



**BHARATHIDASAN UNIVERSITY  
TIRUCHIRAPPALLI- 620 024**

**M.Sc. ZOOLOGY**

(For the candidates admitted from the academic year 2014 -15 onwards offered through  
Centre for Distance Education)

**Course Duration: 2 Years – (Non-Semester System)**

**Eligibility:** UG Degree with Zoology

Year	Paper	Title of the Paper	Exa m Hour s	Mark s
<b>I YEAR</b>	Major Paper I	Phylogeny of Invertebrates & Chordates	3	100
	Major Paper II	Cell Biology & Genetics	3	100
	Major Paper III	Environmental Biology & Evolution	3	100
	Major Paper IV	Developmental Biology & Immunology.	3	100
	Major Paper V	<b>Practical I</b> (covering theory papers I–IV)	4	100
				500
<b>II YEAR</b>	Major Paper VI	Animal Physiology and Biochemistry.	3	100
	Major Paper VII	Biophysics, Biostatistics & Computer applications	3	100
	Major Paper VIII	Biotechnology & Microbiology	3	100
	Major Paper IX(Optional)	Aquaculture / Poultry science	3	100
	Major Paper X	<b>Practical II</b> (Covering theory papers VI - VIII)	4	100
	TOTAL			1000

( Passing minimum 50% - both theory and practical)

**Note: Compulsory Record should be submitted at the time of practical examination.**

## PAPER - I

### PHYLOGENY OF INVERTEBRATES AND CHORDATES

**Unit I:** Phylogeny of Invertebrates- Protozoa- Phylogenetic origin and evolution of the class- Metazoa- various theories of origin-colonial, syncytial, orthodox and Tuzuet's theory; Bilateria- Theories of origin; Coelomata- definition of coelom- origin of coelom –types,

**Unit II:** Origin and phylogeny of Arthropod-Trilobites-structure and significance; Origin and evolution of Mollusca- fossil ammonites and their significance; Molecular and biochemical phylogeny of Echinoderms; Echinoderm larvae and phylogeny

**Unit III:** Minor Phyla and their position in animal kingdom- General characters, morphology, anatomy and affinities of Rotifera, Phoronida and Chaetognatha.

**Unit IV:** Palaeontology and evolution of chordates: Geological time scale; Origin of chordates- Jawless vertebrates-Characteristic features of Lamprey; Ostracoderm-characters and classification-cephalapsida, Anapsida, Pteropsida and Coelolepsida, evolutionary position of ostracoderm; Primitive jawed vertebrates-origin of jaws, acanthodians, appearance of placoderms.

**Unit V:** Origin of Reptiles-Amphibian and reptilian features of seymouria, mammal like reptiles, aquatic reptiles, flying reptiles; rise and fall of dinosaurs; fossil birds and their significance; origin of primates- adaptive radiation of lemuroids, Tarsius- new world monkeys, old world monkeys and apes, Australopithecines.

### BOOKS FOR REFERENCE:

#### INVERTEBRATES

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

#### CHORDATES

1. COLBERT, H. EDWIN (1989), Evolution of the Vertebrates, II Ed., Wiley Eastern Limited, New Delhi.
2. KENT, G.C. (1976), Comparative anatomy of the Vertebrates, McGraw Hill Book Co., Inc., New York.
3. ROMER, A.S. (1974), The Vertebrate Body, W.B. Saunders, London.
4. ROMER, A.S. (1979), HYMAN's Comparative Vertebrate Anatomy, III Ed., The University of Chicago Press, London.
5. NEWMAN, N.H. (1961), Phylum Chordate, The University of Chicago Press, Chicago.

## **PAPER - II**

### **CELL BIOLOGY & GENETICS**

#### **UNIT – I**

Prokaryotic and eukaryotic cells – Membrane structure- lipid composition – protein components – principles of membrane transport – carrier proteins – ion channels and membrane potential – vesicular transport – secretory pathways, Cell-cell junctions.  
Structure and functional significance of mitochondria, Endoplasmic reticulum – Cell communication – general principles – pathways of intracellular signal transduction.

#### **UNIT - II**

Interphase nucleus – structure and functions – cell cycle control and cell death :  
Overview of cell cycle – control system – apoptosis.  
Biology of cancer – The development and causes of cancer – properties of cancer cells- Tumour virus – on cogenes – tumor suppressor genes – molecular basis of cancer – cell behavior- molecular approaches to cancer treatment.

#### **UNIT – III**

Central Dogma – Structure of DNA and RNA, DNA replication – semi conservative – enzymes involved in replication. DNA repair mechanisms.  
Genetic code – wobble hypothesis. Prokaryotic transcription- enzymes and proteins involved- mechanisms- promoters- enhancers-post transcriptional modifications.  
Protein synthesis – ribosomes – factors involved in protein synthesis – process of translation- post translational modifications.

#### **UNIT – IV**

Multiple alleles and isoalleles – Linkage – crossing over – chromosome mapping – sex linked, sex influenced and sex limited traits – general concepts and variations in the mechanisms of sex determination in eukaryotes- heterogametic and homogametic gynandromorphs.  
Microbial genetics: regulation of gene expression in prokaryotes – concepts of enzyme induction and repression – positive and negative control- operon model – lac operon.

#### **UNIT – V**

Population genetics: gene pool and gene frequencies – equilibrium of gene frequencies – Hardy Weinberg equilibrium – changes in gene frequencies- factors affecting Hardy Weinberg equilibrium.  
Human Genetics: Pedigree construction, inheritance pattern ( autosomal, sex linked, sex limited and sex influenced) – inborn errors of metabolism in man, Human karyotype, chromosomal syndromes in man. Human genome project- objectives, strategies and progress.

## **BOOKS FOR REFERENCE**

### **CELL BIOLOGY**

1. De ROBERTIS, E.D.P. and De ROBERTIS, E.M.F. (1987), Cell and Molecular Biology, VIII Ed., Lea and Febiger, Philadelphia.
2. DAVID FREIFELDER (1998), Molecular Biology, II Ed., Narosa Publishing House, New Delhi.
3. LEWIS, KELEINSMITH and VALERIS M. KISH (1988), Principles of Cell Biology, Harper and Row Publications, New York.
4. POWAR, C.B. (1983), Cell Biology, Himalaya Publishing House, Bombay.
5. WATSON et al., (1987), Molecular Biology of the Gene, The Benjamin Cummings Publishing Co., Inc., California.

### **GENETICS**

1. BENJAMIN LEWIN (2000), Genes VII, Oxford University Press, New York.
2. DANIEL L. HARTL (1994), Genetics, III Ed., Jones and Bartlett Publishers, Boston.
3. JOHN D. HAWKINS (1996), Gene Structure and Expression, III Ed., Cambridge University Press.
4. ROBERT H. TAMARIN (1996), Principles of Genetics, WCB Publishers.

## **PAPER - III**

### **ENVIRONMENTAL BIOLOGY AND EVOLUTION**

#### **UNIT - I**

Concept of ecosystem - Energy flow – Tropic structure and levels - Pyramids, food chain and food web ecological efficiencies, and productivity and its measurement- Dark and light reaction. Adaptations of Pelagic, Benthic. Sandy and Muddy Shore with reference to physicochemical features of environment of coastal ecosystems.

#### **UNIT - II**

Community : Definition, nature and flux of energy through communities. Influence of competition, predation and disturbances- Community succession - Homeostasis. Biogeochemical cycles - Cycling of non-essential elements and organic nutrients.

#### **UNIT - III**

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

Environmental pollution and its biological effects. Air, Water, soil and noise pollution. Biological indicators and their role in environmental mointoring. Problems of urbanization - Sewage, solid waste and industrial waste disposal and management. Social forestry

#### **UNIT IV**

Mechanism of Evolution : Lamarckism – Darwinism – De Vries Theory of mutation- modern synthetic theories of evolution. Adaptations - Batesian and Mullerian mimicry and evolution. Polymorphism.

#### **UNIT – V**

The role of polyploidy – Isolation and isolating mechanisms - pre mating, post mating . Speciation and concept of species - Clones, peripheral population and peripheral isolates. Founder principles and genetic evolution – Fossil evidences.

#### **Text Books**

1. Odum, E.P. (1983). Basic Ecology. Saunder's CollegePublishing, New York.
2. P.A. Moody (1978). Introduction to Evolution. Harper International.
3. G.L. Stebbine (1979). Processes of Organic Evolution. Prentice Hall India, New Delhi.
4. E.O. Dodson (1990). Evolution. Reinhold, New York.
5. Ismail, S.A. (1997). Vermicology, Biology of Earthworms - Orient Longman, Chennai.
6. D.S. Bendall (ed) (1983). Evolution from Molecules to Men. Cambridge University Press.
7. M. Grene (ed) (1983). Dimensions of Darwinism. Cambridge University Press.
8. E.C. Minkoff (1984). Evolutionary Biology. Addison- Wesley. London.
9. Montagu (ed) (1980). Sociobiology examined. Oxford University Press.

## **PAPER- IV**

### **DEVELOPMENTAL BIOLOGY & IMMUNOLOGY**

#### **DEVELOPMENTAL BIOLOGY**

UNIT-I: Structure of gametes –the egg and sperm- Fertilization-cellular differentiation-morphological , physiological, chemo differentiation and cyto differentiation.

UNIT-II: Cleavage, Blastulation, Pattern of embryonic cleavage, Mechanism and control of cleavage. Amphibian Gastrulation: Totipotency and pluripotency. Morphogentic movements, Formation of extra embryonic membranes.

UNIT-III: Organogenesis- Development of eye- Influence of hormones on growth and metamorphosis of insects and amphibians.Regenerative ability in various invertebrates and vertebrates-mechanism of regeneration in amphibians-blastema formation – Factors affecting regeneration. Aging and alterations in development – Gene regulation of aging.

#### **IMMUNOLOGY**

**Unit IV:**Types of Immunity – innate and acquired, passive and active- Primary and secondary lymphoid structures and organs – structure and functions of bone marrow, thymus, spleen, bursa of Fabricius, GALT, BALT and Lymph nodes. Cells of immune system – origin and differentiation of T,B cells and macrophage, antigens – class determinants – reactive sites and receptor sites

**Unit V:**Antibody – immunoglobulin – primary structure – classes, functions, synthesis (cellular, subcellular and molecular)-Major histocompatibility complex (HLA) and its products in man. Diseases and immune response – viral – bacterial diseases – parasitic infections – tumour immunology.Immune deficiency diseases – AIDS. Autoimmune diseases – examples, concept and mechanisms.

#### **References:**

##### **Developmental Biology**

- BALINSKY, B.L., (1981) An Introduction to Embryology, V Ed., Saunders Co., Philadelphia.
- BERRILL, N.J., (1986) Developmental Biology, Tata McGraw Hill, New Delhi

##### **Immunology**

- Sells, S. (1987). Basic Immunology, Elsevier Science Publishing Co., New York.
- TIZARD, I.R., (1995). Immunology – An Introduction, IV Ed., Saunders College Publications, Philadelphia.
- KUBY, J. (1994). Immunology. W.H.Freeman and Co., New York.
- NANDHINI SHETTY (1996). Immunology : Introductory Text Book. New age International Pvt. Ltd. New Delhi

## **PAPER - V**

### **Practical -I**

#### **Animal Phylogeny, Cell Biology, Genetics, Environmental Biology, Evolution, Developmental Biology and Immunology**

##### **Animal Phylogeny**

1. Invertebrate fossil – Trilobite, Nautiloid
2. Vertebrate fossil - Ostracoderm, Archaeopteryx

##### **Cell Biology**

1. Squash preparation – Onion root tip
2. Squamous epithelial cells

##### **Spotters**

Cell types – Epithelium, Muscle, Nerve Cell, Bone cell

##### **Genetics**

Spotters :

Mendelian traits ,Pedigree chart - Explanation, Human Karyotype, Human Syndromes  
Down's Syndrome, Turner's Syndrome and Klinefelter's Syndrome

##### **Environmental Biology**

1. Estimation of dissolved O<sub>2</sub>
2. Estimation of dissolved CO<sub>2</sub>

##### **Spotters**

Rocky, Sandy and muddy shore fauna.

Animal association – Mutualism and parasitism.

##### **Evolution**

Spotters :Peripatus, Limulus, Sphenodon, Endangered animals (any two)

##### **Developmental Biology**

1. Chick Blastoderm, mounting
- Spotters :Frog - Egg, blastula and Yolk plug  
Chick - 24 hours and 72 hours of development.

##### **Immunology**

Blood grouping (ABO & Rh)

Spotters:

Lymphoid organs (Human)

## PAPER - VI

### ANIMAL PHYSIOLOGY & BIOCHEMISTRY

#### UNIT - I

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

-Muscle physiology- Molecular structure and chemical composition of muscle fiber and physiology of muscle contraction - Transmission of nerve impulse - reflex action.

#### UNIT - II

Chemical co-ordination - neurosecretions in insects, molluscs and crustaceans - endocrine glands in vertebrates - endocrine control of reproduction in vertebrates with Reference to Man. Mechanism of endocrine secretion and functions.

#### UNIT - III

Receptors - classification and function – Structure of Ear- mechanisms of hearing- Structure of Eye - physiology of vision in Man- Chromatophores- Bioluminescence – High altitude physiology and physiology of diving.

Migration in birds and fishes - temperature regulation in poikilotherms, homeotherms and heterotherms hibernation, aestivation - diapause.

#### Unit-IV

**Proteins:** Classification – Globular and fibrous proteins – Structure and functions.

**Carbohydrates:** Mono, oligo and polysaccharides – Structure, properties and functions.

**Lipids:** Classification, structure, properties and functions.

**Amino Acids:** Structure and classification and functions

#### Unit-V

##### Enzymes

Classification – Properties – Mechanism of action of enzymes – Active sites – Coenzymes. Prostaglandins – their classes, functions and Pharmacological uses.

##### Biological Oxidation

Nucleotides, Flavoproteins, Cytochromes – Redox potential – Oxidative phosphorylation. Energy relation, energy rich compounds, their roles.

#### REFERENCES

##### ANIMAL PHYSIOLOGY

1. Hoar, W.S. (1968) : General and Comparative Physiology, Prentice Hall.
2. Prosser, C.L. (1973) : Comparative Animal Physiology, 3rd edn. W.B. Saunders & Co., Philadelphia.
3. Wood, D.W. (1968) : Principles and Animal Physiology.
4. Bentley, (1971) : Endocrine and osmoregulation Springer Verlag, N.Y.,
5. Palmen, J.D. Brown, J.R. and Hastings, J.W. (1970) : Biological clocks, Academic Press, London.

##### BIOCHEMISTRY

1. LEHNINGER L. ALBERT, DAVID. L. NELSON, MICHAEL M. COX. (1993), Principles of Biochemistry, CBS Publishers and Distributors, Delhi.
2. STRYER, L. (1988), Biochemistry, W.H. Freeman and Company, New York.
3. COOPER, T.G. (1977), The Tools of Biochemistry, Wiley Interscience Publication, John Wiley and Sons, New York.
4. SMITH et al., (1985), Principles of Biochemistry, McGraw Hill (Mammalian Biochemistry).
5. VOET, D. and VOET, J. (1995), Biochemistry, John Wiley and Sons, New York.



## **PAPER – VII**

### **BIOPHYSICS, BIOSTATISTICS AND COMPUTER APPLICATIONS**

#### **UNIT – I**

Structure and properties of atoms and molecules –Energy sources – Principle and application of thermodynamic laws- Natural radiations – Properties of natural light. Photoelectric effect – Photodynamic sensitization – LASER – Concept of spectroscopy. Visible, NMR spectroscopy ;Atomic absorption and plasma emission spectroscopy. Measurement of radio activity – Gieger Muller counter – Isotopes as tracers.

#### **UNIT - II**

Principles and application of chromatography – Paper – Thin layer – Column – Ion – exchange – Gel filtration – Gas liquid – HPLC and Affinity. Principles and applications of electrophoresis – Paper electrophoresis – Agarose gel electrophoresis – PAGE – SDS-PAGE – Immunoelectrophoresis – Isoelectric focussing.

#### **UNIT – III**

Primary and Secondary data – methods of data collection – processing of data – classification and tabulation organization of data – individual, discrete and continuous series – sampling designs. Diagrammatic and graphic presentation of data – Bar diagram – Pie diagram – frequency polygon – frequency curve – histogram.

#### **Unit-IV**

Measures of central tendency – mean, median, and mode. Measures of dispersion – range, standard deviation and variance – standard error – correlation – rank correlation, coefficient of correlation – simple linear regression.

#### **Unit-V**

Definition of computer –types – basic components of computer – input and output devices – CPU – memory and its types – number system in brief – brief account of software and hardware. Introduction to MS Excel – MS Power Point – Internet, website, browser (explorer and Mozilla) and Email – computer application in biology.

### **REFERENCES**

#### **BIOPHYSICS**

1. DANIEL, M. (1989), Basic Biophysics for Biologists, Agro-Botanical Publishers, Bikaner, India.
2. De ROBERTIS, E.D.P. and De ROBERTIS E.M.F. (1987), Cell and Molecular Biology, VIII Edition, Lea and Febiger, Philadelphia.
3. DOG, A., DOUGLAS and JAMES J. LEARY (1992), Principles of Instrumental Analysis, Under Golden Sunberst Series.
4. Das.H.K , (2005). Text Book of Biotechnology. Wiley Dreamtech , India, Pvt Ltd, New Delhi.

#### **BIOSTATISTICS**

- 1, Bailey, N.Y.J(1997), Statistical Methods in Biology, III Ed, Cam University Press, N.Y.
- 2, Sokal, R and James, F. (1973), Introduction to Biostatistics, W.H.Freeman And Company LTd, Tokyo, Japan.

## **PAPER -VIII**

### **BOTECHNOLOGY & MICROBIOLOGY**

**UNIT-I:** Basic principles of genetic engineering- Gene cloning – Tools – Enzymes and Vectors. Gene cloning strategies.

**UNIT-II:** Molecular techniques in Biotechnology, Southern , Northern and Western blotting. PCR- Principles, types and applications. DNA sequencing and DNA finger printing. Gene transfer methods.

**UNIT-III:** Fermentation- Process and types – applications of biotechnology in the field of medicine, agriculture, industry and in pollution control.

**Unit IV:** Classification of microbes- Morphology and ultra structure of bacteria, fungi and viruses.. bacterial culture techniques. Bacterial growth curves and nutritional requirements.

**Unit V:** Causative agents, mode of transmission, control, prevention and treatment of Polio, Rabbits , AIDS, Leprosy, Tuberculosis, Cholera.

#### **References:**

##### **BIOTECHNOLOGY**

1. BROWN, C.M., CAMPBELL, I. and PRIEST, F.G. (1988), Introduction to Biotechnology, Blackwell Scientific Publications, UK.
2. PRIMROSE, S.B. (2000), Modern Biotechnology, Blackwell Scientific Publications, Oxford, London.
3. KESHAV TREHAN (1996), Biotechnology, New Age International Pvt. Ltd. Publishers, New Delhi.
4. Watson et.al. (1999) Recombinant DNA. Freeman and Company, New York

##### **MICROBIOLOGY**

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

## **PAPER - IX**

### **OPTIONAL I –AQUACULTURE**

#### **UNIT – I**

Importance of aquaculture – Over exploitation of wild fish stocks – advantages of aquaculture – Aquaculture production trends in the world and in India. Scope for aquaculture in India. Basic Fish farm design : selection of site, grow - out and nursery ponds.

#### **UNIT – II**

Cultivable species of fish, crustaceans, molluscs and algae. Culture systems: Extensive, intensive and semi-intensive culture. Integrated farming. Advantages of polyculture, monoculture and monosex.

#### **UNIT – III**

Culture of carp species –oyster culture: pearl oyster. Prawn culture: the problems in penaeid prawn(shrimp) culture due to socio-economic and environmental problems. Freshwater prawn culture. Potential for ornamental fish culture. Common species for ornamental fish farming.

#### **UNIT – IV**

Fish disease management : Common bacterial, viral, fungal, protozoan and crustacean diseases, their symptoms and treatment. Water quality maintenance. Importance and composition of feeds; types of feed: wet and dry feeds.

#### **UNIT – V**

Marketing the products: Marketing the fish to local markets and for export. Harvesting and transport. Quality control and norms of MPEDA for export of fishes. CANNING AND FREEZING.

#### **References:**

1. Arumugam.N. 2008. Aquaculture Saras Publications, Nagercoil.
2. Rath, R.K. (2000) Freshwater Aquaculture. Scientific Publishers, (India), PO. Box.91, Jodhpur.
2. Jhingran, AVG (1991) Fish and Fisheries of India. Hindustan Publishing Co.
3. Baradach, JE, JH Ryther and WO Mc Larney (1972) Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley Inter science, New York.

## **PAPER – IX**

### **OPTIONAL II- POULTRY SCIENCE**

#### **Unit – I**

Introduction to poultry science-scope and importance. Nomenclature of breeds of fowl, classification of fowls, selection of breed. Housing and equipments-General Principles of building poultry sheds, deep litter system, laying cages.

#### **Unit – II**

Brooding and rearing- methods of brooding. Debeaking. Management of chicks, growers, layers, broilers. Summer and winter management.

#### **Unit – III**

Food stuffs for poultry, feed additives- feed formulations for chicks, growers, layers and broilers.

#### **Unit – IV**

Symptoms, prevention, control and treatment of viral, bacterial, fungal, protozoan, worms, ticks, mites and lice affecting fowl. Vaccination schedule for fowls.

#### **Unit – V**

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

#### **Reference Books:**

1. Banerjee G.C (1992) A text book of animal husbandry, oxford and IBM publishing Co., New Delhi.
2. Shukula, G.S and Upadhyay V.B (1997) Economic Zoology, Rakesh Rastogi, Meerut.
3. Sunilkumar Das, 1994. Poultry Production CBC Publishers and Distribution, Delhi.

## **PAPER - X**

### **Practical-II**

#### **ANIMAL PHYSIOLOGY, BIOCHEMISTRY, BIOPHYSICS, BIostatISTICS AND COMPUTER APPLICATIONS IN BIOLOGY, ANIMAL BIOTECHNOLOGY AND APPLIED MICROBIOLOGY**

1. Enumeration of RBC & WBC
2. Qualitative test for Ammonia, Urea and Uric acid
3. Qualitative test for Protein, Carbohydrate and Lipid
4. Calculation of Mean, Median and Mode.
5. Staining - Simple and Gram's staining

#### **Spotters:**

Haemoglobinometer, Haemocytometer  
Sphygmomanometer, Stethoscope  
ATP Model, Haemoglobin Model, DNA model  
(Diagram / Model)  
P<sup>H</sup> meter, Spectrophotometer, Histogram, Pie diagram  
Input and Output devices.

#### **Vector:**

Plasmid, Phages (Diagram) PCR, Transgenic animal – Sheep, Mice, Cow, Fish (Photos)  
Petriplate, Inoculation loop, Autoclave and Microscope.

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