

- To get a pass in theory or practical, a student should obtain 50% of the aggregate of internal and external marks
- No separate pass minimum for internal
- 34 marks out of 75 is the pass minimum for theory in the external
- 27 marks out of 60 is the pass minimum for practical in the external

### M.Sc. ZOOLOGY

#### Scheme of Distribution of Credit and Course

Year	Semester	Subject	Credit		Hours		Course	
			T	P	T	P	T	P
I	First	Cell Biology (Major)	5	3	6	4	1	1
		Biochemistry (Major)	5	3	6	4	1	1
		Biophysics (Major)	5	3	6	4	1	1
		Techniques in Biology (Major Elective)	5	3	6	4	1	1
	Second	Genetics (Major)	5	3	6	4	1	1
		Ecology (Major)	5	3	6	4	1	1
		Biostatistics, Computer Applications and Information Technology (Major)	5	3	6	4	1	1
		Sericulture (Major Elective)	5	3	6	4	1	1
II	Third	Microbiology (Major)	5	3	6	4	1	1
		Immunology (Major)	5	3	6	4	1	1
		Evolution (Major)	5	3	6	4	1	1
		Entrepreneurial Zoology (Non Major)	5	3	6	4	1	1
	Fourth	Physiology	5	3	6	4	1	1
		Developmental Biology	5	3	6	4	1	1
		Biotechnology	5	3	6	4	1	1
		Aquaculture (Major Elective)	5	3	6	4	1	1
Total			90	0	86	3	16	4
			90		120		20	

Work load per week

$$I \text{ MSc I } 22+8 = 30 \times \frac{1}{2} = 15$$

$$II \text{ } 22+8 = 30 \times \frac{1}{2} = 15$$

$$I \text{ MSc II } 22+8 = 30 \times \frac{1}{2} = 15$$

$$II \text{ } 22+8 = 30 \times \frac{1}{2} = 15$$

physical hours  $\rightarrow 90$   $\frac{180}{2} \rightarrow$  calculated hours

1582

*W. J. Srinivas*  
**PRINCIPAL**  
 Arulmigu Palaniandavar College  
 of Arts & Culture,  
 PALANI - 624 601.

**Semester I**  
**Major Paper**  
**Cell Biology**

**90 hours**

**Unit 1:**

Cytoskeleton – Microfilaments – Microtubules - Cilia and flagella - Plasma membrane Composition and structure – Membrane associated receptors - Extra cellular space - Cell adhesion - Intercellular junctions

**Unit 2:**

Structure and function of Endoplasmic reticulum, Golgi complex, Lysosome, Ribosome, Peroxisom

**Unit 3:**

Nucleus - Nuclear envelope - Structure and function of chromatin organization of nucleosome - Euchromatin and Heterochromatin - Unusual chromosomes - Polytene and Lampbrush chromosomes Mechanism of chromosome formation Nucleolus Organization and functions

**Unit 4:**

Mitochondria Ultra structure Cellular respiration Oxidative phosphorylation Energetics - Biogenesis and mitochondrial replication - Chloroplast - Ultra structure Photosynthesis – Energetics - Biogenesis - Replication and differentiation

**Unit 5:**

Cell cycle and its components - GO-GI transition - Spindle organization - Chromosome movements - Synchronisation of cell division - Mitosis and Meiosis - Differences between Normal and Cancer cells - Membrane and biochemical changes in Cancer cells - Nuclear and chromosomal changes Tumour viruses Oncogenes - Environmental factors inducing cancer - Hormones in relation to cancer

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**Text Books:**

1. Essentials of cell and Molecular Biology, De Robertis, E.D.P. and De Robertis E.M.F. 1981, Saunder International Edition.
2. Cell Biology, 2nd Edition, Karp G., 1985, McGraw Hill

**Reference Books:**

1. Cell and Molecular Biology, 8th Edition, De Robertis, E.D.P., De Robertis, E.M.F., 2001, Lippincott Williams and Wilkins.
2. Cell and Molecular Biology: Concepts and Experiments, Karp G., 1996, John Wiley & Sons
3. Molecular Biology of the Cell, 3rd Edition, Alberts, B., et al., 1994, Garland Publishing Inc.
4. Cell and Molecular Biology, 3rd Edition, Sheeler P., Bianchi D.E., 1987, John Wiley & Sons
5. The cell (all volumes). 2nd Edition, Brachet, J. and Mirsky, A.K., 1967, Academic Press
6. Cell Physiology, Howland, J.L., 1973. Mac Millan Publishing Co.

7. Biology of the cell: An evolutionary approach, De Witt, 1977, Saunder company
8. Membrane Biochemistry, Sim E., 1982, Chapman and Hall
9. Cytology. 2nd Edition, Wilson, G.B. and Morrison, J.H., 1967, Reinhold Publishing Corporation, New York.
10. DNA replication, Kornberg, A., 1974, W.H. Freeman and Company

## **Major Paper II**

### **Biochemistry**

90 hours

#### **Unit 1:**

Water and electrolytic dissociation - Acid-Base balance - Concept of pH, pI“ pH meter – Buffers - Buffering action - Physiological buffers - Acidosis and alkalosis

#### **Unit 2:**

Structure of simple sugars – Glycolysis – Kreb's cycle – Gluconeogenesis – Cori's lactic acid cycle – Blood sugar level in human

#### **Unit 3:**

Structure of amino acids -Primary, secondary, tertiary and quaternary structure of proteins – Deamination - Transamination - Transmethylation of amino acids

#### **Unit 4:**

Structure of fatty acids - sterols – Theories of oxidation of fatty acids -  $\beta$ -oxidation of fatty acids

#### **Unit 5:**

Structure of DNA - Structure of different RNA – Purine and Pyrimidine metabolism

#### **Text Books:**

1. Text Book of Medical Biochemistry, 2nd Edition, Ramakrishnan S., Prasanna K.G., Rajan R., 1995, Orient Longman Ltd.
2. Text Book of Biochemistry and Human Biology, 2nd Edition, Talwar, Srivastava, Moudgil, 1989, Prentice Hall of India Pvt. Ltd.

#### **Reference books:**

1. Lehninger Principles of Biochemistry, 3rd Edition, Nelson D.L., Cox M.M., 2001, Macmillan Worth Publishers
2. Biochemistry, 2nd Edition, Voet D., Voet J.G., 1995, John Wiley & Sons Inc.
3. Biochemistry, 4th Edition, Stryer L., 1995, W.H.Freeman and Co., New York
4. Harper's Biochemistry, 25th Edition, Murray R.K., Granner D.K., Mayes P.A., Rodwell V.W., 2000, McGraw Hill
5. Outlines of Biochemistry, 5th Edition, Conn E.E., Stumpf P.K., Bruening G., Doi H.R., 1997, John Wiley & Sons

## **Major Paper III Biophysics**

**90 hours**

### **Unit 1:**

Structure of atom Electronic configuration - Valency – Chemical bonds – Primary Chemical bonds - Covalent and ionic bonds- Secondary Chemical bonds -- Hydrogen 'bond, Hydrophilic and hydrophobic interaction, Van der Waal's interaction – Interaction between molecules - stability of molecules - Interaction between DNA and protein

### **Unit 2:**

Bioenergetics - Laws of thermodynamics – Enthalpy, entropy and free energy - Exergonic and endergonic reactions- Open systems - Efficiency of synthesis and oxidation of glucose-energy metabolism and high energy compounds

### **Unit 3:**

Biological membranes - Transport of ions - Kinetics of simple and facilitated diffusion - Kinetics of secondary active transport – Primary active transport systems - Physiological role of (Na<sup>+</sup>+K<sup>+</sup>) ATPase – Bacterial rhodopsin

### **Unit 4:**

Kinetics of chemical reactions - Rate of reaction – Factors influencing rate of reaction - Effect of temperature - Arrhenius equation - Enzymes - Mechanism of enzyme action – Enzyme kinetics – Michaelis-Menten equation

### **Unit 5:**

Electromagnetic spectrum – Visible spectrum - UV and other invisible spectrum - Effect of radiation on bio molecules - Delayed effects of radiation - Ionising radiation - Doseresponse relationship - Bioluminescence

### **Reference Books:**

1. A Biologist's Physical Chemistry, 2nd edition, Gareth Morris, 1978, ELBS Book Society and Edward Arnold (Publishers) Ltd. Thermodynamics for
2. Chemists, Glasstone S., East West Press Pvt. Ltd.
3. The Biochemistry of membrane transport, West I.C., 1983, Chapman and Hall
4. Physical Chemistry, 7th Edition, Alberty R.A., 1987, John Wiley & Sons
5. Radiobiology of Humans and Animals, Yarmonenko, 1988, Mir Publishers, Moscow
6. Foundations of Biophysics, Stanford A.L., Academic Press
7. Basic Biophysics for Biologists, Daniel M., 1989, Agrobotanical Publishers

## **Major Elective Paper I Techniques in Biology**

### **Unit 1:**

Microscopy – Principles – Magnification – Resolution - Contrast – Types of Microscopes – Light (Bright field, Dark field, Phase contrast, Fluorescent microscopes) – Electron (Transmission and Scanning electron microscopes) – Cytophotometry - Flow cytometry – Fixation - Micro technique - Staining

**Unit 2:**

Separation of molecules - Chromatography – Principles and applications - Paper, Thin layer, gel filtration, ion exchange, affinity, high pressure liquid chromatography Electrophoresis – Principles and applications – Paper, Gel, Cellulose, Ethyl acetate Ultracentrifugation – Velocity and buoyant density

**Unit 3:**

Nucleic acid hybridization - Principles and applications DNA denaturation and renaturation - Cot curves - Sequencing of protein and nucleic acids - Southern, Northern and South-Western blotting techniques – Polymerase chain reaction

**Unit 4:**

Analysis of molecular structure – X-ray diffraction - Spectroscopy – Visible, NMR, ESR - Atomic absorption and plasma emission spectroscopy

**Unit 5:**

Principles and applications of tracer techniques - Isotopes –Radioactive isotopes Measurement of radioactivity - GM Counter - Scintillation counter Solid and Liquid scintillation counters - Autoradiography

**Reference books:**

1. Principles and Techniques of Practical Biochemistry, 4<sup>th</sup> Edition, Wilson K. And Walker J., 1994, Cambridge University Press
2. Quantitative analysis, 5<sup>th</sup> Edition, Day R.A., Underwood A.L., 1988, Prentice Hall of India Pvt. Ltd., New Delhi Chromatographic methods, 4<sup>th</sup> Edition,
3. Braithwaite A., Smith F.J., 1985, Chapman and Hall, London
4. A Biologist's guide to principles of Practical Biochemistry, 3<sup>rd</sup> Edition, Wilson K., Goulding K.H., 1986, ELBS
5. Electrophoresis – A Practical approach, Anbalagan K., 1985, Life Science Book House, Madurai
6. Practical Biochemistry, 3<sup>rd</sup> Edition, Plummer D.T., 1987, Tata McGraw Hill Pub.Co.Ltd
7. Laboratory Manual in Biochemistry, Jayaraman J., 1992, Wiley Eastern Ltd.

## **Major Paper IV**

### **Lab in Cell Biology and Biochemistry**

**60 hours**

**Cell Biology**

1. Microscopy – Bright field microscopy – Principles and operation
2. Microscopy - Phase contrast microscopy Principles and operation.
3. Micrometry - measurement of cell size.
4. Micro technique Fixation, dehydration, infiltration, embedding, sectioning, staining.
5. Histochemical localization of Proteins.
6. Vital staining
7. Cellular constituents of Human Blood
8. Karyotyping in fish
9. Isolation of nuclei using centrifugation
10. Isolation of DNA from yeast/liver

11. Isolation of RNA
12. Measurement of DNA by spectrophotometry Biochemistry

### **Biochemistry**

**60 hours**

1. pH meter — Principles and operation
2. Titration curve - Estimation of pK value of a weak acid
3. Aminoacids as Zwitterions
4. Preparation of Buffers
5. Buffering action of an aminoacid
6. Isolation and separation of aminoacids - Paper Chromatography
7. Isolation and separation of sugars – Thin layer Chromatography
8. Separation of pigments - Column Chromatography
9. Separation of proteins - SDS Polyacrylamide Electrophoresis
10. Estimation of carbohydrates – Anthrone method.
11. Estimation of proteins - Phosphotungstic acid method
12. Estimation of ascorbic acid – Titrimetric method
13. Estimation of salivary amylase activity - Effect of temperature
14. Estimation of salivary amylase activity – Effect of pH
15. Determination of  $K_m$  and  $V_{max}$  of salivary amylase:

## **Semester II Major Paper V Genetics**

**90 hours**

### **Unit 1:**

Recombination in Prokaryotes – Bacteria - Transformation - Conjugation – Transduction - Mapping of bacterial chromosome – Conjugation and restriction enzyme mapping Transposons - Recombination in eukaryotes – Linkage and crossing over – Three point test crosses – Genetic mapping – Problems

### **Unit 2:**

DNA as genetic material – Experimental evidences - Semi conservative replication of DNA DNA replication apparatus and enzymology DNA damage and repair mechanism - Molecular basis of spontaneous and induced mutations

### **Unit 3:**

Mechanism of transcription in Prokaryotes and Eukaryotes – RNA processing - Capping, Polyadenylation, splicing, introns and exons - Ribonucleoproteins - Structure of mRNA – Genetic code Deciphering the genetic code Characteristics of genetic code Translational events Protein synthesis – Regulation of gene expression – Attenuation and antitermination - Operon concept - lac and trp operon

### **Unit 4:**

Law of DNA constancy C-value paradox Numerical and structural changes in chromosomes Chromosomal aberration Ploidy Euploidy and Polyploidy Aneuploidy Syndromes Turner's, Klinefelter's, Down's syndromes Inherited disorders - Sickle cell anemia, Thalasemia - Genetic counselling

**Unit 5:**

Hardy-Weinberg equilibrium Gene frequencies in natural population when there is dominance, co-dominance, sex-linked genes – Change in gene frequencies due to lethal, recessive, over dominance, inbreeding - inbreeding co-efficient - inbreeding depression Heterosis Polygenic inheritance Statistical analysis of quantitative characters Heritability - Components of phenotypic variance

**Text Books:**

1. Molecular Biology, 2nd Edition, Freifelder D., 1987, Narosa Publishing House
2. Genetics – A blue print of life, Mitra S., 1996, Tata McGraw Hill Pub. Co.

**Reference Books:**

1. Principles of Genetics, 9th Edition, Gardner E.J., Simmons M.J., Snustad D.P., 1991, John Wiley & Sons
2. Genetic analysis, 4th Edition, Griffith, Miller, Suzuki, Lewontin, Gerbart, 1993, W.H.Freeman and Co., New York
3. Genetics, 3rd Edition, 2002, Strickberger, 2002, Prentice Hall of India
4. Genes VII, Lewin B., 2000, Oxford University Press
5. Microbial genetics, 2nd Edition, Maloy S.R., Cronan J.E., Freifelder D., 1994, Panima Pub.Co.

## **Major Paper VI Environmental Biology**

**90 hours**

**Unit 1:**

Ecosystem - Structure – Classification and examples – Energy - Concept of productivity - Food chain and food web – Trophic levels – Energy based classification of ecosystems Biogeochemical cycles Patterns and basic types Global cycling of nitrogen, phosphorus, Sulphur, carbon and water Recycle pathways – Limiting factors and physical environment

**Unit 2:**

Population dynamics – Basic concepts of rates - Population growth form Population fluctuations – Density dependent and density independent population control - Population distribution - Population structure – Energy partitioning - r and K- selection – Life history traits and tactics

**Unit 3:**

Population in communities – Inerspecific interaction - Competition, predation, herbivory, parasitism, allelopathy, commensalism, co-operation, mutualism – Concepts of habitat, ecological niche, guild - Ecotone and edge effect - Ecosystem development - Strategies - Concept of climax - Evolution of biosphere

**Unit 4:**

Renewable and non-renewable resources - Energy - Fossil fuels, Nuclear fuels, Biomass biogas, Solar energy Wildlife – Endangered species - Principles of conservation Biodiversity conservation - Germplasm conservation - Cryopreservation of sperms and embryos – Environmental awareness Role of government, media Environmental education

**Unit 5:**

Pollutants of air, soil and water - Carbon monoxide and air pollution - Pesticides, heavy metals, industrial effluents, urban wastes, organic pollutants, radioactive pollutants - Oil and water pollution - Food additives as contaminants – Effects of aquatic, soil and air pollution – Acid rain - Biological indicators - Role in environmental monitoring

**Text Books:**

1. Modern Concepts of Ecology, 9th Edition, Kumar, H.D., 1997, Vikas Publishing House Pvt. Ltd.
2. Fundamentals of Ecology, 3rd Edition, Odum E.P., W.B. Saunders Company

**Reference Books:**

1. Basic Ecology, Odum E.P., 1983, Saunders College Publishing
2. Ecology, Colinvaux P., 1986, John Wiley & Sons
3. Ecology and Tropical Biology, Ian Deshmukh, 1986, Blackwell Scientific Publications
4. Concepts of Ecology, 3rd Edition, Kormandy E.J., 1986, Prentice Hall of India Pvt Ltd.
5. Air Pollution, Rao M.N., Rao H.V.N., 1998, Tata McGraw Hill Pub. Co.Ltd.

**Major Paper VII****Biostatistics, Computer Applications and Information Technology****90 hours****Unit 1:**

Statistics Data - Population - Sample - Collection of data Presentation of data Tables, graphs, diagrams, scatter plot - Summarization of data)- Measures of Central tendency – Mean, median, mode, quartiles, deciles, percentiles, - Measures of dispersion - Range, mean deviation, variance, Standard deviation, standard error, co-efficient of variation, quartile deviation, confidence limit - Probability Laws of probability Probability distribution - Characteristics of Normal, Binomial and Poisson distribution

**Unit 2:**

Experimental design Principles – Replication, randomization and local control Hypothesis testing – Sampling distribution – 't' distribution and Student's 't' test 'F' distribution and one way ANOVA test – Non-parametric test – Chi square distribution and chi square test Simple correlation - Simple linear regression - Regression equation -- Testing the significance of correlation and regression co-efficient values Rank correlation

**Unit 3:**

Computer – Types of computer - Computer hardware - CPU, input and output devices Auxiliary storage devices - Computer software's – Programming languages – Machine assembly and higher level languages

**Unit 4:**

Commercial software - dBase, WordStar, Office - Statistical packages - Sigmastat

**Unit 5:**

Information technology Storage and retrieval methods Intranet and internet Principles, access, regulations email Internet service providers and websites Databases in Biology



- PubMed - Sequence analysis – Genome and protein database - Computer and genome research

**Reference Books:**

1. Mathematics and statistics for the Biosciences, Eason, Coles and Gettingby, 1980, Ellis Horwood Ltd.
2. Statistical methods, 6th Edition, Snedecor G.W., Cochran W.G., Oxford & IBH Publishing Co.
3. Biostatistical analysis, 2nd edition, Zar J.H., 1984, Prentice hall Inc.
4. The ABCs of the Internet, 2nd Edition, Crumlish C., 2002, BPB Publications
5. Introduction to Bioinformatics, Lesk A.M., 2003, Oxford university Press
6. Biostatistics – A foundation for analysis in the Health Science, 5th Edition, Daniel W.W., 1991, John Wiley Sons

**Major Élective Paper II  
Sericulture**

**60 hours**

**Unit 1:**

Taxonomic classification of mulberry - Methods of propagation and cultivation  
Harvesting and storage - Pests and diseases of mulberry

**Unit 2:**

Taxonomic classification of mulberry silkworm - Life cycle - Morphology of egg, larva, pupa and adult- Anatomy of silkworm larva – Embryonic development of silkworm- Hibernation of eggs - Voltinism

**Unit 3:**

Rearing House - Rearing appliances – Brushing -Rearing of young age and late age silkworms – Care during rearing , moulting and bed cleaning - Optimum environmental conditions – Mounting - Spinning - Harvest, storage and marketing of cocoons  
Diseases of silkworm – Mode of infection, symptoms and treatment

**Unit 4:**

Reeling appliances - Methods of reeling - Reeling industry

**Unit 5:**

Sericulture farm management - Economics of sericulture - Cocoon marketing and role extension centres

**Text Books:**

1. The Silkworm - Biology, genetics and breeding, Dilip De Sarkar, 1998, Vikas Publishin House Pvt. Ltd.
2. An introduction to Sericulture, 2nd Edition, Ganga G., Sulochana Chetty J., 1998, Oxford & IBH

**Reference Books:**

1. Principles of Sericulture, Hisao Aruga, 1994, Oxford & IBH Publishing Co. Pvt.Ltd.
2. Handbook of Practical Sericulture, 4th Edition, Ullal S.R., Narasimhanna M.N., 1994, Central Silk Board, Bangalore.

3. Mulberry cultivation, Sericulture Manual I, Rangaswami G., Narasimhanna M.N. Kasiviswanathan K., Sastry C.R., Jolly M.S., 1995, Oxford & IBH Pub. Co. P: Ltd.
4. Silkworm rearing, Sericulture Manual II, Krishnasamy S., Narasimhanna M.N., Sryanarayanan S.K., Kumararaj S., 1995, Oxford & IBH Publishing Co. Pvt. Ltd.
5. Silk reeling, Sericulture Manual III, Krishnaswamy S., Madhava Rao N., Suryanarayanan S.K., 1991, Oxford & IBH Publishing Co. Pvt. Ltd.

## **Major Paper VIII**

### **Lab in Genetics and Environmental Biology**

#### **Genetics**

**60 hours**

1. Law of segregation - Demonstration with coins/beads
2. Law of independent assortment - Demonstration with coins/beads
3. Probability - Coin toss
4. Probability - Demonstration using playing cards
5. Probability - Number of boys and girls in a family of three children
6. Observation of simple Mendelian traits in the class population
7. Pedigree analysis for any two of simple Mendelian traits
8. Chromosomal disorders in human - Down's, Turner's and Klinefelter's syndromes
9. Statistical analysis - Variation in height/weight of students
10. Correlation analysis – height and weight/ length and width
11. ABO blood grouping in the classroom population
12. Calculation of gene and genotype frequency - using ABO blood group data
13. Study of normal and mutant forms of Drosophila

#### **Environmental Biology**

**60 hours**

1. Estimation of primary productivity of aquatic macrophytes – Light and Dark bottle method
2. Estimation of primary productivity of terrestrial plants - Harvest method
3. Estimation of primary productivity of terrestrial plants - Chlorophyll content. Method
4. Estimation of secondary productivity – Biomass production in silkworm – long term study
5. Estimation of ecological efficiencies – Field study
6. Analysis of industrial effluents/ sewage water – Total and dissolved solids
7. Analysis of industrial effluents/ sewage water - Biological oxygen demand (BOD)
8. Analysis of industrial effluents/ sewage water -- Chemical oxygen demand (COD)
9. Bioassay of pesticide - Estimation of LC50 value for fish/any aquatic animal
10. Estimation of dust pollution in an urban locality – Time course kinetics of deposition of dust
11. Educational tour and submission of field study report

**Semester III**  
**Major Paper IX**  
**Microbiology**

**75 hours**

**Unit 1:**

Structure of prokaryotic cell – Structure of bacterium - Classification of prokaryotes - Identification Staining Gram and acid fast staining Structure of Virus Bacteriophage Growth of microorganisms – Nutrition Nutrient media Culture methods – Physiology of growth – Methods of measurement of growth – Growth curve

**Unit 2:**

Basic mechanisms of metabolism in microbes - Pathways of hexose breakdown mo Oxidation of pyruvate - Biosynthesis of low molecular weight building blocks Fermentation - Electron transport under anaerobic conditions - Photosynthesis in bacteria

**Unit 3:**

Potable water – Sewage treatment with microbes - Treatment of industrial effluents Micro organisms involved in Carbon, phosphorus and Nitrogen cycle

**Unit 4:**

Biology and economic importance of Agaricus bisporus, Rhizobium and Pseudomonas Food preservation – Spoilage of milk and milk products, meat and meat products by microorganisms pasteurization and other processing techniques Fermentation technology - Fermentor – Types of fermentor - production of microbial products through fermentor - Production of alcohol, vinegar, penicillin

**Unit 5:**

Biology, infective processes and control of diseases – Vibrio cholerae, Tubercle bacilli, Mycoplasma, Immunodeficiency virus

**Text Books:**

1. General Microbiology, 7th edition, Hans G.Schlegel, 1995, Cambridge University Press
2. Text Book of Microbiology, 5th Edition, Ananthanarayanan, Jayaram Paniker, 1997, Orient Longman

**Reference Books:**

1. Food Microbiology, 4th Edition, Frazier W.C., Westhoff D.C., 1995, Tata McGraw Hill Pvt. Ltd.
2. Industrial Microbiology, Casida L.E., 1993, Wiley Eastern Ltd.
3. Microbiology, 5th Edition, Pelczar M.J., Chan E.C.S., Kreig N.R., 1998, Tata McGraw Hill Pub. Co.Ltd.
4. Microbiology, 4th Edition, Prescott, Harley, Klein, 1999, WCB McGraw Hill Co.
5. General Microbiology, 3rd Edition, Stainer R.Y., Doudoroff M, Addberg E. A., 1970, MacMillan India

# Major Paper X

## Immunology

90 hours

### Unit 1:

Lymphoid Lineage - T-cells and its types, B cells and its types, Null cells and its types  
Myeloid lineage - Eosinophil, Basophil, neutrophil, mast cell, Antigen presenting cell, platelet, monocytes and macrophages - Primary lymphoid organs (Thymus, Bonemarrow, Bursa of Fabrcius - Secondary Lymphoid organs - Lymph node, spleen, payer's patches (GALT), Tonsils (MALT).

### Unit 2:

Primary and secondary humoral response Factors influencing antibody formation. - Mechanism of cell mediated Immune response cytokines and their actions - Factors causing hyper sensitivity response – Types of hypersensitivity response (Type I, II, III, IV and V) - Protozoan disease (Malaria) - Bacterial disease (Tuberculosis) - Viral disease (HIV).

### Unit 3:

Structure and functions of Immunoglobulin Types of Immunoglobulin (structure, Biological properties of Immunoglobulin G, M, A, D and E) - Detection of antigenantibody reaction - Precipitation agglutination, cytolysis, complement fixation, flocculation, opsonisation, immunofluorescence) f classical and alternate pathways of complement system – Biological functions of complement system, complement fixation fest.

### Unit 4.

Major Histocompatibility Complex Structure of MHC Molecules and their polymorphism – Transplantation – glassification of Graft - Mechanism of graft rejection - Host vs Graft, reaction - Graft vs Host reaction Immuno suppressive therapy during transplantation - Properties of tumour cells, causes of tumour, tumour antigens, Immune response to tumour, Immuno diagnosis of tumour, Immunotherapy of tumour.

### Unit 5:

Montoux test for tuberculosis - Widal test for typhoid - VDRL test for syphilis - ELISA and Western blot for AIDS Immunization and Immunization scheduler. Vaccines (attenuated, heat killed vaccines) - Recombinant vaccinia vector vaccine, DNA vaccine, Anti idiootype vaccine, multivalent sub unit vaccines - Monoclonal antibodies and their production.

### Reference Books:

1. Kuby Immunology, 4" Edition, Goldsby R.A., Kindt T.J., Osborne B.A., 2000, W.H.Freeman and Company
2. Roitt's Essential immunology, 9" Edition, 1994, Roitt, I.M.,Blackwell Science
3. Immunology - A short course, 3rd Edition, Benajamini E., Sunshine G., Leskowitz S., 1996, Wiley-Liss
4. Immunology, 8th Edition, Weir D.M., Stewart J., 1997, Churchill livingstone
5. Immunology, Chakravarty A.K., 2000, Tata McGraw-Hill
6. An Introduction to Immunology, C.V.Rao, Narosa Publising House, 35, Grams Road, Thousand Lights, Chennai – 600 006.

## **Major Paper XI**

### **Evolution**

**75 hours**

#### **Unit 1:**

Origin of life Evidences for evolution from biogeography comparative anatomy, embryology, physiology, biochemistry, palaeontology, genetics, – Theories of evolution - Darwinism, Lamarckism, Mutationism

#### **Unit 2:**

Genetic basis of variation Mutation Neutralist hypothesis Hybridization and evolution - Role of isolating mechanisms – premating and postmating problems of isolating mechanism

#### **Unit 3:**

Speciation - Structure of species – Genetics and ecology of speciation - Mayor's Founder principle – Modes of speciation - Allopatric and Sympatric speciation –

#### **Unit 4:**

Origin of higher categories - Simpson's definition -Evidences from fossil record Polyploidy – Modes of origin of higher taxa – Mosaic mode - Connecting link - Quantum evolution - Simpson's adaptive grid – Rates of evolution Punctuated equilibrium - Extinction and its causes

#### **Unit 5:**

Fossil records of human evolution - Recent findings in East and South Africa - Trends in human evolution - Cultural evolution - Osteodontokeratic culture - Pebble tool culture - Paleolithic culture – Neolithic culture - Language, Self awareness and death awareness – Sociobiology - Selfish gene- Altruism – Kin selection

#### **Reference Books:**

1. Introduction to Evolution, Moody P.A., 1978, Harper international
2. Process of organic Evolution, Stebbins, G.L., 1979, Prentice hall India
3. Evolution, Dodson E.O., 1980, Reinhold
4. Evolution from molecules to Man, Bendall D.S., 1983, Cambridge University Press
5. Dimensions of Darwinism, Grene M., 1983 Cambridge University Press
6. Evolutionary Biology, Minkoff E.C., 1984, Addison Wesley
7. Sociobiology examined, Montagu, 1980, Oxford university Press
8. Human Biology and behaviour – An anthropological perspective, 4<sup>th</sup> Edn., 1985, Weiss M.L. and Mann A.E., Little Brown & Co.

## **Non – Major Elective Paper**

### **Entrepreneurial Zoology**

**90 hours**

#### **Unit 1:**

Entrepreneurship - Preparation of Model Project Survey Financial mobilization Leadership - Managerial skill – Budget preparation - Successful operation - Quality check and improvement - Problem solving procedures - Statement of profit/loss - Self analysis – Expertise contact – Further improvement

#### **Unit 2:**

Poultry - Rearing and management of chick – Broilers and layers - Marketing of eggs and broilers - Disease control - Economics

#### **Unit 3:**

Ornamental Fish culture - Introduction Common ornamental fishes (Rosy barb, flying fox, male angel fish, gowrami, male black molly, Guppy, common gold fish) – Construction of tank (base covering, plant and fresh water set up) water quality management - Feeds and methods of feeding - Breeding of Ornamental fishes – Rearing - Fish disease and treatment - Economics

#### **Unit 4:**

Sericulture - Biology of Silkworm - Silkworm rearing - Marketing of cocoons - Disease control - Economics

**Unit 5:** Vermiculture - Introduction - General morphology of earth worm Earthworm species employed in vermicompost (*Eisenia foetida* and *Eudrilus eugeniae*) – Vermicomposting materials – Steps involved in vermicomposting (bedding, layering, spreading and watering) – Method of harvesting - Application of vermicompost - Economics

#### **Reference Books:**

1. Animal husbandary, G.C. Banerjee, Oxford and IBH Publishing Co.
2. Modern aspects of commercial poultry keeping, 9th edition M.R.Gnanamani, Giri Publications.
3. Guidelines for ornamental fish culture, David Kingston et al., 2006, Veterinary University Training and Research centre (Fisheries).
4. An Introduction to Sericulture, G.Ganga and J.Sulochana Chetty, 1991, Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Advances in Biotechnology, Ashok Pandey, Educational Publications and distributors, New Delhi Vermicology, Ismail, S.A., 1997, Orient Longman Ltd.

## **Major Paper XII**

### **Lab in Microbiology and Immunology**

#### **Microbiology**

**60 hours**

1. Safety and hygiene in the laboratory."
2. Cleaning of glassware and modes of sterilization.'
3. Measurement of microbes using ocular and stage micrometer
4. Preparation of culture media and agar slants for micro organisms.
5. Counting of Viable cells by serial dilution and spread plate or pour plate.
6. Estimation of Mircoflora of milk by Methylene Blue Reductions.(MBR)
7. Test for antibiotic sensitivity.
8. Gram staining
9. Acid fast staining
10. Isolation of nitrogen fixing symbiotic bacteria from root nodule.
11. Identification and sketching of bacterial and viral diseases

#### **Immunology**

60 hours

1. Anatomy of lymphoid organs
2. Histology of lymphoid organs
3. Preparation of single cell suspension and enumeration
4. Isolation of lymphocytes and enumeration
5. Preparation of antigen
6. Immunization of rabbit/bird
7. Bleeding and preparation of antiserum
8. Haemagglutination and haemolysis titration
9. Ammonium sulphate precipitation of immunoglobulins
10. Ouchterlony technique of gel diffusion
11. Immuno electrophoresis of human serum and anti-human serum

## **Semester IV**

### **Major Paper XIII**

#### **Physiology**

**90 hours**

#### **Unit 1:**

Nutritive requirements – Feeding mechanism - Digestion - Absorption - Circulatory fluids) Blood constituents – Haemodynamics – Blood flow and Blood pressure

#### **Unit 2:**

Respiratory pigments - Blood gas transport- Respiratory quotient excretion – excretion through nephridia - Kidneys and excretion - Hormonal regulation - Osmoregulation – Exchange and maintenance of ions and water - Absorption of salts Osmotic relations of multicellular animals - Freshwater, marine, estuarine and terrestrial animals

#### **Unit 3:**

Types of muscle and functions - Contractile proteins - Ultra structure of striated muscle – Mechanism of contraction - Calcium ions and muscle contraction - Myo-neural junction - Nervous control of muscle contraction - Structure of nervous system- Nerve cell Impulse generation and conduction – Receptor neurons Phasic and tonic receptors Stimulus and response – Inter neuronal transmission - Synaptic transmission

**Unit 4:**

Classification of sensory receptor cells Sense organs Chemoreception  
Mechanoreception -Thermoreception Photoreception Receptor and functional  
properties of sense organs – Physiology of sense organs

**Unit 5:**

Endocrine system Neuroendocrine system in insects Endocrine system in human:  
Pituitary, Adrenal, Thyroid, Pancreas - Hormonal control of migration in birds and  
fishes

**Reference Books:**

1. Comparative Animal Physiology, 3rd Edition, Prosser C.L., 1984, W.B.Saunders
2. General and Comparative Physiology, Hoar W.S., 1976, Prentice Hall of India
3. Eckert Animal Physiology, 4" Edition, Randall D., Buurgren W., French k., 1997 W.H.Freeman and Company
4. Text Book of animal Physiology, 2nd Edition, Nagabhushanam R., Kadarkar M.S.Sarojini R., 1999, Oxford & IBH
5. Animal Physiology: Adaptation and Environment, 4Ch Edition, Nielsen K.S., 1994, Cambridge University Press
6. The Comparative endocrinology of invertebrates, 2nd Edition, Highnam K.C., Hill L., ELBS and Edward Arnold Publishers

**Major Paper XIV**  
**Developmental Biology**

**90 hours**

**Unit 1:**

Gametogenesis – Oogenesis – Types of eggs - Growth, development and maturation of oocyte - Nuclear activities during oocyte growth - Spermatogenesis Seminiferous tubules - Differentiation of spermatozoa - Fertilization - Approach of spermatozoon – Reaction of egg - Essence of activation – Changes in the egg cytoplasm caused by fertilization

**Unit 2:**

Cell divisions in cleavage - Chemical changes Patterns of cleavage Morula and Blastula Role of egg cortex – Morphogenetic gradients – Manifestation of maternal genes – Fate map - Gastrulation - Primary organ rudiments Metabolism and gene activity during gastrulation – Spemann's primary organizer - Morphogenetic movements - Neural induction - Induction and differentiation of Brain, eye, ear, limb, heart, kidney - Inductive tissue interactions in development -Salivary gland, eye lens, thymus, metanephric kidney

**Unit 3**

Differentiation - Chemical basis of differentiation - Selective action of genes – Sequence of gene action in development Nuclear transplantation Role of cell death in development - Aging – Teratogenesis -Malignant growth – Neoplasia

**Unit 4:**

Morphogenetic processes in later part of ontogenesis – Metamorphosis – Changes in organization of tissues Causation of metamorphosis - Hormonal control of amphibian



and insect metamorphosis – Regeneration - Regenerative ability in animals – Histological processes involved in Salamander limb regeneration Polarity and gradients in regeneration Stimulation and suppression of regeneration - Asexual reproduction - Forms of asexual reproduction - Sources of cellular material in asexual reproduction

**Unit 5:**

Endocrine control of reproduction in insects and Crustacean Hormones in human reproduction – Regulation of breeding cycles – Oestrous and menstrual cycle - Placental and parturition hormones – Prolactin

**Reference Books:**

1. An introduction to Embryology, 5th Edition, Balinsky B.I., 1981, Holt Saunders International Edition
2. Developmental Biology, Berrill N.J., 1974, TMH Edition
3. Developmental Biology, 2nd Edition, Browder, 1984, Saunders College Publishing
4. Development, Berrill, N.J., Karp G., 1976, McGraw Hill
5. Biology of developing Systems, Grant P., 1978, Holt Rinehart and Winston
6. Animal regeneration, Diwan A.P., Dhakad N.K., 1996, Anmol Publications Ltd.
7. Fertilization, Metz C.B., Monroy A., 1967, Academic press

**Major Paper XV  
Biotechnology**

**90 hours**

**Unit 1:**

Tools of genetic engineering - Restriction endonucleases – Nomenclature – DNA ligases CK - Reverse transcriptase DNA polymerase - Cloning vectors Plasmids – Phages Cosmids – Phagemids – cDNA bank - Gene Bank

**Unit 2:**

Techniques of genetic engineering - Gene cloning in E.coli, yeast, plant and animal cells Transformation - Selection of clones Recovery of cells – Colony hybridization Dek (Electroporation - Microinjection - Shot Gun cloning - Liposome mediated gene

**Unit 3**

Animal cell culture techniques – media and composition establishment of primary culture – tissue culture, organ culture, embryo culture – IVF, embryo transfer in human and farm animals - transgenic animals - Uses of animal cell culture - DNA diagnostics and therapeutics - Stem cells - Characteristics and application

**Unit 4:** Industrial Biotechnology Strain improvement for industrially important secondary metabolites Bioprocess operations - Downstream process Uses of microbes in 'industrial Biotechnology - Ore leaching - Cellulose utilization - Alcohol production Antibiotic biosynthesis - Isolation and purification of enzymes - enzyme immobilization

**Unit 5:** Biotechnology and health care Vaccines -Subunit vaccine and production - rDNA in medicine – human genome project and gene mapping - Microchips in gene mapping rDNA and environment - GMO and GM plants - Ethical, legal, social, environmental and health issues related to gene biotechnology

**Reference Books:**

1. A Text Book of Biotechnology, Dubey R.C., 2001, S.Chand & Company Ltd.
2. Elements of Biotechnology, Gupta P.K., 2003, Rastogi Publications 3
3. Principles of gene manipulation, 5th Edition, Old R.W., Primrose S.B., 1996, Blackwell Science
4. Molecular Biotechnology - Principles and applications of recombinant DNA, 2nd Edition, Glick B.R., Pasternak J.J., 1988, ASM Press
5. Biotechnology –principles and applications, Higgins E.J., Best D.J., Jones J., 1988, Blackwell science
6. Gene Biotechnology, Jogdand S.N., 1997, Himalaya Publishing house
7. From genes to clones introduction to gene technology, Winnacker E.L., 1987, Panima Educational Book Agency
8. Biotechnology, Trehan K, 1991, Wiley Eastern
9. Biotechnology: The Biological Principles, Trevan M.D., Boffey S., Goulding K.H., Stanbury P., 1988, Tata McGraw Hill

**Major Paper XVI**

**Lab in Physiology and Developmental Biology**

**Physiology:**

1. Effect of temperature on oxygen consumption in fish
2. Effect of temperature of opercular movement in fish
3. Survey of enzymes in the alimentary canal of Cockroach
4. Effect of salinity on oxygen consumption in fish
5. Effect of salinity on opercular movement in fish
6. Salt loss in fish
7. Salt gain in fish
8. Qualitative estimation of haemin crystals
9. Studies on the nature of excretory products of Cockroach
10. Kymograph recording - Muscle twitch
11. Permeability of biological membranes

**Developmental Biology:**

1. Oogenesis - Histological studies
2. Spermatogenesis - Histological studies
3. Induced ovulation in frog/fish
4. Observation of developmental stages of frog
5. Observation of metamorphic changes by rearing of amphibian larvae
6. Wound healing and cell aggregation in frog embryos
7. Induction and differentiation of lens in frog embryo
8. Influence of hormones on amphibian metamorphosis
9. Regeneration of tail in amphibian larvae
10. Polarity and gradients in regeneration of tail in amphibian larvae
11. Observation of developing chick embryo - Vital staining
12. Identification of developmental stages of chick embryo
13. Oestrous cycle of rat – Histological studies of vaginal smear

14. Histology - Development of heart, limb, kidney and lungs in chick embryo
15. Histology - Development of heart, limb, kidney and lungs in a mammalian embryo

**Major Elective Paper III  
Aquaculture**

60 hours

**Unit 1:**

Importance of aquaculture – Basic qualification of candidate, species - Cultivable fresh water and marine species - Construction of ponds - Site selection - Soil and water types – Types of ponds - Preparation and management – Aquatic plants and their control - Fish enemies and their control - Fertilization of ponds.

**Unit 2 :**

Brooders care and management - Bund breeding- Artificial breeding - Induced spawning of carps – Application of synthetic hormones – Transportation of fish seed - Natural culture of fish feed organisms - phytoplankton (diatom) zooplankton (Rotifers, cladocerans) Artemia, Tubifex – Artificial feed - Feed formulations and management.

**Unit 3:**

Animal husbandry cum aquaculture, agriculture cum aquaculture - Ectoparasite, Bacterial, viral and fungal diseases.

**Unit 4 :**

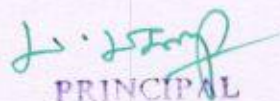
CNP Fishing Gears - Line fishing (Hand line), Barbet trap, Cover pot, Gillnet, beam trawl, Bull trawl – Modern method-Echo sounding method, Electric fishing.

**Unit 5 :**

Preservation - Drying, salting, smoking, canning, refrigeration – marketing.

**Reference Books:**

1. Fish and Fisheries of India, Jingram, V.G., 1997, Hindustan Publishing Co., New Delhi
2. A Hand book of Fish forming, Agarwal, S.C., 1994, Narandra Publishing House, Delhi.
3. Fresh water aquaculture, Rath, R.K., 1993, Scientific Publishers, Jodhpur
4. Pond and Fish culture, Hall, C.B. 1999, Agro Botanical Publishers, India
5. Manual of fish genetics, Karl Marx, K, Sundararaj, V. and Vasu, 1996, Chennai
6. Fisheries Science, Santhanum, R. Daya Publishing house, 1995, New Delhi  
Prevention and Control of fish and prawn disease II Edn., 2000. – Bismas, K.P. Narandra Publishing House, Delhi.

  
**PRINCIPAL**

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