling 1992, Ecology : Theories and Applications, Prentice Hall, new Jersey 539 pp.
4. Noss, R.F. & A.Y. Cooperinder 1994, Saving Nature's Legacy : Resboring and protecting Biodiversity. Island Press, Washington, D.C. 416 pp.

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## **NON MAJOR ELECTIVE COURSE IV- ORNAMENTAL FISH CULTURE**

### Unit I

Importance of ornamental fish culture

**Design and setting up of fish tank:** Types, construction, accessories and maintenance of home aquarium

Aquarium plants and their uses.

### Unit II

#### **Popular tropical fresh water ornamental fishes and their characteristics**

Live bearers – guppy, molly, platy and swordtail

Egg layers-fighter, gourami, angelfish, koi carp, zebra fish and red tailed shark

A compatible group of fishes for home aquarium

**Food and feeding:** artificial feeds-making pelleted food – quantity and time of feeding.

### Unit III

**Fish food organisms:** Culturing micro algae, zooplankton, tubificid blood worms, brine shrimp.

**Genetics and Biotechnology:** Genetics of gold fish, koi carp, guppy and platy

**Diseases and treatment methods in brief:** Ectoparasite – anchor worm and argulus, white spot, fin rot, mouth fungus, dropsy and velvet disease.



## **Unit IV**

Breeding of aquarium fishes: Conditioning to breed, signs, mode of reproduction; breeding of gold fish, fighter, angel fish and barbs, breeding of live bearers; Care of the fry  
Techniques for the genetic improvement of these fishes.

## **Unit V**

Economics of Commercial farming:

Construction and Management of commercial ornamental fish farm: Structure, construction and types; costs and returns estimate

Setting up of an exporting unit: Collection, breeding and rearing unit;

Reconditioning of export stock: transportation techniques – oxygen packing, method of packing, anesthetics use, transport and export consignment

### **Text Book:**

Ramanathan et al., 2000, Tropical freshwater ornamental fish culture, Department of fisheries farm management, Veterinary and animal sciences University, Tamil Nadu.

### **References:**

1. Dey. V.K. 1995, Hand book of aqua forming, MPEDA India
2. Jameson, J.D. Srinivasan. A. and Venkataramanujam. 1995, Ornamental fish culture technology, TANUVAS publication Chennai
3. Jameson, J.D. and Santhanam. R. 1996, Manual of ornamental fishes and farming technologies Peejay, Thoothukkudi.

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