

(for students admitted from 2008-'09 onwards)

**UNIT I**

Introduction to Animal Kingdom. Outline classification, major hierarchies. Definition of Taxonomy, systematics, classification, identification, nomenclature, International code of Zoological Nomenclature & International Congress of Zoology and International Commission on Zoological Nomenclature

**UNIT II**

Phylum : Protozoa

General characters and classification up to the classes with examples. Type Study: *Plasmodium* sp. Life cycle, different species, symptoms, health care, control measures. Protozoan parasites and disease: *Leishmania*, *Entamoeba*, *Trypanosoma*, *Balantidium*.

**UNIT III**

Phylum: Porifera

General characters and classification upto the classes with examples.

Type Study: *Sycon* sp. Reproduction of sponges, Gemmules, Canal system of sponges.

**UNIT IV**

Phylum: Coelenterata

General characters and classification upto the classes with examples.

Type Study: *Aurelia* sp.

Corals and coral reefs.

**UNIT V**

Phylum: Platyhelminthes

General characters and classification upto the classes with examples.

Type Study: *Taenia solium*

Common Cestode and Trematode parasites of man.

**UNIT VI**

Phylum: Aschelminthes

General characters and classification upto classes with examples.

Type Study: *Wuchereria bancrofti*

Common nematode parasites of man.

**UNIT VII**

Phylum: Annelida

General characters and classification upto classes with examples.

Type Study: *Megascolex* sp.

Vermiculture.

**UNIT VIII**

Phylum: Arthropoda

General characters and outline classification

Type Study: *Periplaneta* sp.

Economic importance of insects in relation to agriculture and human health.

## **UNIT IX**

Phylum: Mollusca

General characters and classification with examples.

Type Study: *Pila* sp. Pearl culture

## **UNIT X**

Phylum : Echinodermata

General characters and classification with examples

Type Study: *Asterias*

Water - vascular system, Larval forms of Echinodermata.

## **UNIT XI**

Phylum: Hemichordata

General characters and classification with examples.

Type Study: *Balanoglossus* sp. Phylogenetic significance.

### ***Reference Books:***

Hickman, Jr.C.P. 1981 Integrated Principles of Zoology 7<sup>th</sup> Ed.

Terera Andesirk and Gerald A 1990 Biology Life of earth

Ayyar, E.A., Manual of Zoology Part I

Jordan E.L. 2004 Invertebrate Zoology Chand & Co

Jordan and Verma 2006 Invertebrate Zoology, Chand & Co

Kotpal series, Rastogi Publication

**B.Sc. (vi) - SEMESTER I – PART III a MAJOR**

**MICROBIOLOGY**

**4 Hours / week**

**5 Credits**

(for students admitted from 2008-'09 onwards)

**Objective:** To expose the students to various micro-organisms and their applied aspects.

**UNIT I**

History of Microbiology

Pasteur, Lister, Alexander Flemming - General Classification of microorganisms - Salient features of bacteria, viruses, algae, fungi, and yeast.

**UNIT II**

Structure of the Bacterial cell - cell wall - Gram +ve and – ve.

Bacterial photosynthesis, Respiration - aerobic and anaerobic, Fermentation/ nutrition and growth. Reproduction, genetic transfer system in microbes.

**UNIT III**

Industrial Microbiology: Microbes in the production of alcohol and antibiotics.

Dairy microbiology: Microbiology of milk and milk products, milk-borne diseases.

Agricultural microbiology: Nitrogen cycle, phosphorous cycle, nitrogen fixation, soil fertility and biogas.

**UNIT IV**

Microbiology of Drinking water.

Methodology of bacterial analysis of water - Waterborne diseases.- Sewage - biological sewage purification methods. Chlorination of water and its implication – Trihalomethane (THM).

**UNIT V**

Medical Microbiology – study of common bacterial (10), fungal (5) and viral (5) diseases of man and their preventive measures.

**Reference Books:**

Microbiology – Anna K. Joshua

Microbiology – Norton C.F.

Microbiology – Pelcazar, Reid and Chan

Text Book of Microbiology – Ananthanarayanan and Jayaram

Food Microbiology – Frazier

Industrial Microbiology – Casida L.F

Microbiology of water and Sewage-Geinyl and Lord

General Microbiology – Boyd

Microbiology – Atlas – Biology of Microorganisms – Brock and Madigan  
General Microbiology – Stainer, John, Mark  
Microbiology – Zinsser

**B.Sc (vi) - SEMESTER I: Part III c. ALLIED I  
ANCILLARY ZOOLOGY –I**

**4 Hours/week**

**3 Credits**

(for students admitted from 2008-'09 onwards)

**Invertebrata**

**UNIT – I**

Outline Classification of Animal Kingdom.

**UNIT – II**

Protozoa: General characters, Classification upto classes, Life history, Mode of infection & preventive measures of *Entamoeba histolytica*, *Trypanosoma gambiense*, *Plasmodium vivax*.

**UNIT – III**

Porifera: General characters, Classification upto classes, General organization of a simple sponge, spicules, Parenchymula, Amphiblastula, Gemmule, canal systems, Economic importance of sponges.

**UNIT – IV**

Coelenterata: General characters, Classification upto classes, General organization of sea anemone, Basic knowledge about polymorphism, coral reef.

**UNIT – V**

Platyhelminthes: General characters, Classification upto classes, structure, life history, Mode of infection of *Fasciola hepatica*, parasitic adaptations, Platyhelminth parasites of man.

**UNIT – VI**

Aschelminthes: General characters, Aschelminthic parasites of man and their significance.

**UNIT – VII**

Annelida: General characters, Classification upto classes, Metamerism – Cephalisation.

**UNIT – VIII**

Arthropoda: General characters, Classification upto classes, Pests of paddy, brinjal, sugarcane, vectors and household insects (mosquito, housefly, flea, bed bug, termite, silver fish, carpet beetle, cockroach).

Commercial importance of Insects – Lac culture, Apiculture, Sericulture

## UNIT – IX

Mollusca: General characters, Classification upto classes, Pearl culture. Economic importance of Molluscs.

## UNIT – X

Echinodermata: General characters, Classification upto classes with local examples.

### Reference Books:

1. Manual of Zoology – Ekkambarathan Ayyar and Ananthakrishnan.

<b>B.Sc. (vi) - SEMESTER I &amp; II – PART III c : ALLIED - I</b>
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<b>ANCILLARY ZOOLOGY PRACTICAL</b>
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<b>2 Hours / week</b>
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<b>2 Credits</b>
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(for students admitted from 2008-'09 onwards)

### Observation:

1. *Amoeba* sp., *Euglena* sp., *Paramecium* sp., *E. histolytica*, *Noctiluca* sp., *Euplectella*, *Spongilla* sp., *Sycon* sp., *Physalia* sp., *Aurelia* sp., Sea anemone, *Fasciola* sp., Miracidium, Redia, Cercaria, *Taenia* sp., Scolex and Proglottids of *Taenia* sp., Lac insect, Silkworm cocoon, *Mytilus* sp., *Chiton* sp., *Dentalium* sp., *Octopus* sp., *Asteropecten* sp., *Holothuria* sp., *Salmacis* sp.
2. Two major pests of Paddy and Brinjal
3. Four specimens of insects of public health importance
4. Dissections: Cockroach- All systems
5. Mountings: mouth parts of Cockroach, Honey bee, House fly, Mosquito, Honey bee – antenna cleaner and Pollen basket
6. Field visit to observe the damage caused by pests of paddy and brinjal

### Observation:

1. Amphioxus – entire, C.S. through pharynx and intestine
2. 5 Elasmobranchs and 5 Teleosts of South India
3. Exocoetus
4. Parental care in Amphibia (*Ichthyophis* sp. and *Alytes* sp.)
5. 5 poisonous reptiles – Cobra (*Naja* sp.), Krait (*Bungarus* sp.), Viper (*Echis* sp.), *Enhydrina* sp., *Phrynosoma* sp.
6. Chameleon
7. 2 Aquatic birds
8. Echidna, Platypus, Bat, Loris
9. Demonstration : Frog, - Digestive system, circulatory system, urinogenital system -
10. Mounting: Placoid scales

**B.Sc. (vi) - SEMESTER I – Part IV a : NON - MAJOR**

**LIFESTYLE RELATED AILMENTS**

***4 Hours / week***

***2 Credits***

**(for students admitted from 2014- 2015 onwards)**

**Objective**

To enable non-Zoology students to get the basic insights to various functions and malfunctions.

**UNIT I:** Changing patterns in health foods. Obesity, gall bladder stones, ulcers, structure of the stomach, role of enzymes. Liver cirrhosis, Fatty liver, regenerative capacity of liver etc. How can we safeguard the liver? Importance of maintaining blood sugar through production of insulin. Diabetes mellitus. Role of Pancreas. Can we reduce the diabetic problem?

**UNIT II:** Understanding the role of stress. Study of the basic structure of heart and its functions. Understanding bypass, stenting, angioplasty, angina, AF (atrial fibrillation), myocardial infarction and arteriosclerosis / atherosclerosis, ECG.

**UNIT III:** Allergies leading to wheezing, asthma-causes, smoking and its ill effects, their influence on the alveoli of the lung. Pollution through inhalation of carbon monoxide etc.

**UNIT IV:** Importance of EEG, Dementia, Alzheimer's, Parkinson's, Stroke aneurysm.

**UNIT V:** Kidney stones, significance of urea, creatinine, electrolytes in blood, urinary infection, ultra-filtration, kidney transplants, dialysis.

**UNIT VI:** Concept of fertility and infertility- Male and Female reproductive systems, Impotency, Endometriosis, ectopic, IVF, ICSU, Surrogacy, STD, Birth control measures etc.

**B.Sc. (vi) - SEMESTER II – Part III a MAJOR**

**ANIMAL LIFE II**

**6 Hours / week**

**5 Credits**

(for students admitted from 2008-'09 onwards)

**UNIT I**

The Chordates: General characteristics, four chordate hallmarks (dorsal tubular nerve cord, notochord, gill slits and post anal tail) adaptations that have guided chordate evolution, ancestry and evolution. General characteristics and classification for subphylum- Urochordata and Cephalochordata.  
Type Study: *Ascidia*, *Amphioxus*.

**UNIT II**

Agnatha: Ostracoderms and Cyclostomata – classification and general characteristics.

**UNIT III**

Gnathostomata : Placoderms – classification and general characteristics.

**UNIT IV:**

Fishes: Evolution and phylogeny, cartilagenous fishes (Elasmobranchii, Holocephali), Bony fishes (Teleostomi); Dipnoi, Crossopterygii, Branchiopterygii and Actinopterygii : Chirolepis – chondrostei, Holostei and Teleostei. Fins and locomotion, swim bladder, accessory respiratory organs, deep sea fishes, specialized organs: Electric organs, sound producing organs, light producing organs, poison glands. Migration and parental care. Food fishes of India (10 marine and 10 FW).

**UNIT V**

Amphibians: Movement onto land – physical contrast between aquatic and land habitats. Origin and relationships of amphibians, appearance of lungs, development of limbs for travel on land, earliest amphibians, amphibian contribution to vertebrate evolution. General characteristics and classification – Coecilians (Apoda) Salamanders and newts (Urodela), frogs and toads (Anura) - parental care.

**UNIT VI**

Reptiles: origin and adaptive radiation of extinct reptiles – general characteristics and classification up to orders with local examples – poisonous and non-poisonous reptiles with special reference to snakes of India. – Reptiles of Mesozoic Era – Phylogeny of Reptiles

#### **UNIT VII**

Birds: Origin and relationship, general characteristics with local examples. Common Birds of India ( any Ten)- Form and function, movement and integration, migration and navigation, Ratitae perching mechanism, flight adaptations.- Types of beak and feet, nesting and parental care

#### **UNIT VIII**

Mammals: General characteristics and Classification up to orders with examples – Dentition in mammals – Placentation – Flying mammals – Aquatic mammals – Adaptive radiation – Phylogeny – Human Skeletal System

#### **UNIT IX**

Jaw suspension in vertebrates – Aortic arches in vertebrates – Development of brain and kidney in vertebrates.

#### **Reference Books:**

Hickman  
E.K. Ayyar  
Jordan  
J.Z. Young

<b>B.Sc. (vi) - SEMESTER II: Part III a MAJOR</b>
<b>ANIMAL LIFE &amp; MICROBIOLOGY PRACTICAL</b> <b>2+2 Hours / week</b> <b>5 credits</b>

(for students admitted from 2008-'09 onwards)

#### **Animal Life - Invertebrata**

1. Identification and observation of features of taxonomic and economic importance (in relation to biological, agricultural and health) sketching and systematic position of the following specimens.

Biological: *Paramecium*, *Euplectella*, *Aurelia*, *Heteronereis*, *Limulus*, Honeybee, *Chiton*, *Sepia*.

Agricultural: Earthworm, *Bombyx mori*, any one pest of paddy and brinjal.

Health: *Entamoeba*, *Taenia solium*, *Anopheles* and *Musca domestica*.

2. Dissection: Digestive, reproductive and nervous systems of Cockroach/ Grasshopper
3. Study of larval forms: Miracidium, Redia, Cercaria, Nauplius, Glochidium and Pluteus.
4. Mounting: Mouthparts of cockroach – Honey Bee: sting apparatus, pollen basket and antenna cleaner.

#### **Animal Life - Vertebrata**

1. Demonstration of dissections of various systems: Alimentary, circulatory and urinogenital systems of frog.
2. Mounting: Placoid scales of Shark.



3. Slides and specimens:

Prochordates: *Herdmania*, *Amphioxus* (section through pharynx) Agnatha: *Petromyzon* and Ammocoetus larva.

Fishes: *Trygon*, *Acipenser*, *Protopterus*, *Echeneis* and *Hippocampus*.

Accessory respiratory organs: *Anabas*.

Amphibia: *Ichthyophis*, *Salamander* and *Alytes*.

Reptiles: *Chelonia*, poisonous and non-poisonous snakes (Krait, Cobra, *Eryx*, *Typhlops*).

Birds– one representative of ratitae and carinatae.

Mammals: Echidna, Platypus and *Loris*.

### **Microbiology**

1. Sterilization
2. Culture preparation
3. Culture of microbes
4. Gram staining (+ve and -ve) (Demonstration)

**B.Sc. (vi) - SEMESTER II – PART III c : ALLIED – I**

**ANCILLARY ZOOLOGY II**

**4 Hours / week**

**3 Credits**

(for students admitted from 2008-'09 onwards)

### **Chordata and General Principles**

#### **UNIT I: Prochordates:**

Basic chordate characters – *Amphioxus* – anatomy.

#### **UNIT II: Pisces**

General characters – outline classification – type study – Shark – parental care in fishes – Common edible fishes of South India (about 10 fishes)

#### **UNIT III: Amphibia**

General characters – outline classification upto orders with few examples in each – Parental care in Amphibia.

#### **UNIT IV: Reptiles**

General characters – classification up to orders – Poisonous reptiles – identification of poisonous and non-poisonous snakes of India – Poison apparatus and its function, Reptiles of economic importance.

#### **UNIT V: Birds**

General characters – fossil birds – migration in birds – economic importance.

**UNIT VI: Mammalia**

General characters – classification upto 3 major groups – Aquatic mammals – flying mammals.

**UNIT VII: Physiology**

Blood – composition – functions – coagulation – groups.

**UNIT VIII: Ecology**

Environmental pollution – wildlife conservation.

**UNIT IX: Embryology**

Gametogenesis – fertilization – parthenogenesis – placentation in mammals.

**Unit X: Genetics**

Sex determination – Syndromes.

**Reference Books:**

1. Manual of Zoology – Ekkambaranathan Ayyar and Ananthkrishnan.

**B.Sc. (vi) - SEMESTER III – PART III a – MAJOR**

**CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY    3+3 Hours / week    5 Credits**

(for students admitted from 2008-'09 onwards)

**Cell Biology**

*Objective: The Course is intended to enable the student to understand the structure and consequently to appreciate the functioning of the cell and its components. A brief history of the development and future of this field is included to enable the student to pursue higher studies in Cell Biology.*

**Unit: I – Brief History of Cytology**

(6 classes)

Invention of the microscope -Discovery of the cell-Foundations of the cell theory and its contributions to Biology.

**Unit: II – Methods of cell study**

(12 classes)

Principles of the light microscope - Histochemical techniques of fixation

Freeze-drying and autoradiography - Biochemical techniques of cell fractionation, Principles of Electron microscopes.

**Unit: III – Ultrastructure, Biochemistry and functional role of** (16 classes)

Plasma membrane -Endoplasmic reticulum -Ribosomes - Golgi Complex – Lysosomes - Mitochondria - Centrioles -Nuclear components, chromosomes, nucleic acids.

**Unit: IV – Genetic code**

(12 classes)

Nature of Genetic code – characteristics of triplet code – cryptoanalysis of genetic code.

**Unit :V- Protein Biosynthesis**

Role of mRNA, tRNA – Activation - Initiation – Elongation – Termination process.

**Unit:VI – Cell Division**

(10 classes)

Mechanics of Mitosis and Meiosis -Parthenogenesis.

***Reference Books:***

1. Cell Biology, Structure, Biochemistry and Function – Phillip Sheeler and Donald E. Bianchi, 2<sup>nd</sup> Ed. John Wiley And Sons, 1983
2. Cell Biology – DeRobertis *et al.*, VIIth Edition, W.B.Saunders Company, 1985
3. Cytology – P.S. Verma & V.K.Agarwal 8<sup>th</sup> Edition S.Chand & Company,2004
4. Cell and Molecular Biology- DeRobertis, 8<sup>th</sup> Ed., Lippincott,2005.

**Developmental Biology**

**INTRODUCTION**

Historical review – Ontogenic and Phylogenic development

**UNIT I : GERM CELL**

Structure of sperm and egg (Human) – Types of eggs. Egg membranes – egg organization – Role of Pituitary and other related endocrines in gametogenesis – Estrous cycle.

**UNIT II : FERTILIZATION**

Mechanics - Physiology – Theories and development – Experimental works in Fertilization - Biochemical changes during fertilization

**UNIT III : CLEAVAGE AND GASTRULATION**

General principles – Outlines of Physiology – Comparative account in Frog, Chick and Man

#### **UNIT IV : EMBRYONIC ADAPTATIONS**

Embryonic Membranes and their function – Placentation in mammals

#### **UNIT V : PARTHEONOGENESIS AND REGENERATION**

Artificial partheonogenesis – Experiments on Artificial Parthenogenesis and their findings – Regeneration in invertebrates and vertebrates – Regeneration studies in Amphibians.  
Types of Placenta in Mammals

#### **UNIT VI : HUMAN DEVELOPEMENT**

Puberty and related changes – Menstrual cycle – Menopause – Pregnancy and related problems – Parturition – Lactation – Contraception and family welfare.

#### **UNIT VII : REPRODUCTIVE TECHNOLOGY**

Super ovulation – Synchronisation of estrous – Artificial insemination – Embryo collection – Semen and Embryo preservation – Embryo transfer – Pregnancy diagnosis – Amniocentesis.

#### ***Reference Books:***

Balinsky – Text Book of Embryology  
Nelson – Comparative vertebrate embryology  
Berril – Developmental Biology  
Raven – Developmental Physiology  
Barrington- Structure and Function of Invertebrates  
Subramonium – Developmental Biology  
Berril & Berth – Development  
McEwven – Comparative Vertebrate Embryology

**B.Sc. (vi) - SEMESTER III - PART III a: MAJOR**

**ENDOCRINOLOGY**

***4 Hours / week***

***5 Credits***

(for students admitted from 2008-'09 onwards)

**UNIT I - Endocrine glands**

Localization – structure – function and secretion.

**UNIT II - Hormones**

General function – types of hormones – steroids – peptides - second messenger – transport – metabolism.

### **UNIT III**

Receptors and hormones.- Mechanism of action

### **UNIT IV: Pituitary**

Structure – synthesis – release and action

### **UNIT V Thyroid**

Structure – secretion - functions – parathyroid and their role - Pathophysiology

### **UNIT VI: Adrenal**

Structure – secretion – function - Pathophysiology

### **UNIT VII: Endocrine functions of the ovary and testis**

Cyclic events of ovaries - Pathophysiology

### **UNIT VIII**

Pineal, thymus and gastrointestinal hormones and their significance.

### **UNIT IX**

Hormones in invertebrates.

### ***Reference Books:***

D. Turner, General Endocrinology.

Williams –Endocrinology

**B.Sc. (vi) - SEMESTER III – PART IIIc: ALLIED II**

**BIOCHEMISTRY - I**

***4 Hours / week***

***3 Credits***

(for students admitted from 2008-'09 onwards)

## **UNIT I**

Physicochemical forces acting on the living body:

Definition of pH, its determination, maintenance of pH in blood – water - buffers and electrolytes in the body and their functions, Definition of osmosis (a method of determining osmotic pressure - oedema and dehydration).

## **UNIT II**

Carbohydrates: Classification and structure of monosaccharides (glucose and fructose in detail) disaccharides (sucrose, maltose and lactose in detail), polysaccharides (starch, glycogen and cellulose) - properties.

## **UNIT III**

Proteins: Classification and structure of amino acid – properties. Classification and structure of Protein – primary, secondary and tertiary structures - quaternary structure with Haemoglobin as example – porphyrins.

## **UNIT IV**

Lipids: General classification of lipids – saturated and unsaturated Fatty acids – names and properties - characterization of fats, saponification value, iodine value - compound and derived lipids.

## **UNIT V**

Enzymes: Definition, classification, mechanism of enzyme action, enzyme substrate complex, enzyme inhibitors, Factors affecting enzyme activity.

### ***Reference Books:***

Lehninger, Albert L. 1970. Biochemistry Worth Publishers, Inc., New York, pp.833.

Jain, L.L. Sunjay Jain & Nitin Jain 2005. Fundamental of biochemistry, S. Chand and Company Ltd., New Delhi, pp.1230.

Ambika Shanmugam 1974. Fundamentals of Biochemistry for Medical Studies. Second Edition (Revised), Aries Agencies, Chennai, pp.647.

Biochemistry – Satya Narayanan

(for students admitted from 2008-'09 onwards)

1. Preparation of solution with ppm, ppt and percentage concentration.
2. Preparation of different molar solutions.
3. Preparation of different normal solution
4. Principles of titrimetry
5. Preparation of buffers with varying pH.
6. Qualitative analysis of Carbohydrates.
7. Qualitative analysis of Proteins.
8. Qualitative analysis of Lipids.
9. Quantitative estimation of carbohydrates.
10. Quantitative estimation of proteins.
11. Quantitative estimation of triglycerides.
12. Quantitative estimation of moisture
13. Separation of aminoacids by paper chromatography.
14. Colorimetric estimation of Creatinine.
15. Determination of enzyme activity : Salivary Amylase
16. Determination of enzyme activity: Alkaline Phosphatase
17. Principles of colorimetry and centrifugation.

**B.Sc. (vi) - SEMESTER III – PART IV b : Inter Disciplinary****WILD LIFE MANAGEMENT****4 Hours / Week****3 Credits**

(for students admitted from 2008-'09 onwards)

*Preamble: This paper deals with wild life from an Indian point of view. The objective of this paper is to expose the student to the potential of Indian forestry and wildlife and to equip him/her to undertake minor projects in this area. He/she will also be in a position to attempt questions in this topic in competitive examinations.*

**UNIT I** Introduction

Definitions, ancient history of wild life in India and its present status. Scope fo wild life biology. Governmental and NGO involvement in protection and conservation of wildlife. Relationship between animals and man.

**UNIT II** : Wildlife ecology

Aquatic, terrestrial, forest and mountain ecosystems. Food chain and food web. Animal populations – natality, mortality, fecundity and growth. Intraspecific and interspecific relationships. Dispersal and factors influencing dispersal. Population analysis and interpretations. Effects of man's involvement on wildlife. Scrub jungle ecology.

**UNIT III:** Wildlife in India.

Endangered species and economically important fishes. Amphibiology – endangered species and economically important amphibians. Herpetology – endangered species and economically important reptiles; special emphasis on Olive Ridley, Crocodiles and snakes. Ornithology – endangered species and economically important birds; bird migration, nesting, bird watching, birds in relation to humans. Mammalogy – endangered species and economically important mammals, Mammals in human life.

**UNIT IV** Wildlife management

Concepts and principles; planning and execution. Habitat evaluation – physical and remote sensing. Habitat conservation and protection. Capture and marking technique for census and treatment – bird rings and radio collars.

**UNIT V:** List & location of Zoos, Sanctuaries, Parks and Biosphere reserves of India.

Role of these in preservation and conservation management. Rehabilitation programmes (eg. Project Tiger). National parks – Khaziranga, Gir, Bandhipur, Kanha, Guindy, Corbett, etc. Marine National Parks – Mannar, Kutch, Point Kalimer, etc. Sanctuaries – Periyar, Mudumalai, Vedanthangal, Bhandipur, etc. Zoos – Mysore, Trivandrum, Vandalur, Hyderabad, etc.

**UNIT VI:** Forestry and Sylviculture

Major vegetation types in India – classification, characteristics, composition and distribution. Indian Forest Act (1927) – Forest Conservation Act (1985).

**UNIT VII:** Wildlife conservation and Legislation



Administrative set up – Central, State, Quasigovernmental. Statutory bodies (IBWL, BNHS, ZSI, WWF, etc). Wildlife protection Act (1972), Rules, regulations and punishment, “Red Data Book”.

**Reference Books:**

1. The Development of International Principles and Practices of Wildlife Research Management by Stephen H. Berwick and U. B. Sahania
2. Ecology of a changing planet by Mark B. Bush
3. Human impact on ecosystem by Trivi and O’Hore
4. National Parks of Madhyapradesh by S. K. Tiwari
5. Endangered Animals of India and their Conservation by S. M. Nair

**B.Sc. (vi) - SEMESTER IV- PART III a – MAJOR**

**MOLECULAR BIOLOGY AND GENETICS 3+3 Hours / week 5 Credits**

(for students admitted from 2008-'09 onwards)

**Unit I**

Nucleic acids: DNA-chemical structure-Purine and Pyrimidines – Chargaff ‘s rule. Watson and Crick model. RNA: chemical structure. Types of RNA: mRNA, tRNA, rRNA. Differences between DNA and RNA.

**Unit II**

DNA synthesis: DNA replication; origin- fork direction; primer, leading and lagging strand, enzymes.

**Unit III**

Transcription: and Translation : RNA polymerase in prokaryote and eukaryote. Initiation – Elongation- Termination. HnRNA. Post –Transcriptional modifications: Splicing: splceosome, intron exon polyadenylation, capping. Reverse transcription –reverse transcriptase-cDNA. Genetic code -Initiation, Elongation and Termination of Translation in prokaryotes and eukaryotes.

**Unit IV**

Regulatory mechanism; Operon model- Jacob & Monod Lac Operon-positive and negative regulation.

**Unit V**

Fundamentals of Genetics: Mendel’s Law, Monohybrid Inheritance- complete dominance, incomplete dominance, codominance.. Dihybrid Inheritance- Independent assortment-Test Cross. Interaction of alleles- complementary , Supplementary and Epistasis. Multiple alleles: Blood Groups-ABO, MN and Rh Blood Groups, Coat colour in rabbit.

**Unit VI**

Linkage-Bateson’s and Punnett’s work on swet pea. Crossing Over- Types, cytological evidence and significance. Mapping of chromosome.

**Unit VII**

Sex Determination: Various Theories;Types-XX-XY, XX-XO, ZZ-ZW. Sex linked inheritance- colour blindness, haemophilia. Gynandromorphs; Human sex linked anomalies. Cytoplasmic Inheritance: Kappa particles in *Paramecium*, maternal effect in *Limnaea*

**Unit VIII**

Mutation: Types Spontaneous – Induced- mutagens-Tautomerization, dimer formation and methylation. Gene mutation –Types-Frameshift, position; addition, Deletion, and substitution. Chromosomal aberration-Numerical: Euploidy, Aneuploidy and Polyploidy. Structural: Inversion, Transversion, Duplication, Deletion. Homologous and Non-homologous Translocation.

## **Unit X**

Applied Genetics:

Eugenics, Euthenics and Genetic Engineering.

### **B.Sc. (vi) - SEMESTER IV – PART III a : MAJOR**

### **CYTOGENETICS, DEVELOPMENTAL BIOLOGY + ENDOCRINOLOGY PRACTICAL**

*2+2 Hours / week*

*5 Credits*

(for students admitted from 2008-'09 onwards)

#### **Cytogenetics**

1. Microscopy - dissection and compound microscopes - identifying the different Components.
2. Dermatoglyphics - ulnar, radial loops, whorls and ridge count
3. Karyotypes - Normal male, normal female, Klinefelter, Turner and Down's syndromes.
4. Identification of prepared permanent slide of : Squamous and columnar epithelium, adipose, bone, cartilage and muscle tissues.
5. Blood smear of man.
6. Blood grouping - A,B,AB,O & Rh<sup>+</sup>ve and Rh<sup>-</sup>ve in human beings.
7. Staining Buccal epithelium (Barr bodies)
8. Mitosis - Preparation, staining and study of different stages in onion root tip.
9. Meiosis - Preparation, staining and study of different stages in grasshopper testis.
10. Study of giant chromosomes in Chironomous larvae.

#### **Developmental Biology**

1. Morphometrics of sperm and ovum
2. Preparation of Sperm smear
3. Study of egg types, cleavage, blastula and gastrula stages of Amphioxus & Frog
4. Dissection of Tadpoles to observe structural peculiarities
5. Study of Human foetal stages
6. Study of developmental stages in chick: 24, 36, 48 and 72
7. Study of pig or goat uterus to observe the placentation type.

#### **Endocrinology**

1. Observation of histological studies of endocrine organs
  - a) ovary b) testis c) thyroid d) adrenal cortex & medula e) pancreas – islets of langerhans f) thymus e) pituitary
2. Estrous cycle - observation in vaginal smear of mice
3. hCG - based pregnancy test.

**B.Sc. (vi) - SEMESTER IV – PART III c – ALLIED II**

**BIOCHEMISTRY – II**

*4 Hours / week*

*3 Credits*

(for students admitted from 2008-'09 onwards)

**UNIT VI**

Metabolism of Carbohydrates – Glycolysis, Krebs cycle, HMP shunt, Glycogenesis, Glycogenolysis, Gluconeogenesis

Metabolism of Proteins: oxidative deamination, transamination, urea cycle.

(Biosynthesis of proteins – basic pattern)

Lipids: Fatty acid breakdown – formation of ketone bodies (Biosynthesis of fats). Cholesterol biosynthesis.

**UNIT VII**

Nucleic acids – structure & significance

**UNIT VIII**

Bioenergetics: I and II Law of Thermodynamics – Free energy, enthalpy of entropy, oxidative phosphorylation, electron transport chain: ATP - Bioenergetics of Glucose fatty acid.

**UNIT IX**

Vitamins: Fat soluble vitamins (Vitamins A, D, E and K) water soluble vitamins (Vitamin B complex and C) with reference to their occurrence and requirements for humans.

**UNIT X**

Hormones: Definition, names of various endocrine glands and their secretations – elementary study of the biological functions of insulin, thyroxine and sex hormones, mechanisms of hormone action.

***Reference Books:***

Lehninger, Albert L. 1970. Biochemistry Worth Publishers, Inc., New York, pp.833.

Jain, L.L. Sunjay Jain & Nitin Jain 2005. Fundamental of biochemistry, S. Chand and Company Ltd., New Delhi, pp.1230.

Ambika Shanmugam 1974. Fundamentals of Biochemistry for Medical Studies. Second Edition (Revised), Aries Agencies, Chennai, pp.647.

**B.Sc. (vi) - SEMESTER V – PART III a : MAJOR**

**BIOTECHNOLOGY**

**5 Hours / week**

**4 Credits**

(for students admitted from 2008-'09 onwards)

**Unit I:** Molecular organization of Cells

Organization of DNA into chromosomes, Histones and DNA – nucleosomal structure –RNA synthesis and RNA processing, RNA processing to form mRNA coding for several proteins – role of nucleolus.

**Unit II:** Gene Technology

Gene manipulation – basic techniques of cloning, vectors used in cloning, Restriction enzymes, linkers, adapters – expression of cloned genes, PCR- Gene expression structures- products and analysis.

**Unit III:** Enzyme technology

Traditional use of enzyme – immobilization of enzymes and applications.

**Unit IV:** Bioprocess technology

Exploitation of microorganism – fermentation technology. Immunotechnology – vaccine production, molecular probes, hybridoma technology – monoclonals. bioremediation etc..

**Unit V:** Environmental biotechnology

Environment and human health; biomonitoring of pollution- waste treatment

**Unit VI:** Applications.

Animal biotechnology: transgenic animals, high yielding and disease resistant animals; Transferring genes into animal oocytes, eggs, embryos and specific animal tissues. Gene transfer to plants.

**Reference Books:**

Molecular biology of cell, Bruce Alberts, Weber, et al.

Molecular Biology of Gene, Watson.

Biotechnology, principles and practices, Primrose.

Concepts in biotechnology, Balakrishnan et al.

Fundamentals of Biotechnology, Gupta

**B.Sc. (vi) - SEMESTER V – PART III a: MAJOR**

**BIOPHYSICS, EVOLUTION & ANIMAL BEHAVIOUR (2+2+2) Hours / week 4Credits**

(for students admitted from 2008-'09 onwards)

**Biophysics**

The subject is introduced to Zoology students to know the physical approach of biological system and to have an overall idea about the subject content.

**Unit-I: Introduction:** Scope of Biophysics; Concept and division of Biophysics; Understanding the physical problems of body; Basic physical laws and its definitions.

**Unit-II: Energetics:** Energy in different forms; laws of thermodynamics; Energy flow in biological systems.

**Unit-III: Molecular Biophysics:** Structure of biomolecules – Protein, haemoglobin, myoglobin, actin, tubulin.

**Unit-IV: Methods of studying molecules:** Principles of Centrifugation, Spectrophotometer, NMR, X-ray diffraction.

**Unit-V: Biomembrane:** Structure of Phospholipids, hydrophobic effects, self assembly, membrane potentials, flux across membranes, selectivity- Nernst, Na, K and ATPase, Donnan; Ion composition-intracellular fluid and extracellular fluid.

**Unit-VI: Electrophysiology:** Nerve conduction and Muscle mechanics-contraction.

**Unit-VII: Clinical Biophysics:** Radiation-radioactive decay, hazards of radiation and radiotherapy; Principles of Ultrasound and CT scan.

**Reference:**

1. A Text book of Biophysics, R.N. Roy, Central Publication 2005
2. Biophysics and Biophysical Chemistry, Debajyoti Das, Academic Press, 2001
3. Essentials of Biophysics, P.Narayanan, New Age International (P)Ltd., 2007.

**Evolution**

**UNIT I**

Origin of life, Growth of evolutionary concepts

**UNIT II**

Evidences in support of organic evolution.

Evidence from Comparative morphology and Anatomy, Embryology, Palaeontology, Physiology and Biochemistry, Genetics, Taxonomy, Geographic distribution

**UNIT III: Theories of Evolution**

Abiogenesis – Biogenesis- Cosmozoic theory – Lamarkism – Darwinism – Neolamarkism, Neo Darwinism – Modern synthetic theory of natural selection– Germplasm

**UNIT IV: Some general principles**

Attavism, Cope's rule – Allen's rule – Allometry – William's rule – Orthogenesis- Extinction, specialization.

**UNIT V: Adaptation**

Types –Mimicry – Coloration – Adaptive radiation in Darwin finches and mammals– Adaptive convergence.

**UNIT VI: Distribution of Animals and Speciation**

Barriers – Isolation and related mechanisms.The species concept – types and process.

**UNIT VII**

Evolution of Man , Cultural evolution of man.

***Reference Books:***

Evolution – process and product, Dodson

Introduction Evolution, Moody.

**Animal Behaviour**

**Unit I : Introduction**

Definitions - ethology, instinct, learning, stimulus, drive and motivation, agonistic behaviour, territorial behavior, courtship behavior. Specific Action Potential (SAP), Psycho-hydraulic model of release of Fixed Action Pattern (FAP).

**Unit II : Animal Orientation**

Tropism, kinesis (definition and classification with examples), taxes (definition and classification with examples). Migration (definition and description of migration in birds).

### **Unit III : Learning behaviour**

Definitions and classification of learning behaviour with examples (habituation, instinct, classical conditioning, trial and error learning, insight learning, imprinting).

### **Unit IV : Social Behaviour**

Communication : Definition and significance of communication. Communication through vision – bee dance, communication through sound - birds, bats (echolocation through ultrasound); communication through chemicals and pheromones.

Courtship: Definition and description with suitable examples from the animal kingdom.

Agonistic behaviour : aggression and appeasement behaviour : definition and description with suitable examples.

Territorial behaviour : Definition and description with suitable examples.

### **Unit V : Rhythmic Behaviour of Animals**

Types of biological rhythms (definitions) – circadian, lunar, tidal, annual; terminologies used (zeitgeber, phase, phase shift, entrainment, free running rhythm, actogram, masking, arrhythmia). Properties of circadian rhythms. The role of different hormones in the control of behavior, with examples.

### **Unit VI : Human Behaviour**

Actions: Inborn, discovered, absorbed, trained and mixed actions.

Gestures: Primary and secondary gestures , Baton signals, greeting signals.

### ***Reference Books:***

McFarland, D, Animal Behaviour

Manning, Introduction to Animal Behaviour

Desmond Morris, Manwatching.

<b>B.Sc. (vi) - SEMESTER V- PART III a: MAJOR</b>
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<b>BIOINFORMATICS &amp; BIostatISTICS</b>
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<b>5 Hours / week</b>
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<b>4 Credits</b>
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(for students admitted from 2008-'09 onwards)

## **Bioinformatics**

### **Unit I: Introduction to Bioinformatics**

Aims, Tasks and Applications of Bioinformatics. Information Retrieval System. Genomics – Recombinant DNA technology - DNA sequencing. Applications of bioinformatics – Human Genome Project, Sample software in biology.

### **Unit II: Biological Databases**

Sequence, structure and literature databases. Data submission Tools, Data Analysis and Prediction Tools. Nucleic acid and proteins sequence data banks. Databases of patterns, motifs and profiles: Metabolic Pathway Databases. Specialized Software packages.

### **Unit III: Genomics and Proteomics**

Genome sequencing technology, Whole genome analysis, Comparative genomics - Proteomics – protein structure prediction (primary, secondary & tertiary) viewer for protein structure – PDB. Gene to Protein Function: Analysis of Proteomes, Analysis of 2-D gels, Human Genome Project.

#### ***Reference Books:***

1. Computers and Common Sense (Fourth Edition)- 1997  
Roger Hunt, John Shelley, Prentice Hall of India Private Ltd.
2. Basic Bioinformatics 2005, S.Ignacimuthu, s.j.  
Narosa Publishing House
3. Introduction to Bioinformatics ( Fourth Edition ) - 2003  
T.K. Attwood & D.J. Parry- Smith, Pearson Education ( Singapore) Pvt. Ltd.
4. Introduction to Bioinformatics - 2003  
Arthur M. Lesk , Oxford University Press
5. Bioinformatics- Methods and Applications- Genomics, Proteomics & Drug Discovery- 2005  
S.C. Rastogi, N. Mendiratta & P. Rastogi , Prentice Hall of India Private Ltd.
6. Bioinformatics- Databases and Algorithms - 2006  
N. Gautham - Narosa Publishing House
7. Discovering Genomics, Proteomics & Bioinformatics- 2003  
A.Malcolm Campbell & Laurie J. Heyer, Pearson Education ( Singapore) Pvt. Ltd.
8. Bioinformatics- Managing Scientific Data- 2003  
Zoe Lacroix & Terence Critchlow, Morgan Kaufmann Publishers.

### **Biostatistics**

#### **Unit I**

Definition – history and development of biostatistics – importance of biostatistics, functions and limitations of biostatistics, data in biology – samples and populations – definitions of variable, variables in biology, accuracy and precision of data, derived variables – Indices, ratios, percentages and rates.

#### **Unit II**

Collection of data: primary data – methods of collection, (survey experimental and observation method), secondary data. Sampling and sampling design – law of statistical regulatory and law of inertia of large numbers.

Types of samples – random and non-random samples.

Classification of data – based on differences in kind, quantitative, geographical, chronological and alphabetical classification.

Tabulation of data – components of tables, types of tabulation – simple and complex. General and special purpose tables.



Diagrammatic representation of data – differences between diagrams and graphs, types of diagrams – one, two and three-dimensional diagrams, pictograms, cartograms.

Graphical representation of data – classification of graphs – graphs of time series and frequency distribution

### **Unit III**

Measures of central tendency – arithmetic mean, other means (weighted, geometric and harmonic), median, mode - measure of dispersion and variability – range, percentile, quartile interquartile range or quartile deviation, mean deviation standard deviation, coefficient of variation – Lorenz curve.

### ***Reference Books:***

Biostatistics – Jyothikumar

Statistical methods in bioinformatics - Ewens W J

Statistical methods in biology - Bailey Norman T J

**B.Sc. (vi) - SEMESTER V- PART III a: MAJOR**

**BIOTECHNOLOGY & BIOINFORMATICS PRACTICALS**

***2+2 Hours / week***

***4 Credits***

(for students admitted from 2008-'09 onwards)

### **Biotechnology**

1. Laboratory organization and GLP
2. Sterilization and Media preparation
3. Culture technique- Basic principles of animal cell culture
4. DNA isolation from bacteria ( Demo)
5. Genomic DNA isolation from animal tissues.

6. Separation of DNA by agarose gel electrophoresis
7. Estimation of DNA by Diphenylamine method.
8. Enzyme immobilization.
9. P.C.R.
10. Design of bioreactor.

### **Bioinformatics**

1. Databases: Literature databases Pub Med, Medline.
2. Protein sequence database: Uni Prot
3. Nucleotide sequence database: Genbank.
4. Similarity search tools-Entrez, FASTA and BLAST.
5. EMBOSS – Pair Wise Sequence Analysis
6. CLUSTAL W – Multiple Sequence Analysis
7. DS Visualizer- Protein Visualization
8. RasMol

<b>B.Sc. (vi) - SEMESTER: V and VI – PART III b. ELECTIVE</b>		
<b>a. AGRICULTURAL ENTOMOLOGY</b>	<b>2+3 Hours/week</b>	<b>2+3 Credits</b>

(for students admitted from 2008-'09 onwards)

**UNIT I:** Introduction to Entomology. Types of damage to plants by insects – insect pests – Causes of insects assuming pest status- Introduction to agronomy.

**UNIT II:** Insect pests of crops:

Pests of Rice: *Rice leaf folder, Rice stem borer, Rice thrips, Rice gall midge, Rice mealy bug, Green rice leaf hoppers, Brown plant hopper, Rice earhead bug, Rice grass hoppers, Whorl maggot.*

Pests of Sugarcane: *Sugarcane Shoot borer, Stem or internode borer, Top borer, Termites, White grubs, Sugarcane leaf hopper, Sugarcane scale, Mealy bug, Whiteflies.*

Pests of Coconut: *Rhinoceros beetle, Red palm weevil, Black-headed caterpillar, White grub.*

Pests of Vegetables: Brinjal – *Shoot and fruit borer, Stem borer, Spotted leaf beetle, Grey weevil,* Tomato – *Fruit borers, Serpentine leaf miner,* – Pests of lady's finger and gourds.

Pests of Beverages: Coffee – *Coffee white borer, Red borer, Green scale,* Tea – *Tea mosquito bug* – Pests of Cocoa.

Pests of Stored products: *Rice weevil, Sweet potato weevil, Lesser grain borer, Tobacco beetle, Drug store beetle, Pulse beetle, Tamarind beetle, Red flour beetle, Indian meal moth, Fig moth, Rice moth, Khapra beetle.*

**UNIT III:** Methods of pest control – Natural control – Applied or artificial control – Prophylactic methods – Curative or direct methods – Cultural methods – Mechanical methods – Physical methods – Biological methods – Chemical methods – Insect attractants – Repellents – Anti feedants – Genetically modified crops – Bt cotton – Bt brinjal – Bt maize.

**UNIT IV:** Pesticides – Classification of Insecticides – Inorganic compounds – Organic compounds – Synthetic organic compounds.

**UNIT V:** Plant protection appliances – Dusting and dusters – Spraying and sprayers – Aircraft application of pesticides – Other equipments.

**UNIT VI:** Integrated Pest Management

**REFERENCE:**

Elements of Economic Entomology – B. Vasantharaj David

**B.Sc. (vi) - SEMESTER: V and VI- PART III b. ELECTIVE**

**a. SERIBIOTECHNOLOGY**

**2+3 Hours/week**

**2+3 Credits**

(for students admitted from 2008-'09 onwards)

**UNIT 1 INTRODUCTION**

Silk producing organisms-tasar silk-muga silkworm-eri silkworm-anaphe silkworm-gonometa silkworm-fagara silkworm-coan silkworm-spiders-mussel-uses of silk-history of sericulture-silk production in the world-sericulture in India-sericulture in pre-british period-sericulture during the british period 10-sericulture after independence-the central silk board-members of CSB-functions of CSB-organizational set-up of CSB-research institutes-CSR&TI,mysore and berhanpore-the national silkworm seed project, Bangalore-the centralsilk technology research institute-the silkworm seed technology laboratory [SSTL]-the seribiotech laboratory-training facilities in sericulture-facilities available for sericulturists-national sericulture projects[NSP]-future scope.

## **UNIT 2 MORICULTURE**

Geographic distribution- optimum conditions for growth- other uses -medicinal value -classification

## **UNIT3 PACKAGE OF PRACTICES FOR MULBERRY CULTIVATION**

Package of practices-planting material-Mulberry varieties recommended-preparation of land-planting direction and season-planting distance-planting system-PIT system-row system-kolar system-strip system-angular system- Irrigation- manuring- harvesting.

## **UNIT 4 DISEASES OF MULBERRY**

Fungal, bacterial and viral diseases- -deficiency diseases.

## **UNIT 5 PESTS OF MULBERRY**

Insect and non-insect pests

## **UNIT 6 BIOLOGY OF *Bombyx mori***

Taxonomic Position of *Bombyx mori* - life cycle of *Bombyx mori* - Races of *Bombyx mori* - classification based on the number of larval moults – classification based on the voltinism-classification based on place of origin- Indigenous pure races of India- Kashmir race- Borapalu- C. Nichi- Chotopolu- Bulupulu- Nistari- pure Mysore- Nyapolu- Sarupat- Moria- Commercial races of India- multivoltine Races- Bivoltine races- races evolved through mutation breeding-races evolved through line breeding methods- races with sex-limited character.

## **UNIT 7 GRAINAGE TECHNOLOGY**

Breeding stations- P4 and P1 stations- P2 stations- P1 stations- selection of A seed cocoon rearer-grainages- procedures in a grainage- diapausing and non-diapausing egg- diapausing eggs-storage of eggs- incubation constant temperature incubation- raised temperature incubation-embryonic method of incubation- transport of eggs.

## **UNIT 8 REARING FACILITIES**

Rearing house- bed cleaning- spinning larvae- disinfection-maintaining optimum conditions.

## **UNIT 9 REARING OPERATIONS**

Disinfection-physical methods-chemical methods-brushing-brushing from loose eggs in egg boxes-brushing from egg cards-maintenance of optimum conditions for rearing-temperature-humidity-quantity of feeding-frequency of feeding-quality of leaf-preparation of leaf for feeding-bed cleaning-frequency of bed cleaning-methods of bed cleaning-spacing-frequency of spacing-methods of spacing-care during moulting-mounting-characteristic features of a ripe worm-process

of spinning-methods of mounting-population density in mounting-precautions to be taken during mounting-harvesting.

#### **UNIT 10 REARING METHODS**

Chawki rearing of young age worms in India-paraffin paper rearing-box rearing-new net rearing-co-operative rearing-chawki rearing methods in Japan-single feeding per instar-wet cloth rearing-closed rearing-pack rearing-kasso rearing-showa rearing-co-operative rearing in Japan- rearing of nature larvae-shelf rearing-floor rearing-shoot rearing.

#### **UNIT 11 DISEASES OF *BOMBYX MORI***

Protozoan disease-bacterial disease [“flacherie”]-bacterial flacherie or gastric injury flachers-septicemia-sotto disease-court disease-viral disease-infectious flacherie-gattine-grasserie-fungal disease-disease of the adult moth.

#### **UNIT 12 PESTS OF SILKWORM**

Uzi fly-Indian uzi fly-Kuoso or Japanese uzi fly-black uzi fly-tasar uzi fly-dermestid beetles-the straw mite (pediculus ventricosus)-ants-nematode-lizards,rats,squirrels & birds.

#### **UNIT 13 COCOON MARKETING**

Transport of cocoon- physical characters of cocoons considered for commercial purposes-defective cocoons- defects due to heritable racial characters- defects arising from mistakes in rearing and mounting- defects due to parasitic infestation- defects due to moth emergence- cocoon markets.

#### **UNIT 14 SILK REARING**

Stifling- sun-drying- steam- stifling- hot- stifling- storage of cocoons- sporting of cocoons-deflossing- cocoon riddling- cocoon mixing or blending- cocoon cooking- boiling for top reeling-boiling for sunken system of reeling- brushing- reeling operations- reeling end formation-intertwining or twisting- drying and distribution of the thread on the reels- reeling appliances-country charkha (traditional charkha)- domestic basin- cottage basin- filatures- re-reeling- lacing, skeining- raw silk testing- visual tests- mechanical tests.

#### **UNIT 15 BY-PRODUCTS OF SERICULTURE**

By-products of moriculture-by-products of rearing-use as compost-use as animal feed-use as suturing material-use as feed for biogas plant-use in pharmaceutical industry-by-products of grainage operation-use of pierced cocoons-use of waste moths-by-products of reeling-defective cocoon wastes-pupal waste-reeling wastes-commerical classification of silk thread wastes-filature wastes-charkha wastes-spun silk.

#### **UNIT 16 AN ASSESSMENT OF SERICULTURE IN INDIA AT PRESENT**

Productivity in moriculture-productivity of silkworm races-bivoltine rearing-productivity of reeling sector-prospects of sericulture.

**Bioprocess Engineering and Technology**

**UNIT I**

Introduction to bioprocess engineering: Basic principles of bioprocess. Types of fermentation: batch, fed batch and continuous fermentation systems. Microbes in industrial process: Isolation, screening and maintenance of microbes for industrial processes. Strain improvement. Microbial growth kinetics.

**UNIT II**

Upstream processing: Microbial Nutrition, Media formulation for industrial fermentation. Development of inocula for the industrial fermentations. Scale up.

**UNIT III**

Bioreactors: batch, fed –batch and continuous bioreactors, biotransformation, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.

**UNIT IV**

Industrial production of chemicals, alcohol(ethanol),acids (citric, acetic and gluconic ),solvents (glycerol,acetone,butanol,antibiotics(pencillin,streptomycin,tetracycline),aminoacids (lysine, glutamic acid),single cell protein. Enzyme and whole cell immobilization and their industrial applications.

**UNIT V**

Downstream processing: Introduction, removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid – liquid extraction chromatography, Membrane process. drying and crystallization. Effluent treatment D.O.C. and C.O.D. treatment and disposal of effluents.

***Reference Books:***

1. Biochemical Engineering, Aiba,S., Humprey,A.E., and Millis,N.F., Unty. of Tokyo Press, Tokyo.
2. Biochemical Reactors. Atkinson,B., Pion, Ltd., London.
3. Biochemical Engineering Fundamentals. Baily,J.E., and Ollis,D.F., McGraw – Hill Book Co. New York.
4. Bioprocess Technology: Fundamentals and applications, KTH, Stockholm.
5. Process Engineering in Biotechnology, Jackson,A.T., Prentice Hall, Engelwood Cliffs.
6. Bioprocess engineering: Basic Concepts, Shuler,M.L., and Kargi,F., Prentice Hall, Engelwood Cliffs.
7. Principles of Fermentation Technology. Stanbury,P.F., and Whitaker,A., Pergamann Press, Oxford.
8. Bioreaction Engineering Principles , Neilson,J., and Villadsen,J. Plenum Press.
9. Chemical Engineering Problems in Biotechnology, Shuler, M.L.(Ed.), AICHE.

10. Biochemical Engineering, Lee,J.M., Prentice hall Inc.

11. Biochemical Engineering – Kinetics, Mass Transport, Reactors and Gene Expression, Vieth, W.F., John Wiley and Sons, Inc.

**B.Sc. (vi) - SEMESTER: V and VI – PART III b. Elective**

**b. VERMITECHNOLOGY**

**2+3 Hours/week**

**2 + 3 Credits**

(for students admitted from 2008-'09 onwards)

**UNIT I**

Concepts of vermitechnology, objectives, scope and application of vermitechnology. Endemic and exotic species of earthworms. Distribution and seasonal dynamics of earthworms. Drilospheres and vermicasts.

**UNIT II**

Special features of Lumbricidae, Megascolidae and Eudrilidae with suitable examples. Biology and anatomy of earthworms : metamerism, musculature, locomotion, digestive system, nutrition, reproductive system, clitellum and cocoon formation. Classification of earthworms.

**UNIT III**

Ideal conditions for vermicomposting and maintaining a vermiculture unit. Types of vermicomposting - large scale and small scale vermicomposting. Vermicomposting - raised bed method and pot method.

**UNIT IV**

Earthworms as bioreactors. Materials required for vermibed preparation. Bioremediation using earthworms - minimizing pollution hazards and application of vermitechnology by recycling of organic wastes.

**UNIT V**

Diseases caused in earthworms, attack of predators and parasites and suitable remedies. Solutions for problems affecting worm bins. Properties of vermicompost. Collection of vermiwash and methods to obtain vermiwash.

**UNIT VI**

Economics of vermiculture - cost benefit analysis : establishment of vermiculture unit, infrastructure, raw materials, labour, accessories. Harvesting of vermicompost, packaging and marketing.

***Reference books :***

1. Invertebrate Zoology - E.L.Jordan P.S.Verma
2. Principles and Practice of Soil Science - Naren Kumar, Dutta
3. Soil Microbiology - N.S.Subba Rao
4. Vermicomposting - P.K.Gupta
5. Vermiculture and Organic Farming - T.V.Sathe

**B.Sc. (vi) - SEMESTER: V – PART IV b. SKILL BASED**

**VERMICULTURE**

**4 Hours/week**

**2 Credits**

(for students admitted from 2008-'09 onwards)

**UNIT I :**

Introduction: Definitions and concept of vermiculture. Soil: major types (red soil, black soil, alluvial soil). Influence of soil organisms in vermiculture - bacteria, earthworms, entomofauna, mites etc. Litter degradation and decomposition.

**UNIT II :**

Types of earthworms : Endemic and exotic species of earthworms. Ecological classification of earthworms - epigeic, anecic and endogeic forms. Physical, chemical and biological changes caused by earthworms in soil - drilospheres and vermicasts.

**UNIT III :**

Vermicomposting - vermicomposting materials, vermicomposting methods (raised bed method and pot method). Vermicompost - quality, properties and advantages over chemical fertilizers. Problems in vermiculture and remedial solutions.

**UNIT IV :**

Natural enemies of earthworms - Pests, parasites and pathogens affecting earthworms. Uses of earthworms in food and medicine - ayurvedic and unani medicine. Recycling of food wastes in vermiculture. Application and scope of vermiculture.

**UNIT V :**

Establishment of vermiculture unit: materials required, conditions for maintenance of vermiculture unit, harvesting of vermicompost, packaging and marketing - cost benefit analysis - man power, infrastructure and other raw materials.

**Reference books :**

1. Invertebrate Zoology - E.L.Jordan P.S.Verma
2. Principles and Practice of Soil Science - Naren Kumar, Dutta
3. Soil Microbiology - N.S.Subba Rao
4. Vermicomposting - P.K.Gupta
5. Vermiculture and Organic Farming - T.V.Sathe



**B.Sc. (vi) - SEMESTER: V – PART IV b. SKILL- BASED**

**COMPUTER BASICS**

**2 Hours/week**

**3 Credits**

(for students admitted from 2008-'09 onwards)

**Unit I**

Introduction : Components of computer – hardware and software, power supply, peripherals.  
Installation of operating system

**Unit II**

MS word, MS excel, MS power point– short cut keys, saving documents, printing, scanning.

**UNIT III**

Internet : LAN, MAN, WAN, types of topology, requirements for internet connections, Integrated Service Digital Networking and its utility, Internet Service Provider (ISP) – IP address, File Transfer Protocol (FTP).

**Unit IV**

Internet access : web pages, web browsers, search engines : google, yahoo, Uniform Resource Locator (URL), electronic mail, installation of antivirus.

**Reference books :**

1. Computers and Common Sense (Fourth Edition), 1997 - Roger Hunt, John Shelley, Prentice Hall of India, Private Ltd.
2. Essentials of Computer Applications - S.Mythili.S.Gopalan

**B.Sc. (vi) - SEMESTER VI – PART III a : MAJOR**

**ANIMAL PHYSIOLOGY AND IMMUNOLOGY**

**4+3 Hours / week**

**5 Credits**

(for students admitted from 2008-'09 onwards)

### **Animal Physiology**

#### **UNIT I: Respiration**

Availability of oxygen. Respiratory organs in animals. Properties and function of respiratory pigments. Regulation of respiration

#### **UNIT II: Circulation**

Types of hearts. Composition and functions of blood. Cardiac rhythm, cardiac output, ECG, Blood pressure. Electrical activity and properties of the heart. Regulation of the cardiovascular function

#### **UNIT III: Coordination (Neuromuscular and neuroendocrine)**

Nerve impulse conduction. Ultra structure of muscle. Theories of muscle contraction

#### **UNIT IV: Excretion**

Structure and functions of different excretory organs in animals. Mechanism of urine formation in man

#### **UNIT V: Homeostasis**

Significance. Mechanism of osmo-ion regulation in fresh water, estuarine and marine fishes

#### **Reference Books:**

Invertebrates Structure and

### **Immunology**

**Unit I** Immunity- Definition. Types of immunity-Active and Passive.

**Unit II** The basis of immunity: Innate Immunity- Natural Barriers, Phagocytosis, Inflammation, Complement system, lectin. Adaptive Immunity- Primary and secondary response, memory, Booster response.

**Unit III** Antibody: Immunoglobulin; Basic structure, classes and role in immunity. Cellular Immunity Hemopoietic Tissue: Types and functions of B and T cells; cytokines and Interleukines.

Antigen: Types and structure. Hapten; Immunogen. Antigen-antibody reaction: Haemagglutination, Precipitation, Immunodiffusion -ELISA

**Unit-IV** Lymphoid organs: Primary and secondary organs- location, structure and role. Bone marrow, Thymus, Bursa of Fabricius, Lymph node, Spleen, MALT, GALT.. Maturation of Immuno-competent cells.

**Unit V** Clinical Immunology. Immune response of Infections caused by bacteria and virus. Diseases- Immunodeficiency, Hypersensitivity and autoimmune. Transplantation-Types of Graft-MHC-HLA.

**B.Sc. (vi) - SEMESTER VI – PART III a : MAJOR**

**ENVIRONMENTAL BIOLOGY AND BIODIVERSITY 4+3 Hours / week 4 Credits**

(for students admitted from 2008-'09 onwards)

**Environmental Biology**

- I. - Abiotic and Biotic factors: Ecosystem concept – Pond as an Ecosystem – Energy flow – Ecological pyramids – Food chain – Significance of food-web. Biogeochemical cycles – Nitrogen – Phosphorous and Carbon cycles.
- II. Ecological factors: Water, pH, salinity, temperature and light as factors. Atmospheric pressure – Moisture in the atmosphere – Hydrological cycle – Humidity.
- III. Population Ecology: Basic concepts of population ecology – Characteristics of population – Inter and intra specific relations among populations.
- IV. Community: Characteristics of a community, Ecological succession – causes of succession, Basic types of succession – General process of succession – Hydrosphere or hydarch; Lithosphere – a xerosphere on rock; climax concept in succession.
- V. Freshwater Habitat: Lentic community; Lake zonation, Thermal stratification of a lake; Eutrophication; Lotic community-streams & rivers; Stream zonation and communities.
- VI. Marine Habitat: Characteristics of ocean, Structure of ocean; Ocean zones; Biotic communities of oceanic zone; Pelagic life of marine organisms and their adaptations – Plankton as a community – Benthic life and adaptations – Intertidal; rocky, sandy and muddy shores. Marine pollution; control of marine pollution.
- VII. Terrestrial Habitat: Biomes – Latitudinal and Altitudinal life zones; Major Biomes; Desert, grassland, Tropical rain forests, Temperate deciduous forests, Taiga and Tundra.
- VIII. Environmental Pollution & Public Health:  
Air pollution – sources of pollution, Acid rains; Ozone; Prevention and control of air pollution. Water pollution; Sources of Pollution and Pollutants; Prevention and control of water pollution. Land pollution: Solid waste Pollution; Radioactive pollution; noise pollution; pollution control through law.

## IX. Natural Resource and their Conservation:

Resources – types of resources; soils of India; Climate of India; climatic regions of India; vegetation of India; Diverse fauna of India; Wild life of India; Endangered flora and fauna of India, Natural parks and sanctuaries. Projects for endangered species, Biosphere reserves. Conservation: soil, land, water conservation; Forest resources; Forest cover; Deforestation, Afforestation.

### ***Reference Books:***

Fundamental of Ecology – Eugene P. Odum  
Elements of Ecology – Clarke  
Animal Population – Browning  
Concepts of Ecology – Kormandy  
Ecology & Environmental Science – H.R.Singh & Neeraj Kumar  
Environmental Biology – P.D.Sharma

## **Biodiversity**

### **Unit I** Introduction

Defining biodiversity, convention on biological diversity, its role, goals, functioning and perspectives.

Mega diverse nations protected areas and biosphere reserves in India, IUCN, categories of threats – Marine Park.

### **Unit II:** Biodiversity from taxonomic and evolutionary perspective:

Origin of scientific taxonomy, basics of taxonomic characterization, characterizing, species (the morphological species concept, biological species concept, the phylogenetic species concept). Taxonomic measures of species diversity, modern developments (database and expert identification systems).

### **Unit III:** Types of Diversity

Ecosystem diversity, (variety of habitats), species diversity, genetic diversity. Methods of measuring species diversity, molecular methods of assessing levels of genetic diversity.

### **Unit IV:** Human society and biodiversity, Cultural diversity, values of diversity.

### **Unit V:** Legislation

A review of national and international treaties, conventions and laws, biodiversity and international environmental law, intellectual property rights over biological products.

### **Unit VI:**

Biodiversity conservations and sustainable use.

### ***Reference Books:***

Ferguson. C. 1980. Biochemical Systematics and Evolution.

Mayor. E. 1994. Principles of Systematic Zoology.  
Agarwal. K.C. 2000. Biodiversity.  
A.B.Choudhari and D.D.Sarkar 2002. Biodiversity Endangered.  
Kumar.V. 2003. Biodiversity Principles and Conservation.  
Kotwal P.C. 2003. Biodiversity Conservation in Managed Forests and Protected Area.  
Trivedi. P.C. 2004. Biodiversity Assessment and Conservation.  
India 2006: Ministry of Information and Broadcasting, Government of India, New Delhi.

<b>B.Sc. (vi) - SEMESTER VI – PART III a: MAJOR</b>
<b>ANIMAL PHYSIOLOGY &amp; IMMUNOLOGY AND ENVIRONMENTAL BIOLOGY &amp; BIODIVERSITY PRACTICALS</b>
<b>3+3 Hours / week</b>
<b>4 Credits</b>

(for students admitted from 20014-'15 onwards)

### **Animal Physiology and Immunology**

1. Estimation of oxygen consumption in an aquatic animal (Fish)
2. Blood smear: Total and differential count
3. Qualitative analysis of excretory products of animals
4. Estimation of salt loss or gain in an aquatic animal in heterosmotic media
5. Enzyme activity in relation to pH
6. Microscopic observation of sections of - Bone marrow, Thymus, Spleen and Lymph node
7. Locate primary and secondary lymphoid organ in any vertebrate (Demo)
8. Human blood smear: Observation of white blood corpuscles
9. Agglutination test: Blood groups
10. Visit to research laboratories

### **Environmental Biology & Biodiversity**

1. Estimation of oxygen content in two water samples.
2. Estimation of salinity in two water samples.
3. Estimation of carbondioxide in two water samples.
4. Qualitative analysis of plankton from any one sample.
5. Study of soil organisms-Species richness, abundance, density, frequency, species evenness.
6. Study of physical characteristics (Temperature, colour & texture) of the soil.
7. Identification of fauna of rocky shore.
8. Identification of fauna of sandy shore.
9. Identification of fauna of coral reef.
10. Study of termitarium.

<b>B.Sc. (vi) - SEMESTER: VI – PART III b. Electives</b>
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<b>c. ON SITE TRAINING</b>
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<b>a) Agricultural Entomology</b>	<b>2 Hours/week</b>	<b>3 Credits</b>
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(for students admitted from 2008-'09 onwards)

1. Land preparation for Paddy and vegetables
2. Survey of Pest in paddy and vegetable fields.
3. Estimation of damage
4. Pest control operations using sprayer and dusters
5. Harvesting
6. Rearing of biocontrol agents and field applications

**Sc. (vi) - SEMESTER: VI – PART III b. Electives****a) Seri-biotechnology****2 Hours/week****3 Credits**

(for students admitted from 2008-'09 onwards)

1. Mulberry :- Land preparation – Preparation of cutting and planting – Irrigation – Application of manures – Leaf harvest and preservation – Annual pruning
2. Sericulture:- Brushing – rearing - feeding – bed cleaning – bed spacing – harvesting – marketing.

**Sc. (vi) - SEMESTER: VI – PART III b. Electives****b) Bioprocess Engineering & Technology****2 Hours/week****3 Credits**

(for students admitted from 2008-'09 onwards)

1. Fermentation Process
2. Production of alcohol
3. Production of any antibiotics
4. Production of aminoacids

**Sc. (vi) - SEMESTER: VI – PART III b. Electives****b) Vermitechnology****2 Hours/week****3 Credits**

(for students admitted from 2008-'09 onwards)

1. Establishment of a vermiculture unit - an overview - preparation of vermibeds.
2. Culture of earthworms - observation of their burrowing activity, formation of drilospheres and vermicasts.
3. Analysis of soil organisms using Berlese funnel - beetles, millipedes, mites, dermapterans etc.
4. Study of soil termites - termite mounds, caste disintegration and social behaviour.
5. Study of natural enemies of earthworms - attack of vermieres by ants, scorpions, beetles, mites, centipedes, snakes etc.
6. Study of litter degradation and decomposition of farmyard wastes - agricultural and animal wastes.
7. Determination of soil pH.
8. Harvesting of vermicompost and packaging.

**B.Sc. (vi) (Voc) - SEMESTER I – PART III b Electives - Vocational****FISH BIOLOGY - THEORY AND PRACTICAL****4+2 Hours / week 4 Credits**

(for students admitted from 2008-'09 onwards)

**Theory****UNIT I**

Introduction to taxonomy; Binomial nomenclature; Characters of Elasmobranches and teleosts; Variations in scales, fins, mouth, teeth and other structures used in taxonomic studies

## UNIT II

Commercially important orders, families, genera and species of Elasmobranches and teleosts; Internal anatomy of fish – digestive system and associated organs, gills, swim bladder, accessory respiratory organs, heart and circulatory systems, lateral sense organs

## UNIT III

Identification of commercially important species of prawns, crabs, lobsters and cephalopods of India – Organization of internal organs of prawn and cephalopod

## UNIT IV

Length-weight relationship – Age and growth – Studies on stomach content and its significance – Feeding in relation to age – Index of preponderance

## UNIT V

Fish reproduction – Sexual dimorphism – Dichromatism – Hermaphroditism – Types of ovary – Ovarian development – Stages of maturity – Types of spawning in Elasmobranches and teleosts – Fecundity – Gonadosomatic index

### **Reference Books:**

Jhingaran Y.G Fish and Fisheries of India.

Bal and Rao. Marine Fisheries of India.

Carl .E. Bond. Biology of Fishes.

Lagler .K.F, J.E Baradack and R.R. Miller. Ichthyology.

Munro. Marine and Freshwater fishes of Ceylon.

FAO Fishes identification catalogue Indian Ocean.

Michael King. Fisheries Biology, Assessment and Management

### **Practicals**

1. Study of external morphology of a teleost fish.
2. Study of the anatomy of a teleost fish.
3. Identification of important marine (Shark, ray, skate, mullet, milk fish, seabass, flat fish, bream, goat fish and pompret) and freshwater (catla, rohu, mrigal, tilapia and mystis) fishes.
4. Gut content analysis of fishes.
5. Study of food and feeding habit of a herbivorous fish.
6. Study of food and feeding habit of a carnivorous fish.
7. Study of food and feeding habit of an omnivorous fish.
8. Male and female reproductive organs of fish.
9. Maturity stages of ovary and testis – Gonadosomatic index (GSI).
10. Fecundity of fishes.

**B.Sc. (vi) (Voc) - SEMESTER II – PART III b Electives - Vocational**

**CAPTURE FISHERIES - THEORY AND PRACTICAL**                      **4+2 Hours / week**                      **4**

**Credits**

(for students admitted from 2008-'09 onwards)



## **Theory**

### **UNIT I**

**Capture fisheries in India; Freshwater fisheries** – Status and resources of Indian major carps, catfishes and freshwater prawn

### **UNIT II**

**Estuarine fisheries** – Status and resources of finfishes – Mullet, Milkfish and Seabass; Status and resources of shellfishes – Clam, Mussel and Oyster

### **UNIT III**

**Marine fisheries** – Status and resources of pelagic fishery – Oil sardines, Mackerel, Tuna and Seerfish; Status and resources of demersal fishery – Elasmobranchs, Flatfishes, Crustaceans (shrimps, crabs and lobsters), Molluscs (bivalves, gastropods and cephalopods)

### **UNIT IV**

**Crafts and gears** – Different types of nets and traps; traditional, non-mechanised and mechanised gears

### **UNIT V**

**Fishery management** – Principles and importance of conservation and management of fisheries, Exploitation and management of EEZ, Role of Government organization – CMFRI, FSI, MPEDA and TANUVAS

### ***Reference Books:***

Srinivastava C.R.L. Fishery Science and Indian Fisheries.

Jhingaran Y.G Fish and Fisheries of India.

B.N. Yadav. Fish and Fisheries.

S.P. Biswas Manual and Methods in Fish Biology.

Narasimhan, Molluscan Fisheries of India.

Santhanam. Fisheries Science

## **Practicals**

1. Visit to Royapuram fish landing centre.

2. Visit to Pulicat fish landing centre.
3. Observation of crafts employed in Pulicat lake.
4. Observation of gears operated in Pulicat Lake.
5. Visit to Sathanur dam.
6. Observation of crafts and gears used in Sathanur.
7. By-catch studies – fish landing sites.
8. Analysis and interpretation of data.
9. Identification of prawns – *Macrobrachium* sp., *Penaeus* sp.; crabs – *Portunus* sps., *Scylla* sp.; lobsters; clams; mussels; oysters; cephalopods – squid, cuttlefish, octopus.
10. Identification of fishes – oil sardine, mackerel, tuna, seer fish and flatfish.

**Credits**

(for students admitted from 2008-'09 onwards)

**Theory**

**UNIT I :** Introduction: Scope and definition, Importance, Origins and growth of aquaculture, Present status of aquaculture.

**UNIT II:** Selection of sites for aquaculture: Land based farms, Open water farms, Water quantity and quality, Sources of pollution, Environmental impacts,

**UNIT III:** Pre-requisites of cultivable organisms (sea weeds, sponge, shell fish, prawn, shrimp and crabs, echinoderm and fin fish), Exotic species, Common aquaculture species.

**UNIT IV:** Farm culture: Extensive, semi-intensive and intensive culture, integrated farming, cage culture, pen culture, raft culture, raceway culture, Sewage fed fish culture. Monoculture and Polyculture.

**Unit V:** Fresh water aquaculture: Present status, preparation of ponds, Liming and fertilization. Nutrition and feeds: Feeding habits and food utilization, Energy sources, Brood stock and larval nutrition, Live feed and artificial feed.

Pests , predators, diseases: Control of aquatic insects, and predatory and weed fishes, Methods of weed control i.e., manual, chemical and biological, important fish and shell fish diseases.

Breeding and culture of freshwater prawns, polyculture with finfish, Air breathing fish culture, and cold water fish culture.

**UNIT VI:** Coastal aquaculture: Introduction, Present status, Brackish water resources, Culture practice in Bherries and Pokkali fields.

Important species of cultivable Penaeid Shrimps. Life history, hatchery production of seed and transportation, Waste water treatment, Stocking, management and harvesting.

Breeding and culture of brackish water fin fish in relation to milk fish and Grey mullets

Mariculture: Culture of edible oysters, mussels, sea cucumbers, pearl oyster and sea weed culture.

**UNIT VII:** Harvesting:

VII.1 : Harvesting methods- Harvesting drainable ponds, Seining undrainable ponds , harvesting cage and raceway farm, harvesting mollusc.

**UNIT VIII:** Aquafarm management.

## **Practicals**

a) Identification of cultivable organisms:

1) Fishes 2) shrimps 3) Prawns 4) Molluscs

b) Identification of aquatic insects, weeds and predatory weed fishes

c) Culture of live feed organism- Field training

d) Identification of parasites and diseases of fish/shrimp

e) Soil and water analysis

f) Study of few brands of Artificial feeds

g) Visits to:

1) Fish farm 2) Shrimp farm 3) CIBA 4) CMFRI

h) Training program.

**BSc (vi) (Voc)- SEMESTER V- Part III b Electives- Vocational**

**FISH DISEASES AND POST HARVEST TECHNOLOGY-THEORY & PRACTICAL**

**4+2 Hours/Week 4 Credits**

(for students admitted from 2008-'09 onwards)

**UNIT I:** Fish, shrimp diseases and Fish health management–Infectious diseases-Bacterial, fungal, viral, protozoan; Non infectious and nutritional diseases. Disease diagnosis, prevention and control measures. Fish immunization and vaccines.

**UNIT II.** Fish as food commodity-Biochemical and nutritional value of fish; fish decomposition-Rigor mortis, post rigor, rancidity, Autolysis. Fish Preservation and processing- Principles and methods- Chilling, freezing, sun drying, salt curing, canning, smoking, irradiation.

**UNIT III:** Fishery products and by-products: Fish liver oil, fish body oil, fish flour sausage, ham, Fish meal, fish silage, fish manure, fish glue, isinglass, fish leather, guano, Shagreen, dried fins, fish roe, Squalene, and chitosan, ambergris, Sea weeds: By-products- Agar, Algin, and Carageenan. Industrial and pharmaceutical uses.

**UNIT IV:** Sanitation in processing units and quality control of fishery products: Importance and methods; HACCP ( hazard analysis and critical control point )principle and quarantine methods: HACCP and Safety of canned foods and unreliability of post process sampling of canned foods to ensure sterilization. Status of a batch of canned foods identifying CCPs and their monitoring by specially trained personnel.

**UNIT V:** Fishery Economics: Definition and application of economic principles to fisheries. Fishery resource as common property resource. Theory of production and law of diminishing returns. Fish markets economics and valuations. “Fishery cooperatives” and their importance. Planning and financing scheme for fisheries.Extension education- Objectives. Role of extension in fishing villages development. Methodologies of extension.

***Reference books:***

1. Balachandran, K.K., Fish Canning Principles and Practices. CIFT, Cochin.
2. Gopakumar K., 2002. Text Book of Fish Processing Technology. ICAR, New Delhi .
3. Hall, G.M., 1992. Fish Processing Technology (Ed), Blackie Academic and Professional, London.
4. Hersom, and Hulland, E.D,1980. Canned Foods.Chemical Publishing Company,Inc., New York
5. Larousse, J and Brown, B. E, 1997. Food Canning Technology. Willey VCH New York
6. Venugopal, V. 2006. Seafood Processing. Taylor & Francis Group, London.

**Practicals:**

1. Identification of common fish parasites
2. Field visits to study diagnosis and treatment of fin fish and shell fish diseases
3. Visit to fish processing plants
4. Filleting of fish, packaging and freezing.
5. Processing of Prawns, Lobster, Squid, Cuttle Fish, Crab etc. in different styles.
6. Identification of fresh and spoiled fish. Studies on physical, chemical and sensory changes.
7. Study of socio-economic status of fisher folk by field visits to fishing villages

**B.Sc. (vi) (Voc) - SEMESTER V – Vocational  
ENTREPRENEURSHIP DEVELOPMENT - THEORY**

*Hours / week*      *Credits*

(for students admitted from 2008-'09 onwards)

**UNIT I**

Need, Scope and characteristics – Types of entrepreneurship – Importance of environmental considerations- Municipal by law and insurance coverage.

**UNIT II**

Special scheme for technical entrepreneurs – Identification of opportunities –Market need, scope and approaches for project formulation.

**UNIT III**

Criteria for principles of product selection and development – Institutions financing procedures and financing procedures and financial incentives SIPCOT, SISI, TIDCO, TIIC.

**UNIT IV**

Creativity and innovation-Problem solving approach-Strength weakness opportunity and threat (SWOT) techniques-Techno-Economic feasibility of the project-Licensing-Registration procedures.

**UNIT V**

Critical path methods (CPM)-Project Evaluation Review Techniques (PERT) as planning tools for establishing-SSI.

**BOOKS RECOMMENDED:**

Entrepreneurial Development – S.Saravanel

Entrepreneurial Development – Gupta

<b>B.Sc. (vi) (Voc) -SEMESTER VI – Part III b Electives - Vocational</b>		
<b>AQUARIUM SCIENCE - THEORY &amp; PRACTICAL</b>	<b>4+2 Hours / week</b>	<b>5</b>
<b>Credits</b>		

(for students admitted from 2008-'09 onwards)

**UNIT I:** Ornamental fish biodiversity of India- History, live bearers and egg layers, common ornamental fishes of India (Fresh water and marine); scope for entrepreneurs in ornamental fish trade.

**UNIT II:** Construction and maintenance of aquarium: Material required, construction, Glass cover, Hood, Aquarium stand, Installation, setting of Aquarium, Planting of aquarium, tank conditioning and stocking, introduction of fish, Decoration, Aeration, Acclimatization, Maintenance. Aquarium accessories: Air pumps, filters, functions of gravel bed, foam filters, power filters, lighting, aquarium heaters.

**UNIT III:** Feed and feeding of ornamental fish: Nutritional requirements, types of fish feed, available feeds in market.

**UNIT IV:** Sexual dimorphism in live bearers and egg layers; Live bearers- Sword tails, white sail fin molly; red platy fish; guppy; Egg layers- Cichlids; Cyprinids; Characins (tetras); Anabantoids (Gourami) loaches and catfish

**UNIT V:** Breeding techniques of aquarium fish: Sexing, selecting the parent; conditioning the fish to breed; various types of breeding, larval rearing and transportation.

**UNIT VI:** Disease of ornamental fish and their cure: Bacterial, fungal, protozoan, crustacean, viral

**UNIT VII:** Aquarium plants and their propagation: Types of aquarium plants; important aquarium plants and their uses.

**Reference books:**

1. Archana Sinha & Radha C Das . 2004. Ornamental fishes. Dr SC Mukherjee, Director, CIFE, Mumbai (Publisher). PP 54
2. M. Kanthaiyapparaju. Simple guide to Aquarium fish keeping. Kasthuri Publishers. PP 122.
3. Dick Mills. 2004. 101 Essential tips Aquarium fish. Dorling Kindersley Limited, Penguin Group (UK). PP 72.
4. Gerhard Brunner. 1973. Aquarium plants. TFH. Publications, Inc, Ltd. PP 157.

**Practicals:**

1. Identification of important ornamental fish – Fresh water and marine
2. Hands on training in ornamental fish culture

3. Knowledge on identification of common pathogens of fish
4. Construction of a typical home aquarium
5. Collection of live feed organisms from the water bodies

<b>B.Sc. (vi) (Voc) -SEMESTER VI – Part III b Electives - Vocational</b>		
<b>FISH BIOTECHNOLOGY - THEORY &amp; PRACTICAL</b>	<b>4+2 Hours / week</b>	<b>5</b>
<b>Credits</b>		

(for students admitted from 2008-'09 onwards)

**UNIT I.** Fish Breeding: Synthetic hormones for induced breeding- GnRH analogue structure and function.

**UNIT II** Transgenesis : Methods of gene transfer in fishes, single gene traits, screening for transgenics, site of integration, applications, regulation of GMOs, IPR, Evaluation of GFP transgenics, monosex production.

**UNIT III** Gene Bank and conservation; Cryopreservation of gametes and embryos.

**UNIT IV** Feed Technology: Micro encapsulated feeds, micro coated feeds, micro-particulate feeds and bio-encapsulated feeds, mycotoxins and their effects on feeds.

**Unit V:** Genetic engineering and its application in fisheries: Recombinant DNA technology: DNA modifying enzymes - types of restriction endonucleases (Type I, II and III), DNA/RNA modifying enzymes (alkaline phosphatases, kinases, exonucleases, ligases, terminal transferases); Vectors - plasmids (replication, copy number control and compatibility), phagemids, cosmids, high capacity vectors (eg. BAC), Hosts: prokaryotic (selected E. coli strains) and eukaryotic (selected yeast strains).

**Unit VI-** PCR – principle, types and applications; Structure and function of DNA polymerase and reverse transcriptase. Genomic DNA library: construction, screening (PFGE-Pulse field gel electrophoresis) and applications.

**Reference Books:**

1. Reddy. P.V.G.K; Ayyappan et al., (2005) “Text Book Of Fish Genetics and Biotechnology”. 218p ICAR publications. ISBN:81- 7164 – 029- X.
2. Lakra.W.S et al.,( 2004) “Fisheries Biotechnology” Narendra Publishing house, 240p ,ISBN- 81 – 85375- 86- 0.
3. Sambrook J et al 1989. Molecular Cloning: A laboratory manual. New York: Cold Spring Harbor, Vol 1-3.
4. T.A. Brown. 1998. Recombinant DNA. Academic Press, London.
5. T.A. Brown. (2002) Genomes - 2nd edition. John wiley & sons, Newyork. 572p.
6. Lewin Benjamin. GENES – IX, London; Jones & Bartlet publishers; 2008;



829P; ISBN: 10-0- 7637- 5222.

7. Primrose S.B, Twyman R.M (2006) Principles of Gene Manipulation and Genomics (7th edn). Blackwell Publishing, Oxford UK

**Biotechnology Practicals:**

1 Field visits to TANUVAS, ornamental fish farms:

- a) Induced breeding
- b) PCR
- c) Diagnosis of WSSV
- d) Cryopreservation of gametes
- e) Live feed culture
- f) HACCP methods

**M.Sc.**

**M.Sc. (vi) - SEMESTER I - PAPER 1 : MAJOR CORE**

**ANIMAL PHYLOGENY**

**6 Hours / week**

**4**

**Credits**

(for students admitted from 2008-'09 onwards)

**Unit I :** Principles of animal taxonomy. Terminology - systematics - nomenclature -taxonomy - classification - identification - taxon - phenon - cladon and siblings - biological species concepts - definition of species, genus, variety, race, strain and breed - Naming of species, sub-species, genera, Zoological commission and Congress - International code of Zoological nomenclature. Keys - definition and types. Atlas, check list, catalogue. Biosystematics - definitions - Classical and Experimental taxonomy and Numerical taxonomy.

**Unit II:** Geological time scale

**Unit III:** Phylogenetic trees and their significance: Protozoan inter-relationships - Origin of Metazoa – theories - Inter-relationships of Coelenterates and their symmetry.

**Unit IV:** Origin of Bilateria - Evolution of Turbellaria and their importance - Rhabdocoela as a stem group.

**Unit V :** Origin and evolution of coelom.

**Unit VI:** Origin of metamerism and Annelidan inter-relationship.

**Unit VII:** Arthropod phylogeny.

**Unit VIII:** Molluscan evolution – Monoplacophora

**Unit IX:** Echinoderm larvae and evolutionary significance.

**Unit X:** Evolutionary trends among minor phyla (Rotifera, Acanthocephala, Pogonophora, Sipunculida, Entoprocta, Ectoprocta, Brachiopoda and Chaetognatha).

**Unit XI:** Phylogenetic importance of Prochordates

**Unit XII:** Theories of origin and evolution of Chordates

**Unit XIII:** Fossil history of fishes (origin and early evolution) and of Amphibians, Reptiles, (major groups) and of Birds and Mammals (origin and evolution of the three sub classes).

**Reference Books:**

The Invertebrates (Vol I to Vol ) – Hyman, L.H.

Arthropod Phylogeny – Gupta, A.P.

The Evolution of metazoan – Hadzi

Lower Metazoa: comparative Biology and phylogeny – Dougherty, E.C.

Evolution of Vertebrates – Colbert

Life of Vertebrates – Young

Vertebrate Paleontology – Romer.

<b>M.Sc. (vi) - SEMESTER I - PAPER 2: MAJOR CORE</b>		
<b>BIOPHYSICS</b>	<b>4 hours / week</b>	<b>2 Credits</b>

(for students admitted from 2014-'15 onwards)

**Biophysics**

*Objectives and Scope: Physics to explain life system – physics affects life system – physics helps life system.*

**Unit I** Theoretical biophysics

Thermodynamics: Laws of thermodynamics, thermodynamics related to chemical reactions – internal free and bond energy. Animal mechanics Motion – kinetics, kinematics, friction, stress, strain and torques.

**Unit II** Molecular Biophysics

Atoms and molecules, Biopolymer, polymerization of organic molecules.

Structure of molecules : Methods and principles of determining molecular weight. Physical principles involved in centrifugation, Chromatography, Electron microscopy, spectrophotometry and NMR – spectroscopy, Optical principles of Fluorescence, Polarizing, Phase contrast and interference Microscope colloids sol/gel changes – emulsions – Tyndall effect.

**Unit III** Membrane biophysics

Structure and function of bio-membranes – ion channels – Gates – Pores and Pumps.

**Unit IV** Radiation Biophysics

Isotopes, Isobars, Radioactivity and Properties of  $\alpha$   $\beta$  and  $\gamma$  rays, detection of Radiation, Hazards of Radiation, and tracer techniques. Non-Ionizing radiation, UV and infrared – definition and properties of Laser.

**Unit V:** Physiological Biophysics

Biophysical aspects of vision and its Aberrations. Biophysical aspects of nerve impulse transmission, Action potential. Biophysical aspects of muscle contraction. Biophysical aspects of hearing.

## **Unit VI Clinical biophysics**

Biopotential recording ECG, EEG and EMG

Imaging techniques. Photography, X-ray and Ultrasound.

Therapeutic applications Diathermy, Radiotherapy and Laser

Principles of CT scan and MRI scan.

### **Reference**

Life Science Physics – Joseph W Kane and Morton M. Sternheim, John Wiley and Sons, New York.

Biophysics – Caesey

Biophysical Science – Eugene Ackerman.

<b>M.Sc. (vi) - SEMESTER I – Paper 4: Major Core</b>		
<b>NANOSCIENCE</b>	<b>5 hours / week</b>	<b>3 Credits</b>

### **Unit I: Basics of Nanoscience**

History of Nanoscience - Definition of nanometer, Nanomaterials and Nanotechnology – Scientific Revolutions – Types of Nanotechnology and Nanomachines – the Periodic table – Atomic Structure - Molecular and atomic size – Surfaces and dimensional space – top down and bottom up - Opportunity at the nanoscale.

### **Unit II: Quantum Mechanics**

Limitation of classical physics - Introduction to quantum physics - Factors affecting to particle size - Quantum confinement - Quantum dots - particle in a box, Quantum wires and wells

### **Unit-III: Properties and types of Nanomaterials**

Mechanical, Thermal, Electrical, Magnetic and Structural. Size effect on shape, electronic magnetic properties of nanomaterials - Carbon nanostructures- electrical and mechanical properties - Carbon nanotubes (CNTs)- Single walled carbon nanotubes (SWNTs), Multiwalled carbon nanotubes (MWNTs) - graphenes, fullerenes.

### **Unit IV: Bionanotechnology**

Biology inspired concepts – biological networks - biological neurons - Quantum dot biolabeling - fabrication of biosensors - DNA based biosensors – Protein based biosensors – Bionanostructures- Micelles, vesicles, multilayer films, biological interactions - future potential.

### **Unit V: Nanotechnology in Health Care**

Nanotechnology in pharmaceutical applications - micro and nano immunosensors and use of gold and silver nanoparticles - DNA and antibodies, DNA Profiling - Prosthetic and Medical Implants

- Nanodiagnostics using nanorobots, *in vivo* imaging capability to detect tumors and genetic defects and other diseases.

Reference Books:

1. Nanoscience and Nanotechnology – Fundamentals to Frontiers – Rao & Singh  
Principles of nanoscience and Nanotechnology – Shah & Ahmed

<b>M.Sc. (vi) - SEMESTER I – PAPER 3 : MAJOR CORE</b>		
<b>MOLECULAR BIOLOGY AND MOLECULAR GENETICS</b>	<b>3+4 Hours / week</b>	<b>4</b>
<b>Credits</b>		

(for students admitted from 2008-'09 onwards)

### **Molecular Biology**

**Objective :** To make the students understand the molecular basis of genes

#### **Unit I Nucleic Acids (DNA and RNA)**

Structures of DNA – (Willkins's and Watson's Model ) – Types of DNA, Complimentary bases in DNA, Properties of DNA, denaturation and renaturation kinetics. Types of RNA – structure of tRNA, DNA – RNA differences.

#### **Unit II Synthesis of DNA**

Origin of replication – DNA polymerases – 5'-3' replication – proteins involved in replication – the end replication problem – telomerase – proof reading – methylation of DNA – brief comparison of eukaryotic and prokaryotic replication.

#### **Unit III DNA repair**

Fidelity of DNA sequences – different types of DNA repair systems with special reference to SOS response.

#### **Unit IV DNA Recombination**

Homologous genetic recombination – enzymes involved in recombination – Holliday model – site specific recombination – prerequisites for recombination – transposons.

#### **Unit V Transcription and Translation**

RNA polymerase in Eukaryotes – initiation and termination of transcription, transcription factors – splicing of RNA – Eukaryotic mRNA processing – transport of RNA from nucleus to cytoplasm – tRNA and rRNA synthesis – transcription inhibitors, translation.

#### **Unit VI Cell Proliferation**

Significance of cell cycle in cancer – abnormal cell growth (Neoplastic growth) concept of oncogenes and anti-oncogenes.

#### ***Reference Books:***

Molecular Biology of the Gene Watson et al.

Biochemistry, Voet, D and Voet, J. John Wiley and Sons, Inc. 1995.

Text of Biochemistry Lehninger et al, CBS publishers and distributors, 1993.

### **Molecular Genetics**

#### **Unit I: Genetic code**

Characteristics of the code - Triplet nature – degeneracy – universality – decoding of DNA - tRNAs translation into peptides, polypeptides, initiation, lengthening, molecular basis of degeneracy of DNA into RNA (copies).

#### **Unit II: Genetic control of hormone regulation**

Analysis of gene control, structure of a gene encoding a polypeptide hormone, housekeeping genes, levels of gene control, Examples of housekeeping genes and homeotic gene.

**Unit III: Gene expression and regulation: Operon concept. Constitutive versus inductive control. Positive and negative regulation of gene expression.**

Examples: Lac, tryptophan

#### **Unit III: Mutation**

Classification of mutations, types of chromosomal, gene (transition, transversion, addition, deletion), tautomerisation, deamination and base analogues, alkylating and other mutagenic agents, molecular effects of mutation, mutagen and antimutagens, mutator and antimutator polymerases.

#### **Unit IV: Microbial genetics**

Molecular model for transformation, recombination maps and transformation, generalized genetic transduction, bacterial conjugation, sex factor, F-episome, conjugation and mapping, F'-episomes plasmid.

#### **Unit V: r DNA technology**

Types of vectors, plasmids, cosmids, YAC's, bacteriophages etc. Restriction enzymes - classification, Cloning, expression of cloned genes, gene therapy.

**Unit VI: Ethics**

Ethical issues that have arisen due to cloning, ART

**Reference Books:**

1. Molecular Biology of the Gene. (Fifth edition)

James D Watson, Tania A. Baker, Stephen P. Bell, Alexander Gana, Michael Levini, Richard Lorick 2006

**M.Sc. (vi) – SEMESTER I - PAPER 4: MAJOR CORE PRACTICAL – I**

**MOLECULAR BIOLOGY AND MOLECULAR GENETICS**

*2+2 hours / week*

*2 Credits*

**(for students admitted from 2014-'15 onwards)**

1. Basic techniques identification of DNA by feulgen reaction
2. Identification of RNA by Methyl green and pyromine staining.
3. Identification of proteins by MBPB.
4. DNA extraction.
5. PCR (Demonstration)
6. Squashes and smears of chromatin and chromosomes. Sex chromatin – human buccal smear.
7. Orange G and Aniline blue staining for heterochromatin.
8. Study of mitotic chromosomes using onion root tip and bone marrow aspirate.
9. Mitotic indices in Onion root tip and Grasshopper testis.
- 10.** Meiotic indices in Grasshopper testis.
11. Drosophila Genetics, Preparation of culture medium and culture of Drosophila handling and maintenance – study of the life history – mutant forms. Chromatographic studies of eye pigments of various eye mutants.
12. Population genetics Location of tasters and non-tasters by PTC tests in a random sample.
13. Multiple factor inheritance studies in a random sample of student population with reference to their height.
14. Case studies – family histories and pedigree charts.

15. Dermatoglyphics
16. Karyotyping.
17. Study of various syndromes with the help of metaphasic plate.

<b>M.Sc. (vi) - SEMESTER II – PAPER 5 : MAJOR CORE</b>		
<b>BIOINFORMATICS &amp; BIOSTATISTICS</b>	<b>5 Hours /week</b>	<b>4</b>
<i>credits</i>		

(for students admitted from 2008-'09 onwards)

## **Bioinformatics**

### **Unit I Introduction to Bioinformatics**

Aims, Tasks and Applications of Bioinformatics. Information Retrieval System, Data submission Tools, Data Analysis and Prediction Tools.

### **Unit II Biological Databases**

Nucleic acid sequence data banks. Databases of patterns, motifs and profiles: Metabolic Pathway Databases. Literature Databases. Database Similarity Searches: BLAST, FASTA, PSI-BLAST algorithms; Pair wise sequence alignment - NEEDLEMAN and Wunsch, Smith Waterman algorithms; Multiple sequence alignments - CLUSTAL, PRAS; Patterns, motifs and Profiles in sequences.

### **Unit II. Genomics.**

Central Dogma hypothesis. Gene structure. Recombinant DNA technology. Gel Electrophoresis, DNA Sequencing. Single Nucleotide Polymorphism. Genome analysis, Genome mapping, Comparative genomics - Paralogs and orthologs, Phylogenetic profiling. Genome Projects.

### **Unit III Proteomics**

Introduction to basic Proteomics technology, Protein structure and Functions- amino acids and peptides; primary, secondary, tertiary and quaternary structures; protein identification and characterization; protein structure and function prediction; Protein Sequencing. Protein prediction from DNA sequence.

### **Unit IV Homology, Phylogeny and Evolutionary Trees**

Sequence Analysis. Alignment and Phylogenetic Trees. Homology and similarity, Phylogeny and relationships, Approaches used in Phylogenetic analysis, Molecular approaches to Phylogeny, Phylogenetic Analysis databases, Hidden Markov Models for homology modeling.

### **Unit V. Microarray Technology**

Introduction to basic microarray technology, - concept of gene expression.

### **Unit VI. Drug Discovery and Pharmacoinformatics**

Overview of the Drug Discovery process and the role of computational methods. Review of basic biological concepts, Characteristics of a drug compound, Elements of molecular pharmacology. Concept of receptor and target. Receptor binding and activation. Ligand-receptor interaction, non-covalent bonds. Ligand into the binding site. Concepts of pharmacophore, bioactive conformation and Active Analog Approach. Molecular docking

### **Reference Books:**

1. Basic Bioinformatics 2005, S.Ignacimuthu, s.j.  
Narosa Publishing House
2. Introduction to Bioinformatics ( Fourth Edition ) - 2003  
T.K. Attwood & D.J. Parry- Smith, Pearson Education ( Singapore) Pvt. Ltd.
3. Introduction to Bioinformatics 2003  
Arthur M. Lesk , Oxford University Press
4. Bioinformatics- Methods and Applications- Genomics, Proteomics & Drug Discovery- 2005  
S.C. Rastogi, N. Mendiratta & P. Rastogi , Prentice Hall of India Private Ltd.
5. Bioinformatics- Databases and Algorithms - 2006  
N. Gautham - Narosa Publishing House
6. Discovering Genomics, Proteomics & Bioinformatics- 2003  
A. Malcolm Campbell & Laurie J. Heyer, Pearson Education ( Singapore) Pvt. Ltd.
7. Bioinformatics- Managing Scientific Data- 2003  
Zoe Lacroix & Terence Critchlow, Morgan Kaufmann Publishers.

### **Biostatistics**

#### **Unit I**

Collection and classification of data – Representation of data –Tabulation of data –Diagrammatic representation of data – differences between diagrams and graphs. Graphic representation of data –frequency distribution.



## Unit II

Elements of probability – sample space, sample point, sample event and venn diagram. Theoretical distributions – fundamentals of Binomial, Poisson and Normal distribution – Central Limit Theorem. Student's t-distribution – characteristics. Use of t-test for small samples. Chi-square test.

## Unit III

Correlation – characteristics. Types, methods of study of correlation – scatter diagram method, graphic method, Karl Pearson's coefficient of correlation – rank correlation – concurrent deviation method – significance. Regression – characteristics, dependent and independent variables – slope and intercept – method of least squares.

## Unit IV

Analysis of variance (ANOVA) characteristics – F-distribution, types and concepts of ANOVA – simple classification (one-way) of ANOVA and Two way ANOVA.

## Unit V

Computer Applications in Biology.

### **Reference Books:**

R.C. Campbell, 1973, Statistics for Biologists  
N.T.J. Bailey, 1985, Statistical Methods in Biology  
W.C. Shester, 1982, Statistics for biological Sciences  
S.N. Schneider 1980, Statistical Methods in biology  
Lewis, A.W., 1974, Biostatistics.

**M.Sc. (vi) - SEMESTER II - PAPER 6 : MAJOR CORE**

**GENERAL ENTOMOLOGY AND APPLIED ENTOMOLOGY**

**6Hours / week**

**4 Credits**

(for students admitted from 2008-'09 onwards)

### **General Entomology**

**Unit I** Reason for insects as a successful group

**Unit II:** Insect classification

Outline classification of insects with examples.

**Unit III:** Basic knowledge of the following orders of insects with special reference to Indian examples: Apterygota: Thysanura, Protura, Collembola, Dipleura. Pterigota:

Exopterygota – Ephemeroptera, Odonata, Orthoptera, Thysanoptera, Mallophaga, Anopleura, Hemiptera. Endopterygota: Lepidoptera, Coleoptera, Diptera, Hymenoptera.

**Unit IV :** Morphology of head Sulci-tentorium – types of mouth parts – type of antenna Morphology of wing hearing segment – wing venation of generalized insect region of wings – wing coupling mechanism – legs and external genitalia types of larvae and pupae.

**Unit V:** Morphology of internal organs: Elementary histology of alimentary canal - respiratory structure - circulatory organs - Brain and sub-oesophageal ganglia. - Internal organs of reproduction.

**Unit VI:** Structure and composition of integument – moulting

Metamorphosis and role of hormones in metamorphosis

Insect digestion – digestion of carbohydrates, fats, proteins – role of micro organisms in digestion

Elimination of nitrogenous wastes

Mechanism of respiration

Composition of Haemolymph and its function – Course of circulation - heartbeat

***Reference Books:***

Chapman, R.F. The Insects structure and function

Nayar, K.K. and David, General and applied entomology

Wigglesworth, V.B. The principles of insect physiology

B. Vasanthraj David, T. Elements of economic entomology

Snodgrass, G.E. Insect morphology

Snodgrass, Principles of insect morphology.

Richard O.W. and Davies, R.G. Imms' General Text books of Entomology, Vol. I

Richard O.W., and Davies, R.G. General Text Book of Entomology, Vol. II

Mani, M.S. General Entomology.

**Applied Entomology**

**Unit I:** Economic Importance of Insects: Insect pests – types – causes for insects attaining pest status – Types of damages to plants

**Unit II:** Agricultural Entomology: Biology, Nature, extent of damage and control of pests of Paddy, Brinjal, Mango, Cotton

**Unit III:** Storage of Entomology: Nature of damage and control of external and internal feeders of stored product

**Unit IV:** Veterinary Entomology: Nature of damage and control of insect pests of cattle, fowl, sheep and goat

**Unit V:** Medical Entomology: Nature of damage and control of insects associated with human beings – mosquito, house fly, fleas and head louse

**Unit VI:** Basic knowledge of forensic entomology

**Unit VII:** Beneficial insects: Kinds of honey bees – bee keeping – care and maintenance of an apiary- Types of silk worms and silk – mulberry varieties – Biology and behaviour of lac insect and lac cultivation

**Unit VIII:** Pest control: Methods and principles of insect pest control – Natural control ( Climate, topographic features and natural enemies) – Artificial / Applied control (prophylactic, curative measures, cultural, mechanical, physical, biological, legal and chemical methods) – recent trends in pest control- IPM

**Unit IX:** Insecticides: Classification based on mode of entry, mode of action, chemical nature, hazards of insecticides, resurgence and outbreak, plant protection appliances.

**Unit X:** Integrated pest management programme, plant quarantine and pesticides registration in India.

**Reference Books:**

Chapman, R.F. The Insects structure and function

Nayar, K.K. and David, General and applied entomology

Wigglesworth, V.B. The principles of insect physiology

B. Vasanthraj David, T. Elements of economic entomology

Snodgrass, G.E. Insect morphology

Snodgrass, Principles of insect morphology.

Richard O.W. and Davies, R.G. Imms' General Text books of Entomology, Vol. I

Richard O.W., and Davies, R.G. General Text Book of Entomology, Vol. II

Mani, M.S. General Entomology.

<b>M.Sc. (vi) - SEMESTER II : PAPER 7 : MAJOR CORE</b>
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<b>RESEARCH METHODOLOGY</b>
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<i>4 Hours /week</i>
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<i>4 credits</i>
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(for students admitted from 2008-'09 onwards)

**Unit I – Introduction to Research Methodology**

Research: Meaning, Objectives, types and significance – Research process.

Research problem: Selection, selection criteria, necessity techniques in selecting a problem.

**Unit II – Research Design**

Research design: meaning need, research designs – Basics of experimental designs – Developing research plan.

**Unit III – Literature Survey**

Source of literature – INSDOC, MEDLINE, Biological abstracts, Current Contents, Pubmed and Online Journals – Types of literature: reviews, abstracts, short notes, journal articles, magazines, periodicals, books and proceedings – Reprint requisition cards and reprint requesting – Organization of collected information – index cards and style of indexing

#### **Unit IV –Data collection**

Methods of data collection- Questionnaires/schedule, Selection of appropriate method for data collection – Guidelines for constructing questionnaires – Guidelines for interviewing – Sample questionnaires – Data Analysis and interpretation – Dissertation /Reporting – Steps in report writing – How to critique an article.

#### **Unit V – Publication**

Preparation of research reports, project reports, scientific report writing – Documentation: Library cataloguing, definition, need, objectives and function of catalogue (Colon Classification, Dewey, ISBS, ISSN, Bar Coding and Accession Number) – Internet Resources: What is Internet, World Wide Web, Navigating the Internet, Electronic mail, and Electronic publication, Online Journals – Structure and ethics of Scientific presentations.

#### **Unit VI – Funding resources and designing research proposals**

World Health organization (WHO), Department of Science and Technology (DST), Indian Council for Medical Research (ICMR) – Structure of Research Proposals: Origin, Objectives, Existing Knowledge of the problem, Current status of the problem, Methodology, Budget and expected outcome.

#### **Reference Books:**

1. Doing Your Masters Dissertation, Chris H, 1<sup>st</sup> edition , Vistaar publications, 2005
2. Research Methodology, Paliniswamy and Shanmugavel.
3. Research Methodology Methods & Techniques, C. R. Kothari.

<b>M.Sc. (vi) - SEMESTER II - PAPER 8 : MAJOR CORE</b>		
<b>DEVELOPMENTAL BIOLOGY</b>	<b>5 Hours / week</b>	<b>4</b>
<b>credits</b>		

(for students admitted from 2008-'09 onwards)

(Objective: To elaborate the Scope of development biology and its development as science and a technology)

#### **Unit I**

Gametogenesis Spermatogenesis and Oogenesis – role of Hypothalamo hypophyseal Gonadal axis. Types of gametes in animals – the developing egg and its environment – sexual cycles (estrus and menstrual) – role of hormones in gametogenesis.

## **Unit II**

Fertilization and Cleavage – physico-chemical events related to fertilization and cleavage – morphological aspects of gastrulation and primary organ formation – physiology of gastrulation.

## **Unit III**

Determination of primary organ rudiments. Embryonic adaptations.

## **Unit V**

Organogenesis – morphogenetic process – development of central nervous system, heart and alimentary canal.

## **Unit VI**

Differentiation and growth – general considerations.

## **Unit VII**

Metamorphosis – regeneration and sexual reproduction

## **Unit VIII**

Reproductive technology: Synchronisation of estrus – control of ovulation embryo transplantation and storage – diagnosis of pregnancy – induction of parturition – out of season and prepuberal breeding – selection technique and sex pre determination – cloning.

### ***Reference Books:***

Introduction to Embryology, Balinsky  
Developmental Physiology, Raven  
Reproduction in farm animals – Hafez  
Reproduction in Farm animals, R.H.F. Hunter.

**M.Sc. (vi) – SEMESTER II - PAPER 9: M AJOR CORE PRACTICAL – II**

**BIOINFORMATICS + BIOSTATISTICS 3 hours / week                      2 Credits**

**(for students admitted from 20014-15 onwards)**

### **Bioinformatics**

1. Basics of Bioinformatics, types of data base, Online sequence retrieval- NCBI.
2. Literature database- Pub Med, Medline, OMIM.
3. Sequence database- Protein- UniProt, Prosite, Pfam, Nucleotide- Gen Bank.

4. Homology study- Basic alignment- BLAST & FASTA.
5. DNA & protein sequence analysis, pair wise (Emboss) alignment techniques.
6. Multiple alignment techniques -Clustal W.
7. Structural Database: - PDB, Protein structure Visualization- PyMol, SPDV.
8. Secondary databases -SCOP, CATH.
9. Metabolic pathway database- KEGG.
10. Docking- Argus lab.
11. Protein Modeller.
12. SAVS ( Ramachandran plot validation)

### **Biostatistics**

1. Representation of data in one, two, three dimensional diagrams and pictograms.
2. Graphic representation of data through graphs of time series and frequency distribution.
3. Statistical software package SPSS- Descriptive Statistics, Correlation and regression, ANOVA- one way and two way

**M.Sc. (vi) – SEMESTER II - : MAJOR CORE PRACTICAL – IV**

**DEVELOPMENTAL BIOLOGY& ENTOMOLOGY 2+3 hours / week      3 Credits**

**(for students admitted from 2014-'15 onwards)**

### **Developmental Biology**

1. Semen collection from Bull.
2. Sperm count.

3. Egg diameter measurement, volume and density of microscopic eggs.
4. Mounting of chick embryos.
5. Study of the developmental stages of chick embryo-24,36,48,60,72,84,96 hours.(any5)
6. Observation of developmental stages of frog and Amphioxus (slides)
7. Dissection of tadpoles to show the anatomical peculiarities and transitions.
8. Regeneration studies in tadpoles/house lizard.
9. Study of placentation in goat/pig and human.
10. Oviparity, ovoviviparity and parental care (spotters)

### **General Entomology**

Dissection of digestive nervous and reproductive systems. Mounting of mouth parts and other special morphological modifications of the following species: *Lepisma*, Earwig, Ant lion, Naiad of Dragon fly, Adult Dragon fly, *Anthia*, *Laccotrephes* or *Ranatra*, Calliphora, *Apis*, *Polistes*, Butterfly

- a. Collection, pinning and preservation of Insects
- b. Identification of some common insects or their damages on MCC (at least 20 insects)
- c. Submission of record and insect box

### **Applied Entomology**

- a. Collection, identification and study of any four insect pests of crops grown in MCC farm – Paddy, vegetables – Brinjal and Okra
- b. Identification of four insect pests of mango
- c. Identification of any four stored product insect pests.
- d. Identification of beneficial insects: Honey bee, Silk worm larval stage and cocoon, chandraki
- e. Insects of medical importance – mosquito, housefly and headlouse
- f. Insecticides : Knowledge of any organochlorine- DDT/HCH, Organophosphorous – Monocrotophos/ Chloropyriphos, Carbamate – Carbofuran, Synthetic pyretheroid – Fenvalerate / Cypermethrin
- g. Knowledge of field layout to study the efficacy of insecticides.
- h. Visit to a biological control laboratory to study the rearing of biocontrol agents
- i. Submission of record

<b>M.Sc. (vi) - SEMESTER III - PAPER 10 : MAJOR CORE</b>		
<b>ANIMAL PHYSIOLOGY &amp; BIOCHEMISTRY</b>	<b>3+3 Hours / week</b>	<b>4</b>
<b>Credits</b>		

## **Animal Physiology**

### **Unit- I Osmotic and ionic regulation (aquatic & terrestrial ) :**

Maintenance of osmotic and ionic balance in animals living in hypo, hyper and iso-osmotic environment.

### **Unit- II Body fluids and their circulation:**

Plasma proteins and regulation of fluid volume.

Cardiac rhythm- Open and closed system- Vascular pump- chambered heart and booster pumps- Pattern of circulation of Vertebrates- The lymph hearts of Vertebrates- Pace makers of myogenic hearts- The rhythm of neurogenic heart- Blood pressure and Haemodynamics.

### **Unit- III Neuromuscular and neuroendocrine integration and regulation:**

Myoneuronal junctions- Patterns of efferent innervation of muscles- Motor units in vertebrate muscle- Fast and slow contractions- peripheral inhibition- Neuromuscular transmitters.

Neurosecretory system- Mechanism of hormone actions (Steroid hormones and cascade amplification system).

### **Unit- IV**

Electric organs: Morphology- physiology

Bioluminescence: Luminescent organs- distribution of bioluminescence- biochemistry of luminescence (firefly- cypridina - coelenterate). Bacterial, extracellular and intracellular luminescence- functional significance of bioluminescence. Sound Production and reception – Communication- Echo-orientation.

### ***Reference Books:***

1. Hoar- General and Comparative Physiology
2. Wilson- Animal Physiology
3. Prosser and Brown- Animal Physiology
4. Tuttle & Schottelius – Text book of Physiology
5. Kunt and Schmidt Nielson - Animal Physiology
6. Potts and Parry – Osmotic and Ionic regulation.
7. Lehninger – Principles of Biochemistry.

## **Biochemistry**

**Unit I:** Enzymes: Classification, mechanism of enzyme action, Michaelis-Menton reaction, enzyme inhibitors.

**Unit II:** Anabolism – biosynthesis: Carbohydrates: central pathway, bypass reactions, gluconeogenesis, glycogenesis. Lipids – Mitochondrial synthesis of fatty acids, non-mitochondrial synthesis of fatty acids, synthesis of triglycerides, synthesis of phospholipids, synthesis of cholesterol, errors in lipid metabolism.

**Unit III:** Catabolism: Carbohydrates – glycolysis, TCA cycle, HMP pathway, glycogenolysis, energetics of the cycles. Proteins – overview of protein catabolism – Transamination, deamination,



fate of ammonia and carbon skeleton, urea cycle. Lipids – mobilization of fats from dietary intake. Break down of fatty acid and cholesterol.

**Unit IV:** Integration of biomolecules - intermediary metabolites – phosphorylation, types, biological oxidation, energy rich compounds – oxidative phosphorylation.

***Reference Books:***

Lehninger, Albert L. 1970. Biochemistry Worth Publishers, Inc., New York, pp.833.

Jain, L.L. Sunjay Jain & Nitin Jain 2005. Fundamental of biochemistry, S. Chand and Company Ltd., New Delhi, pp.1230.

Ambika Shanmugam 1974. Fundamentals of Biochemistry for Medical Studies. Second Edition (Revised), Aries Agencies, Chennai, pp.647.

West, Edward Staunton, Todd Wilbert R. Mason Howard, S. and Bruggen John T. Van. 1974. Textbook of biochemistry Amerind Publishing Co. Pvt. Ltd, New Delhi, pp.1595.

Wilson, Jean, D. Foster Daniel W., Kronenberg Henry M and Larsen Reed, P. 1998. Williams Test book of Endocrinology. W.B. Saunders Company, London, p.1819.

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**Microbiology**

**Objective:** To expose the students to various micro-organisms and their applied aspects.

**UNIT I**

History of Microbiology. Discovery of the microbial world.

**UNIT II**

Bacterial identification. nomenclature and classification, New approaches to bacterial taxonomy / classification including ribotyping and ribosomal RNA sequencing

**UNIT III**

General structure and features, brief account of all group of bacteria and cyanobacteria, Rickettsia, Chlamydia and Mycoplasma

Archaea : Archaeobacteria and extremophilic microbes – their biotechnological potentials

**UNIT IV**

The definition of growth, growth curve, measurement of growth and growth yields, Culture collection and maintenance of cultures. Isolation, pure culture techniques, Methods of sterilization.

**UNIT V**

Different modes of nutrition in bacteria, Sulfate reduction, Nitrogen metabolism – nitrate reduction, nitrifying and denitrifying bacteria, Nitrogen fixation and Microbes used as biofertilizer

**UNIT VI**

Viruses : Classification, morphology and composition of viruses in general, Bacteriophages :  $\phi$ X 174, cyanophages and retroviruses, Viroids and Prions

**UNIT VII**

Applications in Microbiology:- Industrial Microbiology: Microbes in the production of alcohol and antibiotics.

**UNIT VIII**

Dairy microbiology: Microbiology of milk and milk products,

**UNIT IX**

Agricultural microbiology: Nitrogen cycle, phosphorous cycle, nitrogen fixation, soil fertility and biogas. Medical Microbiology – study of common bacterial (10), fungal (5) and viral (5) diseases of man and their preventive measures.

**UNIT X**

Microbiology of drinking water. Methodology of bacterial analysis of water- water borne diseases- Sewage- biological sewage purification methods- Chlorination of water and its implication.

***Reference Books:***

Microbiology – Anna K. Joshua

Microbiology – Norton C.F.

Microbiology – Pelcazar, Reid and Chan

Text Book of Microbiology – Ananthanarayanan and Jayaram

Food Microbiology – Frazier

Industrial Microbiology – Casida L.F

Micro biology of water and Sewage Geinyl and lord

General Microbiology – Boyd

Microbiology – Atlas – Biology of Microorganisms – Brock and Madigan

General Microbiology – Stainer, John, Mark

Microbiology - Zinsser

## **Immunology**

### **Unit I :** Introduction to immunology

History of development of immunology and scope. Classification of immunity – natural, induced, innate, acquired, specific, non-specific. Immune response-primary and secondary and Heideberger-Kendall reaction.

### **Unit II:** Lymphoidal organs

Primary bone marrow, thymus, Bursa of fabricius, secondary spleen GALT, MALT. Peyer's patches, Kupffer cells, etc. – Theory locations structure and function.

### **Unit III:** Principles of classification

Stem cells and differentiation and classification of lymphoid cells.

### **Unit IV:** Fundamentals of immunity

Immunoglobulins – structure, classification, theories of formations and functions. Separation of T and B lymphocytes. Antibody-mediated and cell-mediated immunity. Cytokines. Antigen presentation. Compliment system. Major histocompatibility complex. Phagocytosis. Tolerance.

### **Unit V:** Immunity of viral, bacterial, fungal, protozoan, and helminth infections

Natural response and immunological mechanism against such infectious agents; immune mechanisms of host.

### **Unit VI:** Primary and secondary immunodeficiency states

Occurrence of primary and secondary immunodeficiencies with examples.

### **Unit VII:** Hypersensitivity Reaction

Types I, II, III, IV and V. Roll of immunoglobulins in various types of reactions; Reactions and responses of the system and tests; specific examples for each type. Disease manifestation and modern treatment methods.

### **Unit VIII:** Transplantation and Rejection

Tissue typing and HLA system: (Genetics); grafting and classification of grafts; graft rejection and prevention and role of T. Lymphocytes; immunosuppression, immunomodulators.

### **Unit IX:** Autoimmunity

Types of autoimmune diseases, antibodies, occurrence, genetic factors and pathogenicity diagnostic and prognostic values.

### **Unit X:** Modern trends of immunology

Biotechnological trends in organ / tissue grafting technology, vaccinology; Bispecific antibodies; monoclonal antibodies, vaccines through food. Role of natural research laboratories and institutes.

**Reference Books:**

Immunology by Roiit.

Basic immunology by Gupta

Fundamentals of immunology by Weir

Immunology by Barrett.

**M.Sc. (vi) - SEMESTER III - PAPER 12: MAJOR CORE**

**ENVIRONMENTAL BIOLOGY & BIODIVERSITY**

**4+2 Hours / week**

**4**

**Credits**

(for students admitted from 2008-'09 onwards)

**Environmental Biology**

**UNIT I - ECOSYSTEM ECOLOGY:** Ecosystem components; concept (Aquatic, Terrestrial, Deep Sea, Polar, Micro and Space ecosystem): Biological control of the chemical environment: Production and decomposition in nature: Homeostasis.

**UNIT II - ENERGY in ECOSYSTEM :** Energy and Environment : Concept of productivity.

**UNIT III - SPECIES in ECOSYSTEM :** Concepts of habitat and ecological niche; ecological equivalents; natural selection and speciation: Biological clocks: Ecosystem development and succession.

**UNIT IV - RESOURCES :** Forest, grass land and agriculture; capture and culture fisheries; Land, soil and water; fossil fuel; minerals; wild life; energy of biological origin and non-conventional energy resources.

**UNIT V- RESOURCE MANAGEMENT :** Conservation of biodiversity; renewable and non-renewable; deforestation and afforestation; wild life conservation; land use; desalination and weather modifications; national programmes on conservation.

**UNIT VI - POLLUTION and ENVIRONMENTAL HEALTH :** Air, water and soil pollution; special emphasis on CO<sub>2</sub>, CO, pesticides and heavy metals (lead, mercury, chromium): Solid wastes and their management; Agro-industries, Thermal, Tanneries pollution: Noise pollution: Pollution as it relates to meteorology and climatology; el-nino: Sewage treatment: Environmental laws to monitor pollution.

**UNIT VII - ENVIRONMENTAL EDUCATION AND ORGANIZATIONS** : Goals, objectives and guiding principles; various programmes in India; Environmental organization and agencies: Environmental issues:- silent valley, Narmadha: International bodies: Man and the biosphere programme: National organization:- Department of environment, forest and wild life; Important abbreviations/acronyms.(AEC, BSI, CFC, CPCB, CRZ, DNES, DST, EIA, ENVIS, EPA, EPC, FAO, GEMS, IUCN, MAB, NEERI, NEPA, SPCB, UNESCO, WHO, WWF-INDIA).

**UNIT VIII - BIOREMEDIATION** : Defintion; Need and scope; Environmental application; Future outlook; Phytoremediation:- biotechnology of cleaning up the environment by plants.

**UNIT IX - SPACE ECOLOGY** : Types of life support systems in space; exobiology; hazards of space travel.

## **UNIT X - ENVIRONMENT AND FUTURE OF BIOSPHERE**

**A. GLOBAL WARMING** : Causes:- Co<sub>2</sub>, Methane, Chlorofluorocarbons, Nitrous oxide, Ozone. Consequences:- climatic change, human diseases. Impact:- on forests, Agriculture.

**B. POPULATION GROWTH AND FOOD PRODUCTION** : World population:- growth, regulation, modern technology and population explosion, future of world population, population growth in India.

World food production:- Green revolution, towards second green revolution.

**C. URBANIZATION AND ITS IMPACT ON SOCIETY** : Population growth and urbanization: Factors contributing urbanization:- migration, industrialization, transportation, socio-economic changes: Impact on environment, health, society: Management of urbanization.

**D. ENVIRONMENTAL IMPACT ASSESMENT** : Process and prepatation of environmental impact statement, cost benefit analysis, current status EIA in developed countries(U.S.A.,Canada, Germany, U.K., Japan), and developing countries (India, Indonesia, Philippines). GIS; remote sensing.

**E. ENVIRONMENT AND SUSTAINABLE DEVELOPMENT** : Sustainable growth in the context of Population growth, Urbanisation, Industrial growth, global warming, military conflicts and nuclear war. Biotechnology and nature management as a way to sustainable development: People's participation: Future Scenario.

### ***Reference Books:***

Fundamentals of Ecology – Eugene P Odum 1991.W.B.Saunders Company.

Fundamentals of Environmental Sciences – G.S.Dhalival, G.S.Sangha, P.K.Ralhan. 2000  
Kalyani Publishers.

Ecology and Environment – P.D.Sharma 1999, Rastogi Publications.

Animal Ecology and Environmental Biology – H.R.singh 2001, Shoban Lal Nagin Chad & co

### **Biodiversity**

## **UNIT – I**

Defining Biodiversity Concept, Convention on Biological diversity – role, goals, functions and perspectives. Global biodiversity assessment

## **UNIT – II**

Biodiversity from taxonomic and evolutionary perspectives; Origin of scientific taxonomy, basis of taxonomic characterisation, characterizing species (the morphological species concept, biological species concept, phylogenetic species concept) Phylocode classification. Taxonomic measures of species diversity, modern developments (database and expert identification systems).

## **UNIT - III**

Types of diversity – Ecosystem diversity (Variety and habitat), Species diversity, Genetic diversity, Methods of measuring species diversity and genetic diversity, Causes of biodiversity loss, Effects of biodiversity loss.

## **UNIT-IV**

Human Society and biodiversity- Cultural diversity, Values of biodiversity, People's movement, Climate Change, Conservation – Approaches and Sustainable development.

## **UNIT V**

Mega diverse nations, Hot Spots of biodiversity, IUCN categories of threat, Biosphere Reserves and Conserved areas of India, Projects to Save Threatened species.

## **UNIT VI**

National Biodiversity Act- policy and action, Wild life Regulation Acts, National and International Treaties and Conventions, Intellectual Property Rights over Biological products

### ***Reference Books:***

1. Ferguson. C. 1980. Biochemical Systematics and Evolution.
2. Mayor. E. 1994. Principles of Systematic Zoology.
3. Agarwal. K.C. 2000. Biodiversity.
4. A.B.Choudhari and D.D.Sarkar 2002. Biodiversity Endangered.
5. Kumar.V. 2003. Biodiversity Principles and Conservation.
6. Kotwal P.C. 2003. Biodiversity Conservation in Managed Forests and Protected Area.
7. Trivedi. P.C. 2004. Biodiversity Assessment and Conservation.
8. India 2006: Ministry of Information and Broadcasting, Government of India, New Delhi.

**M.Sc. (vi) - SEMESTER III - PAPER 13: MAJOR CORE PRACTICAL – III**  
**ANIMAL PHYSIOLOGY, BIOCHEMISTRY & IMMUNOLOGY 2+2+2 Hours / week 3**  
**credits**

(for students admitted from 2014-'15 onwards)

**Animal Physiology**

1. Preparation of Maltose standard graph
2. Human Salivary Amylase activity in relation to Temperature
3. Rate of activity in relation to body mass / weight in an aquatic organism (Fish)
4. Estimation of Haemoglobin
5. Estimation of ESR

**Biochemistry**

1. Paper Chromatography.
2. Thin layer chromatography.
3. Quantitative Estimation of Blood Glucose.
4. Quantitative Estimation of Total Protein.
5. Quantitative Estimation of HDL, LDL (Triglycerides).
6. Quantitative Estimation of Creatinine in urine.
7. Quantitative Estimation of Creatinine in serum.
8. Quantitative Estimation of Urea in serum.
9. Quantitative Estimation of Urea in urine.
10. Quantitative Estimation of Serum cholesterol.
11. Quantitative Estimation of Alkaline phosphate

**Immunology**

1. Precipitin Test



2. Dissection to locate primary and secondary lymphoid organs (any vertebrate)
3. Vaccination Schedule and vaccines used.
4. Demonstration of immunization (Intravenous, Intrapertoneal, cutaneous, ocular, oral)
5. Observation of permanent slides of lymphoid organs / tissues.
6. Radial Immunodiffusion and Ouchterlony double diffusion using Agarose, Alveiver's.
7. Fluorescent staining of blood for observation of lymphoid cells.
8. ELISA-demo.
9. Report of survey of awareness of HIV/AIDS amongst students.

Visit to Institute and departments related to immunology and vaccine producing laboratories- Diagnostic centre.

**M.Sc. (vi) - SEMESTER III - PAPER 13: MAJOR CORE PRACTICAL – III**  
**ENVIRONMENTAL BIOLOGY & BIODIVERSITY AND MICROBIOLOGY 2+2 Hours /**  
**week      2 Credits**

### **Environmental Biology and Biodiversity**

1. Qualitative and quantitative analysis of plankton sample.
2. Determination of hardness of water – calcium, magnesium.
3. Estimation of BOD in pond water and polluted water.
4. Study of soil characteristics:- colour, texture, moisture, pH, carbonate and nitrate.
5. Study of terrestrial community by quadrat method :- determining frequency, density and abundance of different species present in the community.
6. Measurement of particulate air pollutants - dust fall and suspended particulate matter from different areas.
7. Visit to sandy shore, muddy shore and rocky shore to collect and study the organisms and their adaptation to the environment.
8. Study of pond / estuarine ecosystem (Estuarine Biological Laboratory, Pulicat): Plankton collection, estimation of primary productivity, PH, salinity, dissolved oxygen content, free carbon dioxide content, analysis of biotic community and construction of food chain and food web.
9. To Study the biodiversity of fauna of the scrub jungle of MCC campus and to estimate Absolute density - Relative dominance - Relative density - Relative frequency - Simpson, Index of dominance - Community dominance index - Community similarities - Coefficient of community - Species diversity index - Index of frequency of occurrence together and Species association test
10. Students may be exposed to the following areas (not for assessment)-sewage treatment plants; drinking water treatment plants; atomic power plants; refineries and tanneries.

### **Microbiology**

1. Commercial kits-based diagnosis.
2. Antibiotic sensitivity(bacterial).
3. Bacterial culture
4. Agar gel diffusion
5. ELISA
6. Preparation of axenic cultures
7. Laboratory Safety, Microscopy, Aseptic Technique
8. Bacterial Cultures, Slide Preparation, Staining, Streaking
9. Streaking, Pour Plates
10. Bacterial Characteristics
11. Differential and Selective Media
12. Bacterial Identification
13. Litmus Milk, Carbohydrate Fermentation, Hydrogen Sulfide and Agglutination Tests

**M.Sc. (vi) - SEMESTER IV - PAPER 14 : MAJOR CORE**

**BIOTECHNOLOGY**

**6 Hours / week**

**4**

**Credits**

(for students admitted from 2008-'09 onwards)

**Unit – 1:** Introduction: Historical perspective; definitions; scope of biotechnology; commercialization of biotechnology. Fundamentals of molecular biology. 5 hrs.

**Unit – 2:** Gene technology: Restriction endonucleases as tools for DNA fragment generation; linkers and adaptors; expression of cloned genes; P.C.R.; vectors; rDNA technology; transgenics; cloning; DNA sequencing; gene libraries; human genome project 10 hrs..

**Unit – 3:** Protein engineering and design: Protein structure and function; methods in protein engineering and design; production of foreign proteins. Gene therapy. 8 hrs.

**Unit – 4:** Enzyme technology: Traditional uses of enzymes; immobilization – methods and uses; biosensors. 5 hrs.

**Unit – 5:** Bioprocess technology: Exploitation of micro-organisms and cells; S.C.P.; mining; over-exploitation in various fields of biotechnology. 8 hrs.

**Unit – 6:** Human health and biotechnology: Application of biotechnology in the field of biotechnology – diagnostics and therapy; human protein replacements; vaccines; A.R.T.; monoclonal antibody technology; immunotechnology; human gene banks; related ethical issues. 12 hrs.

**Unit – 7:** Agricultural biotechnology: tissue culture; micropropagation; somatic hybridization; transgenic plants. 4 hrs.

**Unit – 8:** Animal biotechnology: transgenic animals; high yielding and disease resistant animals; A.R.T. in animal husbandry; cloning and transgenic animals; animals as models and related ethical issues. Fishery biotechnology. 10 hrs.

**Unit – 9:** Environmental biotechnology: environment and human health; biomonitoring of pollution; waste treatment; bioremediation; global environmental problems. Bioethics. I.P.R. and patents. 8 hrs.

**Reference Books:**

1. Molecular biology of the gene. Watson, et al.
2. Concepts of Biotechnology. Balasubramanian, et al.
3. Biotechnology. U. Sathyamurthy.
4. Animal Biotechnology. Ramadas.
5. Introduction to Biotechnology. Gupta.
6. Basics in Biotechnology – Springer Verlag

**M.Sc. (vi) - SEMESTER IV - PAPER 15 : MAJOR CORE**

**MOLECULAR ENDOCRINOLOGY**

**5 Hours /week**

**4credits**

(for students admitted from 2008-'09 onwards)

**Unit I: Role of Hormones**

1. Hormone biosynthesis and secretion
2. Transport of hormones
3. Mechanism of hormone action: Peptide and steroids
4. Receptor types and its mode of action

**Unit II: Endocrine manipulation of Reproduction in Mammals**

1. Overview of hormonal control of reproduction in mammals
2. Manipulation of the estrous cycle
3. Induction and synchronization of estrus
4. Superovulation and embryo transfer
5. Hormones in maintenance of pregnancy
6. Induction of Parturition
7. Inducing puberty

**Unit III: Gonads and fertility disorder**

1. Amenorrhea
2. Polycystic ovary
3. Hirsutism
4. Cryptorchism
5. Varicocele

## 6. Sertoli cell syndrome

### **Unit IV** : Gamete Preservation in Fish & Mammals

1. Sperm motility and metabolism
2. Gamete quality
3. Short-term preservation of spermatozoa
4. Short-term preservation of ova
5. Cryopreservation of gametes

### **Unit V**: Anabolic steroids and Analogues

1. Direct and indirect effects
2. Delivery systems
3. Effects of sex steroids on meat quality
4. Safety issues

### **Unit VI**: Hormonal response to stress

1. Sympatho-adrenal system
2. Hypothalamic – Pituitary axis
3. Role of various hormones in stress responses
4. Effects of stress on reproduction
5. Effects on growth performance

### **Unit VII**: Obesity

1. Cause and Consequences
2. Outline of hormonal involvement
3. Leptin: synthesis, secretion and its role in adipogenesis

### **Unit VIII**: Thyroid disorders and management

1. Antithyroid drugs, dietary goitrogens
2. Goiter
3. Myxedema
4. Cretinism

### **Unit IX** : Insulin and Glucose balance

1. Glucose homeostasis
2. Insulin resistance & Management
3. Diabetes mellitus & Management

### **Reference Books:**

1. G. M. Besser & M. O. Thorner. Comprehensive Clinical Endocrinology, III<sup>rd</sup> Ed. (2002), Mosby.
2. E. Knobil & D. Niell. Encyclopedia of Reproduction (1998), Academic press.
3. P. J. Bentley. Comparative Vertebrate Endocrinology, III<sup>rd</sup> (1998), Cambridge University Press
4. E. J. Squires. Applied Animal Endocrinology (2003), CABI Publications UK.
5. Mac E. Hadley. Endocrinology, V Ed. (2000), Prentice Hall International Inc.
6. Norris. Vertebrate Endocrinology, III<sup>rd</sup> ed. (1998). Lea & Febiger.

7. P. R. Larsson et.al., Williams Text Book of Endocrinology, X<sup>th</sup> Ed. (2002), W.B. Saunders, Philadelphia.

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**M.Sc. (vi) – SEMESTER IV - PAPER 16: MAJOR CORE PRACTICAL - IV**

**BIOTECHNOLOGY AND ENDOCRINOLOGY**

**3+3 Hours / week**

**4Credits**

(for students admitted from 2008-'09 onwards)

**Biotechnology**

1. Design of bioreactor.
2. Electrophoretic separation of proteins (PAGE)
3. Genomic DNA isolation from animal tissues.
4. Detection of DNA.
5. Quantitative estimation of DNA.
6. Enzyme immobilization.
7. Chromatographic techniques – Column Chromatography
8. P.C.R.
9. Principles of animal cell culture.
10. ELISA.
11. Immunoblotting.

**Endocrinology**

1. Dissection to see various endocrine glands in mice/Rat, frog / Wall lizard
2. Observation of histological slides: Pituitary, Thyroid, Adrenal, Pancreas, Thymus, Ovary, Testis and Epididymis
3. Ectomy experiments: Adrenalectomy, Castration, Ovaryectomy in lab mice (any one)
4. GTT experiments
5. Thyroxin test in Tadpoles
6. Estrous cycle study by vaginal smears in mice
7. hCG based pregnancy test

**M.Sc. (vi) – SEMESTER IV -: MAJOR ELECTIVES: PAPER 17**

**ANIMAL BEHAVIOUR**

**4 Hours / week**

**5**

***Credits***

(for students admitted from 2008-'09 onwards)

**Unit I** Introduction: Definition (ethology, instinct –learning, Altruism, agnostic behaviour, derive, displacement behaviour, territorial behaviour, communication, hierarchy, FAP, stimuli, ethogram, Time budgets) Lorenz's and tinbergen's models for release of FAP, modern methods in the study of behaviour.

**Unit II** Describing behaviour: Description by form and function, Advantages and disadvantages, methods of data collection – field observations, capture, recapture, camera tagging, radioelemetry, lab experiments, activity recordings.

**Unit III:** Living groups: Costs and benefits, communication (types, design of signals, variability in signals – bees, birds and bats), behaviour expressed in a group (territorial, altruism, courtship and mating, agnostic hierarchy).

**Unit IV:** Rhythmic behaviour: Kinds of biological rhythms (circadian, tidal, lunar and annual). Characteristics of circadian rhythms, terminology used (Zeitgeber, phase, phase shifts, phase angle difference, entertainment, freerunning rhythm, CT, PRC, Actogram), biological clocks.

**Unit V:** Behavioural Genetics: Single genes and behaviour, chromosomal mutations affecting behaviour, polygenic inheritance of behaviour, behaviour of inbred, recombinant strains, molecular basis of circadian rhythms, phylogeny of behaviour.

**Unit VI:** Neural control of Behaviour: Language of the nervous system, brain centers and their functions, learning and memory, hormones and behaviour.

**Unit VII:** Applied Ethology: Pest control, managing population size, improving productivity promoting the welfare of farm and captive animals, wildlife management.

**Unit VIII:** Human behaviour

Human actions (innate, discovered, absorbed, trained and mixed), gestures (primary and secondary), greeting signals, baron signals.

***Reference Books:***

McFarland, D. Companion to Animal Behaviour

Manning, Introduction to Animal Behaviour

Desmond Morris, Manwatching.

**M.Sc. (vi) – SEMESTER IV -: MAJOR ELECTIVES: PAPER 17**

**AQUACULTURE**

**4 Hours / week**

**5**

**Credits**

(for students admitted from 2008-'09 onwards)

*Objectives: To introduce the knowledge of aquaculture potential and practices in India, and to realize the need for augmenting food production from the aquatic resources through aquaculture*

**Unit I**

Scope and definition. Nature and socio-economic basis. Biological and technological basis. History of aquaculture and its present status at the National and Global level. National and International research and development organizations.

**Unit II**

Classification of cultivable aquatic organisms of India (taxonomic and ecological) pre-requisites for cultivable organisms.

**Unit III**

Basic considerations in aquaculture. Definition of traditional extensive and intensive, semi-intensive culture practices; preparation and management of ponds – construction, fertilization, control of aquatic insects, weeds and predatory and weed fishes. Estimation of live-feed organisms. Procurement of seed and its transportation natural and artificial feeds, nutritional ecology (Energy budgets). Spawning and breeding, parasites and diseases.

**Unit IV**

Productivity and plankton. Methods of productivity studies in an aquatic environment; qualitative and quantitative studies of plankton; culture techniques of phyto and zooplankters.

**Unit V**

Culture Techniques : Sea-weed culture. Resources and utilization; culture techniques.

**Unit VI**

Shell fish culture: Crustacean culture. Shrimp culture, pattern of life-cycles of penaeids and non-penaeids , induced maturation and breeding of cultivable shrimps- Formulated feeds of shrimps and prawns and lobsters. Recent breakthroughs in the induced breeding of shrimp, prawns and crabs. Biology and culture techniques.

**Unit VII**

Fin-fish culture

Patterns of life cycles of brackishwater cultivable fin fishes. Techniques of induced breeding of cultivable fin-fishes. Monoculture, polyculture, special culture techniques of various freshwater, brackishwater, marine finfishes viz., pond, cage, pen, race-way, recirculatory, paddy-cum-fish



culture, sewage-fed fishculture, sustainable aquaculture, culture based fisheries of small reservoirs, flood plain wetland culture fisheries close to jheels. Lab- to -land programmes.

### **Unit VIII**

Constraints of aquaculture (i) low quality and costly feed ingredients, (ii) weak extension network, (iii) lack of field exposure, (iv)insufficient R & D support (v) lack of proper database (vi) non-availability of proper insurance schemes (vii) lack of policy for aquaculture.

### ***Reference Books:***

Reay, R.J. 1979, Aquaculture. Edward Arnold (Publishers) Ltd., pp.56.

T.V.R. Pillai, 1993. Aquaculture – principles and practices fishing news publication, pp.578.

Sinha, V.R.P. 1993. A compendium of aquaculture technologies for developing countries, Oxford I.B.P. Publishing Co. Pvt. Ltd., pp.115.

Annon, 1995, Freshwater fishes Hand Book on aquaculture, MPEDA, Cochin, pp.102.

T.J.Pandian (ed.) 2001. Sustainable fisheries. National academy of agriculture sciences, pp.327.

**M.Sc. (vi) – SEMESTER IV- MAJOR ELECTIVE : PAPER 18**

**TEACHING ZOOLOGY**

*4 Hours / week*

**5**

***Credits***

(for students admitted from 2008-'09 onwards)

**UNIT I : Introduction**

Nature and scope of Life Sciences in Modern times – trends in teaching life sciences – aims and objectives with reference to Bloom's taxonomy – teaching life sciences at different levels.

**UNIT II: Microteaching:**

Teaching skills – demonstration – explaining – Black board writing – skills of stimulus variation – questioning – uses of aids and reinforcement.

**UNIT III: Lesson Planning:**

Principles of lesson planning – its importance – approach to lesson plan – planning for specific behavioural changes – Herbartian steps – its merits and demerits.

**UNIT IV : Education Technology:**

Traditional: importance of aids in teaching – principles and preparation of charts, pictures, models, objects, specimen, transparencies, audio and video tapes – magnifying equipments like microscopes – preservation of biological specimens including herbarium, cultures, aquarium, vivarium, aviary, museum – setting up a lab – accidents and first aid.

Modern Technology: Flow chart – computer aided learning – internet search – use of multimedia.

**UNIT V: Methods of teaching:**

Inductive and deductive approach – Importance of formulation and verification of hypothesis – General methods of Teaching: lecture – Lecture cum demonstration – practical project – PowerPoint presentation – Seminars – group discussion – field trip – organizing seminars and symposia.

**UNIT VI: Evaluation:**

Achievement tools – preparation of question paper – essay type, objective and short answer – blue print of question paper – construction and use of tests – statistical analysis of results and performance – diagnostic tests – remedial measures – teaching and student evaluation.

***Reference Books:***

**Secondary School Teaching Methods**

By Leonard H. Clark, Irving S. Starr

**Exercises for "Methods of Teaching in High Schools":**

Samuel Chester Parker

## Science Teaching Methods

Harold R. Hungerford, A. Tomera

## A Method of Teaching Zoology

By Elliot Whipple

**M.Sc. (vi) – SEMESTER IV- MAJOR ELECTIVE : PAPER 18**

**MEDICAL LABORATORY TECHNIQUES**

**4 Hours / week**

**5**

**Credits**

(for students admitted from 2008-'09 onwards)

### UNIT I: Human Anatomy and Physiology:

Organs and organ systems – levels of organization – study of the following systems in detail: circulation – digestion – urinary – endocrine.

### UNIT II: Lab organization, maintenance and instrumentation:

Code of ethics – organization of Laboratory - laboratory administration - maintenance of records and reporting – construction – care and use of the following equipments: photoelectric colorimeter, spectrophotometer, ECG apparatus, electrophoresis, Biochemical analysers and ELISA Reader.

### UNIT III: Medical parasitology:

Morphology, life cycle, mode of infection, pathogenesis, prophylaxis and treatment of the following parasites found in human.

Protozoology: Rhizopoda – *Entamoeba histolytica*, *Entamoeba coli*, Sporozoa – *Plasmodium* sp., Ciliata – *Blantidium coli* and flagellates – *Trichomonas*, *Trypanosoma*, *Giardia lamblia*.

Helminthology: Nematodes – *Ascaris*, Hookworm, *Enterobius*, *Trichuris*, *Wuchereria*.

Cestodes – *Taenia saginata*, *Taenia solium*, *Hymenolepis nana*, *Diphylobothrium latum*.

Trematodes – Common Blood flukes, Intestinal and Lung flukes and Liver flukes.

### UNIT IV: Clinical immunology

Cell mediated and humoral immunity; Immuno diagnostic test.

### UNIT V : Biochemistry and techniques in Histopathology:

Enzymes: Basic concepts, clinically important enzymes – metabolic disorders.

Use of enzymes, immobilization of enzymes and their application in biotechnology.

Preparation and processing of tissues – Fixation / dehydration / impregnation with paraffin wax / embedding / block making / section cutting / mounting and staining.

### UNIT VI: Haematology and Clinical pathology

Blood – composition – functions – production of cells – Types of anaemias – clotting mechanisms and disorders. Blood groups and blood banking – study of body fluids – sputum. Faeces, semen,

gastro and duodenal contents – cerebrospinal fluid, transudates and exudates – basic information of commitment.

***Reference Books:***

A text book of physiological chemistry, Harold Harper.  
A text book of biotechnology, Kumar  
Anatomy and Physiology for Nurses, Evelyn and Pearce  
Biochemistry, Ambika Shanmugam  
Biotechnology – The biological principles: Treven, et al.  
Cell biology: De Robertis  
Essential Immunology: Roit  
Human Anatomy and Physiology: Best and Taylor  
Immunology: Weir  
Instrumentation techniques: Griffith  
Introduction to Human Anatomy and Physiology: Eldra Pearl Solomon  
Language of Medicine: David Ellen Chabner  
Manual on Medical Lab Technology: CMC Medical Foundation  
Medical Parasitology: Jayaram Panicker  
Medical Physiology: Guyton  
Medical Microbiology: Anantanarayanan and Panicker  
Notes on Clinical Lab Techniques: K.M. Samuel  
Practical Clinical Biochemistry: Herold Varley  
Textbook of Medical Laboratory Technology: Ramnik Sood  
Textbook of Medical Laboratory Technology: Kanai Mukherjee  
Textbook of Biochemistry: Lehninger

<b>M.Sc. (vi) – SEMESTER IV- MAJOR ELECTIVE : PAPER 19 PRACTICAL V</b>		
<b>ANIMAL BEHAVIOUR</b>	<b>2 Hours / week</b>	<b>5</b>
<b>Credits</b>		

(for students admitted from 2008-'09 onwards)

1. Study of birds in MCC campus.
2. Orientation of animals (cockroach, ant-lion larvae, maggots, earthworm, grasshopper and butterfly).
3. Mounting of the legs and sting of honey bees.
4. Study of *Drosophila* eclosion rhythms.
5. Study of mouth parts in insects and their feeding strategies.
6. Study of learning in mice and cockroach.
7. Establishment of the relation between brain and behaviour.
8. Human actions and gestures
9. Study of animals in captivity – visit to the zoo.

<b>M.Sc. (vi) – SEMESTER IV- MAJOR ELECTIVE : PAPER 19 PRACTICAL V</b>		
<b>AQUACULTURE</b>	<b>2 Hours / week</b>	<b>5 Credits</b>

(for students admitted from 2008-'09 onwards)

1. Identification of cultivable organisms and weed and predatory fishes
  - i. Fishes (10) b) Shrimps (3) c) Prawns (3) d) Molluscs (5)
2. Identification of aquatic insects (5)
3. Identification of live-feed organisms (field training)
4. Identification / field visit to identify parasites and diseases of fish/shrimp, utility of PCR & ELISA techniques, medicines and probiotics
5. Water quality analysis and estimation of primary productivity in fish/shrimp farm.
6. Qualitative and quantitative analysis of Planktons.
7. Compulsory visits to 1. Fish farm, 2. Fish Hatchery, 3. Shrimp Farm, 4. Shrimp Hatchery, 5. Visits to CIBA and CMFRI – Kovalam lab and NIOT)

<b>M.Sc. (vi) SEMESTER IV - PAPER 20 : MAJOR ELECTIVE PRACTICAL - VI</b>	<b>3 Hours /week</b>	<b>5</b>
<b>TEACHING ZOOLOGY</b>		
<i>credits</i>		

(for students admitted from 2008-'09 onwards)

1. Preparation of Teaching aids: a) Wet mount b) Dry mount (insect/crab)
  - c) skeleton preparation.
2. Preparation of charts and Herbarium sheets
4. Question paper writing – assessment – evaluation.
  - blue print preparation
5. Lesson plan
6. Power point preparation & presentations
7. Teaching practice in the Zoology Department, MCC.

<b>M.Sc. (vi) SEMESTER IV - PAPER 20 : MAJOR ELECTIVE PRACTICAL - VI</b>	<b>3 Hours /week</b>	<b>5</b>
<b>MEDICAL LABORATORY TECHNIQUES</b>		
<i>credits</i>		

(for students admitted from 2008-'09 onwards)

### **I. Analysis of Body fluids and Medical Microbiology**

Preparation of reagents.

chemical tests – qualitative

Microscopical examination of deposits

Pregnancy tests.

Faeces: routine examination, microscopical examination for ova and parasites. Culture and sensitivity, sputum for AFB, semen analysis. Collection of sample for culture of microorganisms;

different staining techniques, culture and sensitivity test, test for typhoid - Widal / VDRL test, HIV test, HBSAg (Hepatitis B Surface Antigen) and Mantoux test.

## **II. Practical Clinical Biochemistry**

Determination of the following parameters in blood – Blood sugar, urea, creatinine – cholesterol – alkaline and acid phosphatase – SGOT and SGPT – total proteins.

## **III. Haematology and Blood Banking**

Collection of blood - Blood cell counts - TC, TRBC – haemoglobin. Haematological indices, coagulation tests – ESR tests – peripheral smear study. Blood for malaria and microfilaria – ABO grouping and Rh.

**MADRAS CHRISTIAN COLLEGE (Autonomous)**  
**DEPARTMENT OF ZOOLOGY**  
**M.Phil. CURRICULUM**  
(for students admitted from 2008-'09 onwards)

<b>Papers</b>	<b>Title</b>
<b>1.</b>	Research Methodology
<b>2.</b>	Recent Advances in Zoology
<b>3.</b>	Optional: 1. Bioinformatics
	2. Reproductive Endocrinology
	3. Entomology

	4. Invertebrate Reproduction
	5. Animal Behaviour
	6. Fish Biology

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1. RESEARCH :  
Writing a research paper – style of scientific writing – Bibliography
2. CHROMATOGRAPHY:  
Principles and procedures – Unidimensional and two dimensional - paper , thin layer and gas chromatograph
3. HISTOCHEMISTRY:  
Micro techniques, identification of carbohydrates, fats and proteins
4. ELECTROPHORESIS:  
Principles – buffers – preparation of materials. Types of electrophoresis and two dimensional electrophoresis
5. BIostatistics :  
Frequency distribution – class intervals - class limits. General rule for forming frequency distribution. Histogram – frequency, Relative frequency distribution, Cumulative frequency distribution, Types of frequency curves. Statistics vs Biology Population and sample, continuous discontinuous variables, Scientific notation, graphic representation of data. Mean mode and median – other measures of central tendency Standard deviation and related measures. Coefficient elements of probability. Tests of hypothesis and significance. Chi square test, t-test, Regression and correlation ANOVA, Analysis of variance – parametric and non-parametric.
6. MICROSCOPY AND PHOTOMICROGRAPHY :  
Types of microscope – Fluorescent and Electron microscopy – Micrometer – Camera lucida – elements of photography and microphotography
7. COLORIMETRY AND SPECTROPHOTOMETRY:  
General consideration – quantitative estimation of biological compounds in body fluids and tissues
8. RADIOISOTOPES:  
Tracer experiments – Autoradiography – different forms of Counters and laboratory safety.

***Reference Books:***

1. Anderson ,J.B.H.,Durstun and M.Poole 1970.Thesis and Assignment writing.Wiley Eastern Pvt.Ltd.,New Delhi.
2. Atkins.H.J.B.,1960.Tools of biological research (Second Series).Blackwell Scientific Pub.,oxford.
3. Bradshaw,L.J.,1966.Introduction to molecular biological techniques.Prentice Hall Inc., New Jersey.Casartelli.,1965.Microscopy for students.McGraw Hill,New Delhi.
4. Hawk,P.B.,B.C.Oset and W.H.Sommerson,1954,Practical Physiological Chemistry.Mc Graw Hill,New York.

5. Homason,G.L.,1967 Animal Tissue Techniques.W.H.Freeman and Company,London.
6. Newman,D.W.(Ed.),1964.Instrumental Methods of Experimental Biology.MacMillan Co.,New York.
7. Pearse,A.C.E.,1974.Histochemistry,Theoretical and applied .Vol I&II. J.& A .C hurchill Ltd.,London.Schefler,W.C.,1969.Statistics for the Biological Sciences.
8. Smith,R.C.,1962.Guide to the Literature to the Zoological Sciences.Burgan Publishing Co.,Minnesota.
9. Whitney,F.L.,1950.The Elements of Research.

**M.Phil (vi) - SEMESTER I – PAPER-2: MAJOR  
RECENT ADVANCES IN ZOOLOGY**

1. Conservation of natural resources
2. Energy of Biological origin and energy Crisis.
3. Population problem and control.
4. Pollution and control measures
- 5 GENETIC ENGINEERING: techniques and implications
6. HUMAN GENETICS Non-disjunction and its effect – Structural variation and its effects
7. INTEGRATED PEST CONTROL PROGRAMMES for paddy and sugar cane
8. CELL AND TISSUE CULTURE
9. Numerical Taxonomy and principles
10. Biochemical Taxonomy – Trends
11. Aquaculture – Cultivable organisms in India – technology adopted
12. Recent advances in Carcinogenesis

**Bioinformatics**

Introduction to Bioinformatics. Aims and Tasks. Applications and Research, Information Retrieval System.

**I. Molecular Biology**

Introduction. Gene structure Central Dogma hypothesis. Protein structure and Functions. Recombinant DNA technology. Molecular Biology Techniques: Gel Electrophoresis, DNA Sequencing. Protein Sequencing.

**II. Bioinformatics Tools and Databases**

Genomics and Proteomics Sequence Alignment and Analysis. Nucleic acid and Protein Sequence Databases: Structure Databases. Enzyme, Metabolic Pathway Databases. Literature Databases Data submission Tools, Data Analysis and Prediction Tools

**III Homology, Phylogeny and Evolutionary Trees**

Homology and similarity, Phylogeny and relationships, Approaches used in Phylogenetic analysis, Molecular approaches to Phylogeny, Phylogenetic analysis databases, Hidden Markov Models for homology modeling.

**IV. Microarray Technology**

Basic concepts- concept of gene expression. Making Microarray- sample preparation, hybridization Image acquisition. Prediction of cross hybridization, Image processing. Measuring and quantifying Microarray variability.

**V. Drug Discovery and Pharmacoinformatics**

Review of basic biological concepts, Characteristics of a drug compound. Discovering a drug. Target identification and validation. Identifying the lead Compound. Optimization of Lead compound. Structure based drug design. Molecular docking

**Reference Books:**

1. Basic Bioinformatics 2005, S.Ignacimuthu, s.j.  
Narosa Publishing House
2. Introduction to Bioinformatics ( Fourth Edition ) - 2003  
T.K. Attwood & D.J. Parry- Smith, Pearson Education ( Singapore) Pvt. Ltd.
3. Introduction to Bioinformatics 2003  
Arthur M. Lesk , Oxford University Press
4. Bioinformatics- Methods and Applications- Genomics, Proteomics & Drug Discovery- 2005  
S.C. Rastogi, N. Mendiratta & P. Rastogi , Prentice Hall of India Private Ltd.
5. Bioinformatics- Databases and Algorithms - 2006  
N. Gautham - Narosa Publishing House
6. Discovering Genomics, Proteomics & Bioinformatics- 2003  
A. Malcolm Campbell & Laurie J. Heyer, Pearson Education ( Singapore) Pvt. Ltd.
7. Bioinformatics- Managing Scientific Data- 2003

<b>M.Phil (vi) - SEMESTER I – OPTIONAL</b> <b>REPRODUCTIVE ENDOCRINOLOGY</b>
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1. Nature of hormones and hormone action
2. Genetic control of synthesis of hormones.
3. Hypothalamus-hypophysial axis and regulatory mechanism
4. Hypophysial and gonadal interrelationship
5. Gonadal development and sexual differentiation
6. Assay of hormones
7. Regulation of fertility
8. Pregnancy and lactation and its impact on endocrine function
9. Disorders of gonadal function
10. Metabolism in relation to reproduction role of adrenal and thyroid glands in reproduction.

## **M.Phil (vi) - SEMESTER I – OPTIONAL**

### **ENTOMOLOGY**

#### **1.PHYSIOLOGY:**

Insectan integument –hormones and metamorphosis,insect digestion,circulation  
respiration ,excretion,co-ordination and reproduction.

#### **II FORENSIC ENTOMOLOGY:**

Scope and Applications.

#### **III.BIOCHEMICAL ANALYSIS:**

Involving insect host –plant relationship.

#### **IV.INSECT POPULATION ANALYSIS:**

In various habitats .impact of host plants on the reproductive efficiency of the insects. Insect life tables. Modern control measures. Hazards of insecticides-resurgence and secondary outbreak. Biology –nature, extent of damage and control of pests of rice, sugarcane, cotton, fruit trees like mango, orange, banana, grapes-vegetables like brinjal, ladies finger ,etc., groundnut, coconut,- plantation crops like tea and coffee. Host –Parasite-Predator interactions-dynamics-impact on population –Biological control.

#### ***Reference Books:***

1. Fauna of british India Volumes on insects.
2. Geological history and evolution of insects-1953 Scientific American 41,carpenter.
3. Annual Review of entomology Vol 1 to 20
4. Physiology of insect reproduction-Engelmann.
5. Insect endocrinology- K.K.Nayyar.
6. Insect Physiology- Wigglesworth.
7. Introduction to the study of insects- Borror and Delong.
8. Indian Insect Life-Lefroy.
9. Destructive and useful insects- Borror and Delong.
10. Economic entomology-David and Kumarasamy.
11. Insect structure and function-Chapman.
12. General and applied entomology-Nayyar,Ananthakrishnan,David.
13. General Text Book of Entomology-A.D.Imms
14. General Text Book of Entomology – M.S.Mani
15. Ecology of insects-P.W.Price.
16. Annual review of Entomology-1985.

**M.Phil (vi) - SEMESTER I – OPTIONAL**

**INVERTEBRATE REPRODUCTION**

1. Introduction to reproductive biology
2. Reproductive organs in invertebrates.
3. Spermatogenesis and oogenesis.
4. Methods of sperm discharge and insemination, fertilization
5. Patterns of reproduction:  
Parthenogenesis, asexual reproduction, sexual reproduction, hermaphroditism and sex reversal.
6. Environmental factors and reproduction  
Salinity, humidity, temperature, photoperiod, oxygen and diapauses
7. Endocrine control of production
8. Pheromones and reproduction
9. Invertebrate larvae
10. Metamorphosis
11. Sexual behaviour.

***Reference Books:***

1. K.K.Nayar, 1977. Invertebrate reproduction. Oxford & IBH Publishing Co.
2. Giese, A.C and Pearse, J.S., 1974. Reproduction of marine Invertebrates Vols. I, II, III. Academic Press Inc., New York.
3. Wigglesworth, V.B., 1954. The Biochemistry of Development . Pergamon Press, Oxford.
4. Danileviski, A.S., Photoperiodism and Sexual Development in insects. Oliver and Boyd, Edinburgh.
5. Counce, S.J., 1972. In Development Systems: Insects. Academic Press, Oxford.
6. Engleman, F., 1970. The Physiology of insect Reproduction. Pergamon Press, Oxford.
7. Jacobson, M., 1972. Insect Sex Pheromones. Academic Press, New York.
8. Fischer, A and Pfannenstiel, H.D., 1984. Polychaete Reproduction . Gustav F. Verlag, New York.
9. Dorothy E. Bliss, 1983. The Biology of Crustacea. Academic Press.
10. J.M.B.A India . Proceedings of the symposium on Mollusca Part I
11. J.M.B.A India . Proceedings of the symposium on Mollusca Part II.

**M.Phil (vi) - SEMESTER I – OPTIONAL**

**ANIMAL BEHAVIOUR**

**I.SOCIAL BEHAVIOUR PATTERNS:**

1. Means of communication-sound-odour-vision
2. Colonial life –groups-among invertebrates-vertebrates
3. Aggressive behaviour
4. Courtship behaviour
5. Orientation-tropisms-kinesis-taxes-homing
6. Human behaviour –action-gestures.
7. Brain and behaviour

**II.RHYTHMIC BEHAVIOURAL PATTERNS:**

1. Various categories of rhythms in nature-plant examples-animals-human.
2. Endogenous nature of rhythms-terminology used-zeitgeber-Entrainment and free run features.
3. Daily and circadian rhythms-their features-significance.
4. Lunar –tidal rhythms-rhythm in marine animals-characteristics-significance.
5. Annual rhythms-protoperiodicity-circannual rhythms-migration-hibernation.
6. Biological clocks-biochemical and physiological aspects –significance of endocrine hormones-location of the clocks.
7. Human rhythm-shift working –time zone transition-astronautics-applied aspects in psychiatry, pharmacology, medicine, surgery.



**M.Phil (vi) - SEMESTER I – OPTIONAL**

**FISH BIOLOGY**

1. Adaptive radiation in Chondrichthyes and Osteichthyes
2. Morphology and anatomy(all systems)
3. Food and feeding habits
4. Age and growth with special reference to Indian fishes.
5. Spawning and breeding with special reference to Indian fishes.
6. Parasites and diseases.
7. Hill stream fishes.
8. Exotic fishes
9. Larvicidal fishes.
10. Fish in nutrition
11. By –products
12. Taxonomy of commercial important freshwater, estuarine and marine fishes of india.
13. Bionomics of carps ,murrels,pearl spots,mulletts,milk fish,sharks and rays,sardines,mackerels,silver bellies,pomfrets and tunas.

***Reference Books:***

1. Bagenal, T.B., 1979. The Ageing of fish. Unwin Brothers Ltd., Greshnam Press, England.
2. Colbert, E.C., 1969. Evolution of the Vertebrates. Wiley Eastern Ltd. New Delhi.
3. Holden, H.T and D.F.S. Rait, 1974. Manual of fisheries Science .Part I FAO Technical Paper No.115.
4. Jhingran, V.G., 1982 Fish and Fisheries of India. Hindustan Publishing Corporation (India), Delhi.
5. Lagler, K.F., J.E., Bordach and R.R. Miller, 1962. Ichthyology, the study of fishes. John Wiley and Sons Inc., USA.
6. Marshall, N.B., 1965. The Life of Fishes. Wiedenfield and Nicolson. London.
7. Norman, J.R., 1963 .History of Fishes Ernest Benn Ltd., London.
8. Pillay, T.V.R (Ed.), 1972. Coastal aquaculture in the Indo-Pacific Region. FAO, Rome, Italy.
9. Qasim, S.Z., 1973. Some Complication of the problem of age and growth in marine fishes from the Indian Waters. Indian J.Fish., 20(27): 351-371.