

THIRUVALLUVAR UNIVERSITY
MASTER OF SCIENCE
DEGREE COURSE
M.Sc. ZOOLOGY
UNDER CBCS

(with effect from 2012-2013)

The Course of Study and the Scheme of Examinations

S. NO	Study Components		Ins. hrs/ Week	Credit	Title of the paper	Maximum Marks		
	Course Title					CIA	Uni.Exam	Marks
SEMESTER I								
1	MAIN	Paper-1	5	4	Life and diversity of invertebrates	25	75	100
2	MAIN	Paper-2	5	4	Life and diversity of Chordates	25	75	100
3	MAIN	Paper-3	5	4	Cell and molecular Biology	25	75	100
3	MAIN PRACTICAL	Paper 1	12	-	Life and Diversity of Invertebrates Chordates Cell and molecular Biology	-	-	-
4	ELECTIVE (a)Disciplinary or Elective (b)inter Disciplinary	Paper-1	3	3	(A)Aquaculture and Farm Management (B)Biostatistics and Bioinformatics	25	75	100
			30	15		100	300	400
SEMESTER II								
5	MAIN	Paper-4	4	4	Genetics	25	75	100
6	MAIN	Paper-5	4	4	Environmental Biology	25	75	100
7	MAIN	Paper-6	4	4	Bio Technology	25	75	100
8	MAIN PRACTICAL	Paper-1	-	5	Life and Diversity of Invertebrates Chordates and Cell and molecular Biology	40	60	100

M.Sc. Zoology : Syllabus (CBCS)

9	MAIN PRACTICAL	Paper-2	10	5	Genetics, Environmental Biology and Biotechnology	40	60	100
10	ELECTIVE (a)Disciplinary or	Paper-2	3	3	(A)Endocrinology (B) Biochemistry	25	75	100
	Elective (b)inter Disciplinary							
11	Compulsory Paper		2	2	Human Rights	25	75	100
12	Elective Practical Respective Practical of the Elective Chosen	Paper 1	3	3	(a) Endocrinology or (b)Biochemistry	20	30	50
			30	30		225	525	750
SEMESTER III						CIA	Uni. Exam	Marks
13	MAIN	Paper-7	5	4	Animal Physiology	25	75	100
14	MAIN	Paper-8	5	4	Developmental Biology	25	75	100
15	MAIN	Paper-9	5	4	Immunology	25	75	100
16	MAIN PRACTICAL	Paper-3	12	-	Animal Physiology Developmental Biology and Immunology	-	-	
17	ELECTIVE (a)Disciplinary or	Paper-3	3	3	(A) Fisheries Science (or) (B) Biophysics	25	75	100
	Elective(b)inter Disciplinary							
			30	15		100	300	400
SEMESTER IV						CIA	Uni.Exam	Marks
19	MAIN	Paper-10	5	5	Research Methodology	25	75	100
20	MAIN	PROJECT (OR)	5	4	Project / Dissertation with Viva Voce	25	75	100
		Paper-11	5	4	Evolution	25	75	100
21	MAIN	Paper-12	5	5	Entomology	25	75	100

M.Sc. Zoology : Syllabus (CBCS)

22	MAIN	Practical 3	-	5	Animal Physiology Developmental Biology and Immunology	25	75	100
23	MAIN	Practical 4	9	5	Research Methodology Evolution and Entomology	25	75	100
24	Elective (a) Disciplinary or Elective(b) inter Disciplinary	Paper 4	3	3	(A) Sericulture (or) (B) Microbiology	25	75	100
25	Elective Practical (Respective Practical of the Elective Chosen)	Paper-2	3	3	(a) Sericulture (or) (b) Microbiology	20	30	50
			30	30		170	480	650

* For those not choosing Project / Dissertation with *viva voce*,
Main Paper 11 Evolution is compulsory

Subject	Papers	Credit	Total Credits	Marks	Total marks
MAIN	12	4-5	50	100	1200
MAIN PRACTICAL	4	5-6	20	400	400
ELECTIVE	4	3	12	100	400
ELECTIVE PRACTICAL	2	3	6	50	100
COMPULSORY PAPER	1	2	2	100	100
Total	23	-	90	-	2200

THIRUVALLUVAR UNIVERSITY

M.Sc. ZOOLOGY

SYLLABUS

UNDER CBCS

(with effect from 2012-2013)

SEMESTER I

PAPER-1

LIFE AND DIVERSITY OF INVERTEBRATES

OBJECTIVES

To comprehend the systematic position, functional morphology, mode of life, affinities and biodiversity of invertebrates.

UNIT-I

Broad classification of the Animal Kingdom - Principles involved.

Protozoa

Feeding, Reproduction and Parasitic Protozoa

Economic importance of Protozoa

Origin and evolution of Metazoa - theories.

Mesozoa

Porifera

Interrelationship between different classes,

Marine sponges.

Freshwater sponges.

Skeleton Sponges.

UNIT-II

Cnidaria

Origin and evolution, Polymorphism and Reproduction in cnidaria .

Corals and Coral reeves

Origin of Bilateria

Importance of Rhabdocoela as a stem group. Origin and evolutionary trends in coelom formation.

Platyhelminthes

Functional morphology and adaptive biology for parasitic mode of life.

UNIT-III

Annelida

Archiannelida. Interrelationship between different classes of Annelida. Adaptive radiation in Annelida.

Arthropoda

Economic importance of Crustaceans

Phylogeny of Arthropoda, Xiphosura-structure and affinities.

UNIT-IV

Mollusca

Molluscan phylogeny, Monoplacophora - Torsion in Gastropoda - Adaptive radiation in Mollusca

Echinodermata

Phylogeny of Echinoderms.

UNIT-V

Minor Phyla

Structural peculiarities and affinities of Ctenophora, Nemertinea, Rotifera, Pogonophora, Phoronida and Lophophorates.

Invertebrate fossils: Trilobites, Brachiopoda, Cephalopoda and Echinodermata.

REFERENCE BOOKS

1. Barnes. R.D. 1974 Invertebrate Zoology. W.B. Saunders Co., Philadelphia.
2. Hyman L.H. 1951 The Invertebrata, Vol I to VI. Mc Graw – Hill Book Co., New York.
3. Carter, G.S.A. 1969. General Zoology of Invertebrates. Sidewick and Jackson Ltd., London.
4. Borradile, L.A. Eastham, L.E.S. and J.T. Saunders. 1977 The Invertebrate Cambridge University Press.
5. Barrington, E.J. W. 1969. Invertebrate Structure and Functions. English Language Book Society.
6. Moore, R.C. Lalicker, C.G. and Fisher, A.G. 1952 Invertebrate Fossils. Mc Graw Hill Book Co., New York
7. Gardinar, M.S. 1972 Biology of the Invertebrates, McGraw - Hill Book Co., New York.

PAPER-2

LIFE AND DIVERSITY OF CHORDATES

OBJECTIVES

To comprehend the systematic position, functional morphology, mode of life, affinities and biodiversity of chordates.

UNIT-I: TAXONOMY

Principles of taxonomy

Nomenclature- Binomial, Trinomial nomenclature.

Suffix as for super family name-(oidea), familyname (idea), use of suffixes ‘i’, ‘orum’, ‘ae’, ‘arum’, ‘ensis’ and ‘iensis’.

Tautonyms synonyms and Homonyms.

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

Taxonomic key: Indented, Simple non-Bracket Grouped type, combination

Pictorial: Branching type, Circular and Box-type.

UNIT-II

Prochordate phylogeny - systematic position of Prochordates

Ostracoderms: Silurian and Devonian Ostracoderms. Evolutionary position of the Ostracoderms.

Placoderms: Origin of Jaws- Placoderms as ancient “experiment” in the evolution of the jawed vertebrates. Structural peculiarities of Cyclostomata.

UNIT-III

Chondrichthyes: Fossil history of chondrichthyes, tendencies in Elasmobranch evolution.

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

Amphibia: Origin and evolution of Amphibia.

UNIT-IV

Reptilia: Evolution of Reptilia. Saurischian and Ornithischian Dinosaurs - Rhyncocephalia - Adaptive radiation of Reptiles.

Aves: Birds as glorified reptiles. Fossil history of birds. Palate in Birds. . Adaptive radiation in birds.

Mammal: Evolution of Mammals, Structural peculiarities of Prototheria, Metatheria and Eutheria.

UNIT-V

Comparative anatomy: Origin and evolution of the vertebrate integumentary system. Paired fins and limbs, heart and aortic arches and brain of vertebrates.

REFERENCE BOOKS

1. Waterman. A.J. 1971. Chordate Structure and Function. McMillan Co. London.
2. Jolie, M. 1968. Chordate Morphology. East West Press. Pvt, Ltd,
3. Romer, A.S. and Parson, T.S. 1978 Vertebrate Body. W.B. Saunders Co., Philaelpia.
4. Young, J.2.1969. Life of Vertebrates. Clarendon Press, Oxford.
5. Colbert, E.H. 1969. Evolution of Vertebrates. John Wiley and Sons Inc, New York.
6. Holstead. 1969 The Pattern of Vertebrate Evolution. Freeman and Co. San Francisco. U.S.A.
7. Hobart M. Smith, 1960 Evolution of Chordate Structure, Holt, Rinehart and Winston. Inc. New York.
8. Kapoor, V.C. 1998 Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt, Ltd. New Delhi.
9. Hyman, L.H. 1966. Comparative Vertebrate Anatomy. The University of Chicago Press, Chicago.

PAPER-3

CELL AND MOLECULAR BIOLOGY

OBJECTIVES

To understand the structure and molecular basis of cellular interactions, energy transformation, regulation and control of genes, cell cycle and information transfer.

UNIT-I: STRUCTURE AND FUNCTIONS OF CELL ORGANELLES

Plasma membrane: Membrane associated receptors, Membrane transport - Membrane Potentials - Extracellular space - cell adhesion, intercellular recognition - Intercellular junctions.

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

UNIT-II: NUCLEUS

Nuclear - cytoplasmic interactions. Nuclear receptors, Nuclear transplantation - Cell fusion: homokaryons, heterokaryons. Cytoplasts and karyoplasts.

Structure and function of Chromatin - Organisation of nucleosomes - Euchromatin and heterochromatin - Polytene and lambrush Chromosomes

UNIT-III: CELL CYCLES

Cell cycles - its components G₀-G₁ transition - Spindle organization - Chromosome movements - Regulation and synchronization of cell division.

Cancer cell: Differences between normal and cancer cell- structural and functional characteristics -Tumour Viruses-Oncogenes - Environmental factors inducing cancer. Hormones in relation to cancer-Theories of carcinogenesis.

UNIT-IV: INFORMATIONAL MACROMOLECULES

Chemistry of DNA - Polymorphism of DNA - Mechanism and enzymology of DNA replication - DNA repair mechanisms.

Chemistry of RNA - Different types of RNA and their functions.

UNIT-V: INFORMATION TRANSFER

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

REFERENCE BOOKS

1. De Robertis. E.D.F. and De Robertis. E.M.F. 2001. Cells and Molecular Biology, B.I Publications Pvt Ltd, India.
2. Lewin, B.2000 Genes VII. Oxford University Press, New York.
3. Howland J.L. 1973. Cell Physiology, McMillan Publishing Co., New York.
4. De Witt, 1977. Biology of the cell. An evolutionary approach. Saunders Company.
5. Karp, G. 1979. Cell Biology. McGraw Hill Ltd., Japan.
6. Avers. C.J., 1976. CellBiology. Van Nostrand Company, New York.
7. Korenberg. A. 1974. DNA Replication. Dorothy- W.H. Freeman and Company, San Francisco.
8. Hawkins, J.D.1996. Gene Structure and Expression, Cambridge University Press, London.
9. Shanmugam, G., 1988. A laboratory manipulation in fish. Madurai Kamaraj University.
10. Albert, B and Watson. J.D. 1990. Molecular Biology of the cell. Garland Publishing, London.
11. Malacinski, G.M. 2005. Essentials of molecular biology. Narosa Publish House, Chennai.
12. Lodish, H., Berk A .,Matsudaira, P., Kaiser, C.A., Krieger, M., Scott, M.P., Zipursky, S.L.and Darnell, J. 2004. Molecular Cell Biology. W.H. Freeman & Co., New York.

ELECTIVE

PAPER-1

(to choose either A or B)

A. AQUACULTURE AND FARM MANAGEMENT

Objectives

The objective of the paper is to understand the culture practices of both fin fish and shell fishes in India and World. This paper is planned to teach in the lines of knowing the candidate species of important fin and shell fishes. Gaining knowledge in the food and feeding habits, investigating the seed production and farm management and method of farming. And this paper also to provide scope for employment opportunities in aquaculture activities.

UNIT-I: Introduction to Aquaculture

Importance of aquaculture, Global scenario, Present status in India - Prospects and scope.

Aquaculture Farms

Site selection, topography, water availability and supply, soil conditions and quality. Design and layout, structure and construction.

UNIT II: Biology of important cultivable species and their economics

Standard guidance for choosing cultivable species - Seaweeds, Crustaceans (Prawns & Lobsters), Molluses (Clams, Cockles, Mussels and Oysters) and fishes - biological criteria - Environmental adaptability and compatibility - Economic importance - economics, market values, by-products and availability in adjacent region.

UNIT-III: Survey of seed Resources and Seed & Feed Production

Distribution and abundance of natural seed resources, collection methods and segregation.

Artificial seed production - breeding under controlled condition, induced breeding technique, larval rearing, packing and transportation.

Live feed - Microalgae, Rotifer and Artemia - their culture. Feed formulation - Conventional and non-conventional ingredients, feed additives, feed attractants and feed formulations.

UNIT-IV: Culture systems

Traditional, Extensive , Semi-intensive and intensive systems, composite fish culture, paddy-cum-fish culture, integrated fish culture, sewage water fish culture, raceway culture, cage, pen and rack culture Culture system management - pond preparation, production and economics.

UNIT-V: Farm Management

Water quality management - temperature, salinity, pH, O₂,Co₂ levels, nutrients and trace elements.

Control of parasites, predators, weeds and diseases in culture ponds.

Disease diagnosis - ELISA, Western blotting - DNA based diagnosis of diseases and fish vaccines.

REFERENCE BOOKS

1. Balugut, E.A.1989. Aquaculture system and practices. A selected review publishing House, New Delhi.
2. Dash, M.C. and Patnik, P.N.1994. Brackish water culture. Palani Paramount publications, Palani.
3. Michael, B.N. and Singholka, B. 1985. Freshwater Prawn Farming. A manual of culture of *Macrobrachium rosenbergii*. Daya Publishing House, New Delhi.

4. Paul Raj, S. 1995. Shrimp Farming techniques, Problems and solutions. Palani Paramount Publications, Palani.
5. Paul Raj, S. 1996. Aquaculture for 2000 A.D. Palani Paramount Publications, Palani.
6. Pillay, T.V.R. 1990 Aquaculture Principles and Practices. Blackwell Scientific Publications Ltd.
7. Ponnuchammy, R.1997. Practical Guide to shrimp farming. Palani Paramount Publications, Palani.
8. Post, G.M. 1983. Text Book of Fish Health. TFH Publication.
9. Sinha, V.R.P. and Srinivastava, H.C. 1991. Aquaculture Productivity. Oxford and IBH Publications Co., Ltd., New Delhi.

PAPER-1

B. BIOSTATISTICS AND BIOINFORMATICS

OBJECTIVES

To understand the basic concepts of biostatistics and bioinformatics to synthesis an area of modern biology in order to analyze and solve biological problems in a more systematic way through computational management

UNIT-I: INFERTIAL STATISTICS

Introduction: Definition of statistical population and sample in biological studies. Variables: qualitative and quantitative, Discrete and continuous.

Probability; Basic principles - apriori and aposteriori probabilities - addition and multiplication rules of probability. Conditional probability. Theoretical distribution, normal binomial and Poisson - application (computation required).

UNIT-II

Hypothesis testing - Null hypothesis - levels of significance - degrees of freedom - type I and type II errors.

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

Test of significance for large and small samples - comparison of sample mean with population mean comparison of two - sample (computation required)

UNIT-III: CORRELATION AND REGRESSION

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

Uses of scatter diagram and correlation graph in the study of correlation between two variables. Computation of Karl Pearson's co-efficient of correlation - testing its significance, Interpretation.

Regression analysis, derivation of regression equation between two variable regression coefficient - construction of regression lines - properties - application. ANOVA

Population Statistics -Vital statistics - natality and morality rates. Population estimation - population growth.

UNIT-IV: BASIC BIOINFORMATICS

Bioinformatics - Biological /Specialized Database - Servers for Bioinformatics (NCBI, EBI, Genoment) Virtual Library - Data mining - Data Warehousing - Searching techniques - Genomics - Proteomics.

UNIT-V: ALGORITHM IN BIOINFORMATICS

Algorithm and tools sequence analysis - Similarity Search - Genetic algorithm - Gene finding - Protein prediction - Biomolecular visualization - Phylogenetic analysis - Drug designing.

REFERENCE BOOKS

1. Milton, J.S 1992 Statistical Methods in Biological and Health Science. McGraw-Hill Inc, New York.
2. Scheffler, W.C. 1963 Statistics for biological sciences. Addition - Wesley Publication Co., London.
3. Snedecor, G. Wand Cochran, W. G. 1967 Statistical Methods. Oxford Publication Co., New Delhi.
4. Spiegel, M.R. 1981 Theory and problems of statistics, Schaum's Outline Series McGraw -Hill International Book Co., Singapore.
5. Pillai, R.S.N. and Bagawathi, V.2005 Statistics. S. Chand & Co.Ltd, New Delhi.
6. Stansfield,W.O. 1984 Theory and Problems of genetics(including 600 problem) Schaum's outline series.McGraw - Hill Book, Co., New York.

7. Sokal, R.R. and Rohlf, F. J. 1969. Biometry. The Principles and Practice of Statistics in Biological Research. W.H. Freeman and Co., San Francisco.
8. Mahajan, B.K. 1984. Methods in Biostatistics for Medical students and research Workers. Smt. Indu Mahajan, New Delhi.
9. Gupta, S.P. 1988. An easy approach to statistics. Chand & Co., New Delhi.
10. Westhead, D.R., Parish, J.H. and Tugman, R.M. 2003. Bioinformatics. Viva Books Pvt. Ltd., New Delhi
11. Arthur, M.L. 2003. Introduction to Bioinformatics Oxford University Press, New Delhi.
12. Higgins D. and Taylor, W. 2000. Bioinformatics: Sequence, Structure and Databases. Oxford University Press, New Delhi.
13. Durbin, R., Eddy, S.R., Krogh, A. and Mitchison, G. 1998. Biological sequence Analysis. Cambridge University Press, Cambridge, U.K.
14. Baxevanis, A. and Ouellette, B.F. 1998. Bioinformatics: A practical guide to the analysis of genes and proteins. Wiley Interscience, Hoboken, New Jersey, USA.
15. Arthur M. Lesk. 2006. Introduction to Protein structure. Oxford University Press, New Delhi.

SEMESTER II

PAPER-4

GENETICS

OBJECTIVES

To understand the fine structure of genetic materials and regulation of their action. To know the chromosomal basis of genetic disorders, development and differentiation. Also, to know the importance of population genetics and nuances of genetic engineering and applied genetics.

UNIT-I: MOLECULAR STRUCTURE OF GENETIC MATERIAL

Molecular structure of DNA and RNA - Replication, theories, Gene concept - One gene one polypeptide concept.

Identification of DNA and RNA as the genetic material.

Microbial Genetics - Conjugation, transformation and transduction and Sexduction.

Chromosome mapping in prokaryotes (Virus, Bacteria) and eukaryotes (Neurospora and Man)

UNIT-II: REGULATION OF GENE ACTION

Enzyme regulation of gene action. Gene regulation of gene action - Operon concept - GAL and LAC Operon system. Evidence of regulation of gene action.

Genes and metabolism. Inborn errors of metabolism in Man (With reference to protein, carbohydrates, Lipid and nucleic acid).

UNIT-III: CHROMOSOME AND GENETICS DISORDERS

Evolution of sex chromosomes. Dosage compensation - X inactivation. Geneomic imprinting.

Human Genetics: Normal human karyotype - Variations in karyotypes (autosomal and sex chromosomal, structural and numerical) with special reference to classical syndromes in man. Principles and methods of pedigree analysis - statistical evaluation. Genetic counselling - Objectives, ethics and principles . Methods of counselling for point mutation, structural and chromosomal disorders.

UNIT-IV: GENES IN DEVELOPMENT, RADIATION GENETICS AND POPULATION GENETICS

Genes in development and differentiation Mechanism of chromosomal breakage - physical chemical and biological factors or agents. Mutagens and mutagenesis and carcinogenesis - genetic changes in Neoplasia in man

Population genetics:

Population and gene pool. Hardy Weinberg Law-Genetic equilibrium.

Calculation of gene frequencies for Autosomal (Complete dominance, codominance and multiple alleles) and sex linked genes. Factors affecting Hardy Weinberg equilibrium.

UNIT-V: GENETIC ENGINEERING AND APPLIED GENETICS

Genetic Engineering - Restrictive enzymes - Recombinant DNA techniques. Applications of Recombinant DNA technology.

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

REFERENCE BOOKS

1. Watson. J.D. Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. 1987 Molecular Biology of the Gene. W.A. Benjamin/Cummings Co., New York.
2. Sinnot. E.W., Dunn. L.C., Dobzhansky, T.H. 1973. Principles of Genetics. McGraw Hill Co., New Delhi.
3. Daniel L. Hartl. 1994. Genetics. Jones and Barflaff Publishing, Boston.
4. Lewin, B. 2000. Genes VII. Oxford University Press, New York.

5. Ayala, F. I. and Kieger, J.A. Jr., 1980, Modern Genetics. The Benjamin Publishing Co. London,
6. Goodenough, U. 1984. Genetics. Saundes College Publishing Co., London.
7. Curs Sten 1973 Principles of Human Genetics. W.H. Freeman and Co., New York.
8. Jenking, J.B. 1983. Human Geneties. The Benjamin Cummings Publishing& Co., Londen.
9. Market, C.L. & Ursprung, 1973. Development Genetics, Prentice Hall.
10. Gardner E.J. Simmons, M.J. and Snustad, D.P.1991 John Wiley & Sons, New York.
11. Tamarin, R.H. 1996. Principles of Geneties, WCB Publishers Munro.
12. Stickberger, M.W. 1985. Genetics. Printice - Hall of India, Pvt. Ltd., New Delhi.
13. Pandian, T.J. and Muthukrishnan, J. 1988. Workshop on Research Methods for Chormosomal Manipulation in Fish. Department of Biotechnology Govt. of India, New Delhi.
14. Pandian, T.J. and Muthukrishnan, J. 1990. Research Methods for Gene and Chorosome Manipalation in Fish. Department of Biotechnology, Govt. of India, New Delhi.

PAPER-5
ENVIRONMENTAL BIOLOGY

OBJECTIVES

To generate up-to-date knowledge on environmental conservation and management through a comprehensive understanding of the components of ecosystem, biological cycles, habitat ecology, resource ecology, pollution and its management.

UNIT-I: ECOSYSTEM AND COMMUNITY

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

Definition, nature and flux of energy through communities. Influence of competition, pradation and disturbances - Community succession - homeostasis.

UNIT-II: POPULATION AND BIOLOGICAL CYCLES

Structure and distribution - Growth curves - Groups, natality, Mortality - Density indices, Life study tables - factors affecting population growth - Carrying capacity. Population regulation and human population control.

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

UNIT-III: HABITAT AND RESOURCES ECOLOGY

Biomass, Adaptations with reference to physico - chemical features of environment of coastal ecosystems.

Renewable and non - renewable resources - animal resources. Conventional and non - conventional energy sources.

UNIT-IV: ENVIRONMENTAL CONSERVATION AND MANAGEMENT

Principles of conservation - Rain water harvesting - Soil health and fauna inputs in agriculture Biosphere reserves - wildlife conservation and management. Biodiversity - Germplasm conservation and cryopreservation. Social forestry - tribal welfare.

UNIT-V: POLLUTION AND MANAGEMENT

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

REFERENCE BOOKS

1. Odum. E.P. 1996 Fundamentals of Ecology. Nataraj Publishers, Dehra Dun.
2. Trivedi, P.R.and Gurdeepraj, K. 1992. Environmental Biology. Akashdeep Publishing House New Delhi
3. Berwer. A.1988 .The Science of ecology. Saunder's college publishing.
4. Bandopadhyay, J.1985. India's Environment Crisis and response. Nataraj Publishers,Dehra Dun.
5. Smith, R.L.1986. Elements of Ecology. Harpet and Row Publishers, New York.
6. Ismail, S.A.1997. Vermicology, Biology of Earthworms. Orient Longman, Chennai.
7. Alpha Soli, I. Arceivala.1998. Wastewater treatment for pollution control - Second Ed. Tata McGraw Hill Publication Company Ltd., New Delhi.
8. Asthana, D.K. and Asthana, M.2001. Environmental Problems and Solutions. S. Chand and Co., New Delhi.

PAPER-6

BIOTECHNOLOGY

OBJECTIVES

To familiarize the use of the data and techniques of engineering and technology in biology for the study of living organisms, or derivatives of thereof, to make or modify products or processes for specific use. Also, to find solution of problems concerning human activities including agriculture, medical treatment, industry and environment.

UNIT-I: RECOMBINANT DNA TECHNOLOGY

Gene cloning - the basic steps - various types of restriction enzymes - ligase linkers and adaptors - c DNA - transformation - Selection of recombinants. Hybridization techniques chemical synthesis of oligonucleotides.

Gene probe - Molecular finger printing (DNA finger printing) - RFLP - the PCR techniques - Genomic library - Blotting techniques - Southern blotting - Northern blotting - Western blotting

UNIT-II: CLONING VECTORS

Plasmid biology - cloning vector based on E. coli PBR 322 and bacteriophage. Cloning vector for yeast. Cloning vector for Agro bacterium tumefaciens. Cloning vector for mammalian cells - Simian virus 40 - Gene transfer technologies.

UNIT-III: ANIMAL BIOTECHNOLOGY

Cell culture - Organ culture - whole embryo culture - Embryo transfer - In vitro fertilization (IVF) technology - Dolly - embryo transfer in human. Transgenic animal. Human gene therapy. Cryobiology.

UNIT-IV: MICROBIAL BIOTECHNOLOGY

Fermentation - bioreactor - Microbial products - Primary & Secondary Metabolites - enzymes technology - single cell protein (SCP). Biopolymers, Biopesticides and Biofertilizers.

UNIT-V: ENVIRONMENTAL BIOTECHNOLOGY AND APPLICATIONS OF BIOTECHNOLOGY

Bioremediation - bioremediation of hydrocarbons - Industrial wastes - Heavy metals - Xenobiotics - bioleaching - biomining - biofuels. Applications of biotechnology in agriculture, medicine and food science. Genetically modified organism (GMO'S) - GM foods. Biotechnology & biosafety - IPR.

REFERENCE BOOKS

1. Purohit, S.S. and S.K.Mathur. 1999. Biotechnology Fundamentals and Application. Agro Botanica, New Delhi.
2. Alan Scragg. 1999. Environmental Biotechnology, Longman Publication.
3. R.C.Dubey 2001 A text book of biotechnology. Rajendra Ravindra Printer. New Delhi.
4. T.A. Brown 2004 Gene cloning and DNA analysis. Blackwell Science, Osney Mead, Oxford.
5. Dawson, M.T., Powell .R, and Gannon, F. 1996. Gene Technology. Bios Scientific Publishers.
6. Chopra, V.L. and Nanin, A.1992. Genetic Engineering and Biotechnology. Oxford and I BH Publishing Co., New Delhi.
7. Marx, J.L.1989 A Revolution in Biotechnology. Cambridge University, Press, Oxford.
8. Old, R.W.and Primrose, S.B.1985 Principles of Gene Manipulations. An introduction to Genetic Engineering. Oxford Blackwell Publishers, London.
9. Winnacker, E.L. 2003. From Genes to Clones. Panima Publishing Corporation, New Delhi.
10. Gupta, P.K. 2004. Biotechnology and Genomics. Rastogi Publications, Meerut.
11. Das, H.K. 2004. Text Book of Biotechnology. Wiley Dreamtech India Pvt. Ltd., New Delhi.

ELECTIVE

PAPER-2

(to choose either A or B)

A. ENDOCRINOLOGY

OBJECTIVES

To make the students to learn the objectives and scope of comparative endocrinology, anatomy, morphology and histology of endocrine tissues of vertebrates, crustacean and insect endocrine organs and their functions.

UNIT-I: INTRODUCTION TO ENDOCRINOLOGY

Introduction, objectives and scope of endocrinology - modern concepts and problems in Endocrinology - endocrine glands in crustaceans, insects and vertebrates. Experimental methods of hormone research - general classes of chemical messengers.

UNIT-II: PITUITARY AND THYROID GLANDS

Pituitary gland - characteristics, structural organization - hormone secretion and its functions - Hypothalamic control.

Thyroid gland - structural organizations, metabolic effects of thyroïd - effects on reproduction - parathyroid its structure and functions.

UNIT-III: PANCREAS AND ADRENAL GLANDS

Structure of pancreas, pancreatic hormones and their functions.

Structural organizations of adrenals, functions of cortical and medullary hormones.

UNIT-IV: INSECTS AND CRUSTACEAN ENDOCRINOLOGY

Concepts of neurosecretions - endocrine systems in crustaceans - endocrine control of moulting and metamorphosis - neuroendocrine system in insects - endocrine control of moulting - metamorphosis and reproduction.

UNIT-V: VERATEBRATE REPRODUCTIVE ENDOCRINOLOGY

Structure of mammalian testis and ovary - male and female sex accessory organs - hormones of testis and ovary - estrous and menstrual cycle - hormones of pregnancy - parturition - hormonal control of lactation. Hormonal control of metamorphosis in an anuran amphibian.

REFERENCE BOOKS

1. Haris, G.W. and B.T. Donovan. 1968. The Pituitary Gland. S. Chand and Co.,
2. Bentley, P.J. 1985. Comparative vertebrate endocrinology, Second Edition, Cambridge University Press. Cambridge.
3. Mac Hadley. 1992. Endocrinology, 3rd Edition. Prentice - Hall Inc. A Simon & Schuster Company, Englewood Cliffs, New Jersey. USA.
4. Ingleton, P.M. and J.T. Bangara. 1986. Fundamentals of comparative vertebrate endocrinology, Kluwer Academic Publishers.
5. Turner, C.D. and J.T. Bangara. 1986. General endocrinology. Saunders International Student edition. Toppan Company Limited. Tokyo.
6. Barrington, E.J.W. 1985. An introduction to general and comparative endocrinology. Claredon Press Oxford.

PAPER-2

B. BIOCHEMISTRY

OBJECTIVES

To comprehend the chemical constituents of living matter, chemistry of food stuffs and their transformation in animal systems, the energy changes associated with these transformation and hormonal regulation.

UNIT-I: WATER

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

UNIT-II: BIOMOLECULES

Amino acids - structure, classification and function. Peptide bonds. Essential and non - essential amino acids, isoelectric point, switter ion. Protein - structure, classification, Properties of protein - Deamination, transamination, transmethylation.

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

UNIT-III: BIOENERGETICS

Carbohydrate - structure, classification and biological significance.

Lipid - Structure classification and biological significance

MATABOLISM

1. Glycogenesis, 2. Glycogenolysis, 3. Glyconeogenesis, 4. Glycolysis, 5. Hexose mono phosphate shunt. Biosynthesis and Oxidation of Fatty Acids. Energetics.

UNIT-IV: HORMONES

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

Vasoactive Peptide Synthetic Hormones. Mechanism of Hormone action.

UNIT-V: VITAMINS

Water and Lipid soluble Vitamins - structure, classification, sources and deficiencies in man.

Reference Books

1. Murray, R. K, Granner, D.K. Maynes, P.A and Rodweli, V. W. 1998. Harper's Biochemistry. 25th Edition. McGraw Hill, New York.
2. Hames, B. D., Hoopa, N.M and Houghton, J.D. 1998. Instant notes in Biochemistry. Viva Books Pvt. Ltd. New Delhi.
3. Jain, J. L. Jain, S. and Jain N. 2005. Fundamental of Biochemistry, S. Chandra & Co. Ltd. New Delhi..
4. Vasudevan, D.M. and Sreekumar. S. 2000. Text of Biochemistry for Medical students. Jaypee Brothers, Medical Publishers (P) Ltd. New Delhi.
5. Rama Rao, A.V.S.S. 1986. Text Book of Biochemistry. L.K. & S Publishers. A.P.
6. Ambika, S. 1990. Fundamentals of Biochemistry for Medical Students, Published by the author.
7. Lehninger, A.L. 2004. Principles of Biochemistry. CBS Publishers, New Delhi.
8. Zubay, G.1989. Biochemistry. McMillan Publishing Co., New York.
9. Voct, D and Voct, J.G. 2004. Biochemistry. John Wiley and Sons, Inc.

MAIN PRACTICAL

PAPER-1

LIFE AND DIVERSITY OF INVERTEBRATES AND CHORDATES AND CELL AND MOLECULAR BIOLOGY

INVERTEBRATA (Slides / Specimens / Xerox)

1. Identification and study of selected Protozoans and Helminthes of medical importance.
2. Identification and study of sections of available animals from Cnidaria, Aschelminthes and Annelida to understand the evolution of /different types of coelom.
3. Identification and study of larval forms from all major phyla of Invertebrates.
4. Identification and study of types minor phyla.
5. Identification and study of Invertebrate fossils
6. Dissection of digestive system of any insect, pila, sepia / loligo
7. Dissection of nervous system of Prawn, any insect, Pila, and Sepia/Loligo.
8. Dissection of reproductive system of any insect.
9. Mounting of:
 - a. Appendages or Prawn
 - b. Gnathochilarium, Radula of Pila
 - c. Sting of Honeybee
 - d. Pedicellaria of Sea urchin
 - e. Aristotle's lantern of sea urchin
10. Study of prepared slides of mouth part of Honey bee, Housefly, Mosquito, Bed bug and Butterfly to relate structure and function.

CHORDATA (Slides / Specimens / Xerox)

1. Study of the following specimen to bring out their affinities:
 - a. Amphioxus
 - b. Balanoglossus
 - c. Ascidian
 - d. Peteromyzon
2. Study of the following specimens with reference to their adaptive features for their respective modes of life
 - a. Echeneis
 - b. Ichthyophis / Uraeotyphlus
 - c. Hyla
 - d. Draco
 - e. Pigeon
 - f. Bat
3. Study of the following skull types with reference to jaw suspensions
 - a. Fish
 - b. Frog
 - c. Calotes
 - d. Snake
 - e. Rat/Rabbi
4. Dissection and mounting of Weberian ossicles in Cat fish.
5. Dissection of aortic arches in Teleost
6. Dissection of aortic arches in Calotes/rat
7. Dissection and display of IXth and Xth Cranial nerves of cat fish
8. Demonstration of portal system of Rat
9. Demonstration of urinogenital system of Calotes / Rat.

MAIN PRACTICAL

PAPER-2

GENETICS, ENVIRONMENTAL BIOLOGY AND BIOTECHNOLOGY

GENETICS

1. Preparation of culture medium Culture of *Drosophila*. Methods of maintenance. Sex identification. Identification of four mutants.
2. Identification of blood groups A,B, ABO and Rh,
3. Mounting of salivary glands of *Drosophila* larva or *Chironomus* larva. Analysis of banding pattern
4. Preparation of Buccal smear to show squamous epithelial cells.
5. Karyotyping using human metaphase chromosome plates (Giemsa stained). Eye Karyotyping, Identification of syndromes (Down, Klinefelter and Turner) from Karyotype Photographs showing clinical features of each syndrome case.
6. Problems relating to the application of binominal theorem in population genetics with reference to P.T.C., Earlobe attachment etc.

ENVIRONMENTAL BIOLOGY

1. Estimation of Aquatic - Primary productivity - Dark and Light bottle.
2. Estimation of Dissolved oxygen, Salinity, Nitrites, Phosphates, Calcium, Silicates and Alkalinity in water samples.
3. Analysis of Industrial effluent - TDS, TSS, BOD, (COD - Demonstration).
4. Estimation of Earthworm population - Demonstration.
5. Collection, isolation and identification of Plankton.
6. Study of sandy, muddy and rocky shore fauna with special reference to the adaptation to the environment.
7. Animal Association - parasitism, mutualism and commensalisms.

8. Visit to:-
- a). Drinking water treatment plant.
 - b). Effluent treatment plant
 - c). Sewage treatment plant.
 - d). Sandy, Muddy and Rocky Shores.

BIOTECHNOLOGY

Visit to Biotechnology Laboratory to observe the demonstration of,

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

Necessary books may be referred to learn the techniques and to be recorded in the record Note books. Observation of photographs of different instruments used in Biotechnology, their principles and applications.

ELECTIVE

PRACTICAL

PAPER-1

(to choose either A or B)

A.ENDOCRINOLOGY

Dissections of pituitary, thyroid, adrenal, pancreas and gonads in any one suitable Vertebrate.

Dissection of reproductive system in any one suitable vertebrate.

Dissection of neuroendocrine complex in insects.

Dissection of reproductive system in insects.

Parabiosis in insect - cockroach.

Ovariectomy in cockroach.

Histology of pituitary, thyroid, adrenal, pancreas, testis and ovary.

ELECTIVE

PRACTICAL

PAPER-1

B.BIOCHEMISTRY

1. Buffer preparation and determination of Ph - Demonstration,
2. Enzyme kinetics - anyone enzyme (Salivary amylase) Maltose standards, influence of enzyme concentration, time course, pH, Temperature, Substrate concentration (Lineweaver Burk Plot) on enzyme activity.
3. Qualitative analysis of urine - protein, glucose, Ketone and acetone bodies.
4. Chromatography: Determination of amino acids in body fluids and tissues of goat.
5. Quantitative estimation of glucose, protein, cholestoerol, urea and creatinine in the serum of goat.

Principles and application of spectrophotometry or colorimetry, electrophoresis, centrifuge, Chromatography.

SEMESTER III

PAPER-7

ANIMAL PHYSIOLOGY

OBJECTIVES

To derive an unified knowledge of the functions of animals, their parts, organs and their behaviour, through and understanding of their nutrition, respiration, circulation, excretion and physico-chemical coordination with a phylogenetic tinge.

UNIT-I: NUTRITION

Nutrition - nutrients - digestion and adsorption of proteins, carbohydrates and lipids. Role of gastrointestinal hormones in digestion.

UNIT-II: RESPIRATION AND CIRCULATION

Respiration in Invertebrates and Vertebrates - physiology of respiration in Man. Respiratory Pigments, nervous and chemical control of respiration, BMR.

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

UNIT-III: EXCRETION AND OSMOREGULATION

Excretion - excretion of metabolic waste products in relation to the environment - physiology of excretion in Man

iono - osmoregulation in Invertebrates (crustaceans), fishes, birds and mammals -hormonal control.

UNIT-IV: COORDINATION

Neuro muscular co-ordination - types of neurons, transmissions of nerve impulse and reflex action. Chemical composition of muscle fiber and physiology of muscle contraction. Myoneural Junction. Endocrine glands in mammals - Hormones and Functions. Physiology of mammalian reproduction - reproductive cycle - hormonal control of reproduction.

UNIT-V: BEHAVIOURAL PHYSIOLOGY

Bioluminescence - chemistry and functional significance. Behaviour (types - trophism, taxis, kinesis, reflex, learning). Temperature regulation: Poikilotherms, homeotherms and heterotherms - hibernation, aestivation - diapause.

REFERENCE BOOKS

1. Hoar, W.S.1991. General and Comparative Physiology. Prentice Hall of India, New Delhi.
2. Prosser, C.L. 1973. Comparative Animal Physiology, 3rd edn. W.B. Saunders & Co., Philadelphia.
3. Barrington, E.J.W.1975. An Introduction to General and Comparative Endocrinology. Clarendon Press, Oxford
4. Bentley, P.J.1971. Endocrine and osmoregulation, Springer Verlag, New York.
5. Palmen, J.D. Brown, I.R and Hastings, J.W.1970. Biological clocks, Academic Press, London.
6. Welson, A. 1979. Principles of Animal Physiology. McMillan Publishing Co. Inc. New York.
7. Schmidt Nelszen, K.1985. Animal Physiology. Adaptation and Environment Club, London.
8. Herkat, P.C. and Mathur, P.N.1976. Text Book of Animal Physiology. S.Chand Co. Pvt, Ltd., New Delhi.

PAPER-8

DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

OBJECTIVES

To imbibe the current knowledge pertaining to the development of animal embryos of diverse taxonomic groups through experimental analyses based on modern biological tools.

UNIT-I: EARLY DEVELOPMENT

Gastrulation movements: role of egg cortex - cell surface in morphogenesis. Cell adhesion and cell communication. Chemotactic induced aggregation - aggregation in sponges. Experimental analyses in the early development of Echinoderms, Amphibians and birds.

UNIT-II: ORGANOGENESIS

Formation of organ rudiments, differentiation and development of heart and kidney in different mammals. Organiser , Inductive tissue interactions in developments.

UNIT-III: GENES AND DEVELOPMENT

Nuclear transplantation. Cellular differentiation and protein synthesis. Differential activation. Developmental genetic defects. Role of cell death in development.

UNIT-IV: REGULATION OF DEVELOPMENT

Metamorphosis - morphological and biochemical changes during amphibian metamorphosis. Hormonal control of metamorphosis in amphibians - Neuro endocrine control of insect metamorphosis - Biochemistry and mechanism of action of hormones during metamorphosis

UNIT-V: EMBRYONIC NUTRITION

Nutritional requirements of Embryo- modes of embryonic nutrition –Food reserve and embryonic nutrition- embryonic nutrition from mother –physiology of placenta

REFERENCE BOOKS

1. Balinsky, B.I.1981 An Introduction to Embryology. W.B Saunders Co., Philadelphia.
2. Karp,G. and Berrill,N.J.1981. Development. McGraw Hill, New York.
3. Saunders, J.W.1982. Developmental Biology. MacMillan Co., London.
4. Nagabhushanam,R. and Sarojini,R.2002 Invertebrate Embryology. Oxford and IBA Publishing Co.
5. Tyagi,Rajiv and Shukla,A.N.2002. Development of Fishes. Jaya Publishing House, New Delhi.
6. Browder, W.1984.Developmental Physiology. Saunders College Publishing, Rinchert and Winston.
7. Gilbert, S.F.2003.Developmental Biology. Sinamer Associates Inc. Saunderland, Massachusetts, U.S.A.
8. Oppenheimer, S.B.1980.Introduction to Embryonic Development. Allyn and Bacon,Inc. U.S.A.
9. Mitra, S.1994. Genetics, A Blueprint of Life. Tata McGraw - Hill Publishing Company Ltd., New Delhi.

PAPER-9

IMMUNOLOGY

To Understand the Structural and functional basis of immunoglobulins, the mechanism, mediators, detection and application of antigen-reaction in the immune system.

UNIT-I: IMMUNE BIOLOGY

The cellular constituents of the lympho reticular system-phagocytic cells-poly morpho nuclear neutophils, mono nuclear phagocytes eosinophils and lymphocytes

UNIT-II: IMMUNOGLOBULINS

Immunoglobulins-structure, isotypes and biological function. Antigenic determinant on immunoglobulin-isotype, allotype and idio type. Immunoglobulin superfamily, monoclonal and polyconal antibodies. organization and expression of immunoglobulin genes. Synthesis of immunoglobulin and disorders of immunoglobulin synthesis.

UNIT-III: DETECTION AND APPLICATION OF ANITGEN ANTIBODY REACTION

Pracipitation - agglutination - complement fixation - immunoassay using labelled reagents

UNIT-IV: MECHANISM OR IMMUNE SYSTEM

Antigen-antibody interaction and immunodiagnostics. MHC- Restriction organization and inheritance of MHC, Antigen processing and presentation.

UNIT-V: MEDIATORS OF IMMUNE SYSTEM

B-cell Receptors, T-cell receptors, cytokine, adhesion molecules, complements , hypersensitivity reaction , transplantation immunology .

REFERENCE BOOKS

1. Roitt,I.M.1994. Essential Immunology. Blackwell Scientific, Oxford.
2. Richard A.Goldsby, Thomas T.Kindt and Barbara A. Osborne. 2000. Kuby Immunology.Freeman and Co., New York.
3. Stites,D.P.,Terr,A.I. and Parsloio,T.G. 1997.Medical Immunology. Prentice Hall, New Jersey.
4. Janeway,C.A and Travers,P. 1997.Immunobiology.Current Biology Ltd., London.
5. Paul,W.E.M.1989. Fundamentals of Immunobiology. Raven Press, New York.
6. Srivastava,R.,Ram,B.P. and Tyle,P.1991. Molecular Mechanism of Immune Regulation. VCH Publishers, New York.
7. Champion,M.D. and Cooke,A.1987.Advanced Immunology. J.B.Lippincott Ltd., Philadelphia.
8. Kannan,I.2007. Immunology. MJP Publishers, Chennai.

ELECTIVE

PAPER-3

(to choose either A or B)

A. FISHERIES SCIENCE

OBJECTIVES

The aim of the paper is to understand the morphology, classification and identification of fishes and the fisheries and fishery resources of India. Moreover information about the biology of the fishes goes a long way in managing the fishery resources and their sustainable utilization. As fishes constitute perishable commodity, preservation and processing are also quite essential.

UNIT-I: BIOLOGY OF FISHES AND CLASSIFICATION

General morphology and outline classification of fishes - major groups of fishes and their characteristics - morphometric and meristic characters of elasmobranchs and teleost fishes.

Basic anatomy of fish - digestive, circulatory, respiratory, nervous and reproductive systems.

Food and feeding habits, maturity, fecundity, spawning and survival of Indian fishes.

UNIT-II: GROWTH AND POPULATION DYNAMICS

Length-weight relationship and factors influencing growth condition, age determination

Theory of fishing, unit stock, recruitment, growth, mortality, migration, fish tagging and marking.

UNIT-III: INLAND CAPTURE AND MARINE CAPTURE FISHERIES OF INDIA

Fishery zones and type of fisheries in India.

Riverine, Estuarine, Coldwater, Reservoir and Pond fisheries.

Present status and scope of inland capture fisheries - their fishery characteristics, distribution and importance.

Present status and scope of marine capture fisheries - crustaceans (prawn/shrimp, lobster and crabs), Molluscs (clam, cockle, mussel, oyster, cephalopods) and fishes - their fishery characteristics, distribution and importance.

UNIT-IV: FISHERY SURVEY METHODS

Methods of surveying the fishery resources - acoustic method, aerial method, survey of fish eggs and larvae, analyzing population features - growth mortality selection.

UNIT-V: CRAFTS AND GEARS

Principal methods of exploitation of fishes - indigenous and modern gears and crafts.

Principal methods of fish preservation and processing in India

Types of spoilage, causative factors - marketing and economics.

REFERENCE BOOKS

1. Day, F. 1981. Fishes of India, Vol.I and Vol. II. William Sawson & Sons Ltd., London.
2. Jhingran, C.G. 1981. Fish and Fisheries of India. Hindustan Publishing Co., India.
3. Maheswari, K. 1993. Common fish diseases and their control. Institute of Fisheries Education, Powakads, M.P.
4. Santhanam, R. 1980. Fisheries Science. Daya Publishing House, New Delhi.
5. Yadav, B.N. 1997. Fish and Fisheries. Daya Publishing House, New Delhi
6. FAO Volumes for fish identification.
7. Bal D.V. and Rao, K.V. 1990. Marine Fisheries of India. Tata McGraw Hill Publishing Co. Ltd., New York.
8. Biswas, K. P. 1996. A Text Book of Fish, Fisheries and Technology. Narendra Publishing House, Delhi.
9. Srivastava, C.B.L. 1999. Fish Biology. Narendra Publishing House, Delhi.

PAPER-3

B. BIOPHYSICS

OBJECTIVES

To imbibe the principles of physics involved in the structure of biomolecules, energy transformation in living systems and the modern physical instruments for the exploration of knowledge in biology

UNIT-I: STRUCTURE OF BIOMOLECULES

Electron configuration of an atom. Bonds - Covalent bond, Hydrogen bond, Disulphide bond, Peptide bonds. Forces between Molecules - Electrostatic force, Van der Waal's forces - hydrophobic and hydrophilic - biological importance.

UNIT-II: THERMODYNAMICS AND BIOLOGICAL OXIDATION

Laws of Thermodynamics - Concept of free energy and entropy - Exergonic and Endergonic reactions. Rate of reactions - Effect of sunlight and temperature on reactions. Energy of Activation - Arrhenius expression.

Diffusion - Fick's Laws, constant laws. Osmotic coefficient - Gibbs Donnan equilibrium.

Oxidation and reduction reactions - Redox potentials in biological system, High energy phosphate group. Bioluminescence.

UNIT-III: MICROSCOPY

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

UNIT-IV: PHOTO BIOPHYSICS

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

Delayed effects of radiation - Ageing, reduction in life span, cancer.

Radioactive isotopes - measurements - GM tubes, Liquid Scintillation counters. Autoradiography. Effects of radiation.

UNIT-V: BIOPHYSICAL PRINCIPLES APPLIED TO PHYSIOLOGY

Biophysical aspects of vision, hearing, nerve conduction and muscle contraction.

REFERENCE BOOKS

1. Bose, S. 1982. Elementary Biophysics. Jyoth Books,
2. Bums, D.M. and MacDonald, S.G.G. 1979. Physics for Biology and Premedical students. ELBS and Addison - Wesley Publishers Ltd., London.
3. Casey, E.J. 1962. Biophysics concepts and Mechanism. Affiliated East-West Press Pvt. Ltd., New Delhi.
4. Das, D. 1982. Biophysics and Biophysical Chemistry. Academic Publishers. New Delhi.
5. Epstein, H.T. 1963. Elementary Biophysics, selected topics. Addison - Wesley Publishing Company Inc. London.
6. Palanichamy, S and Shanmugavelu, M. 1991. Principles of Biophysics. Palani Paramount, Publication; Tamil Nadu.
7. Roy, R.N. 1996. A Text Book of Biophysics, New Central Book Agency Ltd, Calcutta.

SEMESTER IV

PAPER-10

RESEARCH METHODOLOGY

OBJECTIVES

The main objectives of this paper are to expose students to state of the art instrumentation, to introduce them to the principles and methods of various instruments used in biology and to prepare them to use these techniques in their own research. The course is a combination of lectures and demonstrations on basic principles and applications of the Spectrophotometers, Chromatographs and Electrophoresis system. With the aid of computer system and software, the students are also given hands on training in bioinformatics. Also, this paper is to acquire knowledge on the preparation of research manuscripts etc.

UNIT-I: BIOSTATISTICS & BIOINFORMATICS

Collection and analysis of biological data - mean, median, mode Standard deviation, Standard error, Coefficient of variation, Student 't' test, Skewness, Kurtosis, Chi - square, Correlation, Regression and ANOVA.

Internet - Worldwide Web - Search Engines - their functions. Boolean searching - file formats.

Biological data bases - sequence and structure - date retrieval - searching source data bases - sequence similarity searches - FASTA and BLAST, clustral and phylip.

UNIT-II: SPECTROSCOPY

Absorption and Emission principles - Principle and application of UV-visible, Spectroflurometer, flame photometer, Atomic Absorption and emission spectrophotometers, NMR and Mass spectrometer in Biology.

UNIT-III: CHROMATOGRAPHY & ELECTROPHORESIS

Principles and Application of Chromatography: Paper, Thin layer, column, Ion Exchange, Gel filtration, Gas Liquid, HPLC and affinity.

Principles and Application of Electrophoresis: Paper, Agarose, PAGE, SDS PAGE and Iso-Electric focusing.

UNIT-IV: MICROSCOPY

Principles, construction and biological uses of phase contrast, fluorescence, scanning and transmission electron microscopes.

UNIT-V: PREPARATION OF MANUSCRIPTS

Preparation of index cards-Reference collection - preparation of thesis - preparation of Scientific paper for publication in a Journal. Internet and e-journals. Computer aided techniques for data analysis, data presentation and slide preparation.

REFERENCE BOOKS

1. Anderson, Durston and Polle.1970. Thesis and Assignment writing. Wiley Eastern Ltd., New Delhi.
2. Comir and Peter Wood Ford.1979. Writing scientific papers in English. Pitman Medical Publishing Co., London.
3. Ewing, G.W. 1988. Instrumental methods of chemical analysis, McGraw Hill Book Company.
4. Daniel, M. 1989. Basic biophysics for biologists. Agro-Botanical Publishers, India.
5. Skoog, A., Douglas, J. and Leary, J.J. 1992. Principles of Instrumental Analysis. Sanders Golden Sunberst Series, Philadelphia.
6. Day, R.A. 1994. How to write and publish a scientific paper. Cambridge University Press, London.
7. Palanichamy, S. and M. Shanmugavelu.1997. Research methods in biological sciences. Palani Paramount Publications, Tamil Nadu, India.
8. Wilson and Walker. 2000. Practical biochemistry - principles and techniques. Cambridge University Press.
9. Milton, J.S. 1992. Statistical methods in Biological and Health Sciences. McGraw Hill Inc., New York.
10. Gupta, S.P. 1988. An easy approach to statistics. Chand & Co., New Delhi.

11. Gurumani, N. 2006. Research Methodology for Biological Sciences. MJP Publishers, Chennai.
12. Veerakumari, L. 2006. Bioinstrumentation. MJP Publishers, Chennai.

PROJECT/DISSERTATION WITH VIVA VOCE

(For those choosing this Paper, the Main Practical 4: is compulsory)

Objectives

To promote original thinking, insemination of knowledge, modulation and innovation of thought, as an exercise, in order to transport the young minds to the expanding horizon of their chosen area of knowledge and transform them into knowledge generators.

Project / Dissertation

75 Marks

Viva voce

25 Marks

PAPER-11

EVOLUTION

(This Core Paper is compulsory for those not choosing Project / Dissertation with *Viva Voce*)

OBJECTIVES

To comprehend the scientific concepts of animal evolution through an understanding of its evidences, its mechanics, process and products.

UNIT-I: EVIDENCES

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

Biogeography, Plate tectonics and continental drift - Evidences from systematic, evolutionary taxonomy - Evidences from paleontology - evolutionary trends in fossils, types of fossils. Process of fossilization - Evolution of homeotherms - Evidences from genetics - gene and chromosome homology, hybridization, universality of the genetic code.

UNIT-II: MECHANISM OF EVOLUTION

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

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

Natural selection - In nature and laboratory - Creative aspects of natural selection - modern understanding of selection, stabilizing and diversifying and directional selection.

Adaptation - Nature and types of adaptation - Adaptive trends - Quantifying adaptation - Batesian and Mullerian mimicry and evolution.

Polymorphism - Transient and stable - Maintenance of polymorphism.

UNIT-III: GENETIC BASIS OF EVOLUTION AND SPECIATION

Mutations and their role in evolution - the neutralist hypothesis - population size and evolution - the role of genetic drift - hybridization and evolution - The role of polyploidy, isolating mechanisms - premating, post mating - problems of the origin of isolating mechanism.

Structure of species - Clones, peripheral population isolates,

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

UNIT-IV: ORIGIN OF HIGHER TAXA - I

Definition Simpson's definition of the higher taxa - Evidence for the origin of higher taxa from living forms - Evidences for the origin of higher taxa from the fossil record.

Mechanisms in the origin of higher taxa Polyploidy - Deviation, Allometry - Caenogenesis followed by neoteny.

UNIT-V: ORIGIN OF HIGHER TAXA - II

Modes of origin of higher taxa (1) Mosaic mode. Connecting links between vertebrate classes, (2) Quantum evolution. Simpson's adaptive grid.

Rate of evolution Horotely, Bradytely and Tachytely. Gradualism versus punctuated equilibrium - Extinction and its causes.

HUMAN EVOLUTION

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

REFERENCE BOOKS

1. P.A.Moody. 1978. Introduction to Evolution. Harper International.
2. G.L. Stebbine. 1979. Process of Organic Evolution. Prentice Hall India, New Delhi.
3. E.O.Dodson. 1990. Evolution. Reinhold, New York.
4. D.S.Bendall. 1983. Evolution from molecules to man. Cambridge University Press.UK
5. M. Grene. 1983. Dimensions of Darwinism. Cambridge University Press. UK
6. E.C.Minkoff. 1984. Evolutionary Biology. Addison - Wesley. London.
7. Montagu. 1980. Sociobiology examined. Oxford University press.
8. Abraham, J.C.B. 1987. Evolution: A Laboratory Manual. Macmillan India Ltd., Madras.

PAPER-12

ENTOMOLOGY

OBJECTIVES

To catch up with the tremendous strides of expansion of knowledge in Entomology, this paper is meant to comprehend the classification of insects, economic importance of Entomology with special reference to beneficial insects, sericulture, insect pests and their control, vector borne diseases etc.

UNIT-I: CLASSIFICATION

Classification of insects upto order with examples.

UNIT-II: BENEFICIAL INSECTS

Biology of honey bees, lac insects and their management.

UNIT-III: SERICULTURE

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

UNIT-IV: INSECT PESTS AND THEIR CONTROL

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

Principles and methods of pest suppression: Natural, Cultural, mechanical, physical, chemical, Biological and Integrated pest management.

UNIT-V: INSECTS AS VECTORS

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

REFERENCES BOOKS

1. William S. Romoser and John G. Stoffolano. W. M. 1994. The Science of Entomology C. Brown Publishers, England.
2. Yataro Tazima, Kodarsha .1978. The silkworm. An important laboratory tool. Scientific Book Ltd., Japan.
3. Ananthakrishnan, T.N. 2002. Insect Plant Interactions. Oxford and I.B.H, New Delhi.
4. P.G.Fenemore, Alkaprakash. 1992. Applied Entomology, Wiley Eastern Ltd., Delhi.
5. Nayar, K.K., Ananthakrishnan, T.N. and B.V.David. 1989. General and Applied Entomology. Tata McGraw Hill Publications, New Delhi.
6. Larry P. Pedigo. 1989. Entomology and Pest Mangement. Prentice Hall, New Jersey.
7. Metcalf, C.V. and Flint, W.P. 1979. Destructive and useful insects, their habitats and control. Tata McGraw Hill Publications, New Delhi.
8. Daniel Altman Roberts. 1978. Fundamental of Plant Pest Control. C.R.S. Publishers and Distributors, Delhi,
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10. Richards, O.W. and Davies, R.G. 1997. Imm's General Text Book of Entomology Tenth Edition. Vol I and II. R.I Publications, New Delhi.
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ELECTIVE

PAPER -4

(to Choose either A or B)

A. SERICULTURE

OBJECTIVES

To infuse sound knowledge about the silkworm, their economic importance and diseases and to disseminate Sericulture as a need - based curriculum.

UNIT -I: ECONOMIC IMPORTANCE AND SILKWORM BIOLOGY

Prospects and status - Silk producing species - their distribution - *Bombyx mori* - life cycle - organization of larvae, pupae and moth - structure of the silk gland.

UNIT-II: MORICULTURE

Mulberry - varieties - distribution - methods of cultivation and preparation - Harvest - Transport and preservation of leaves. Feeding and nutrition - specificity of diet - Factors of nutrition - Diet and growth. Pest and diseases.

UNIT-III: SILKWORM REPRODUCTION AND GENETICS

Reproduction - Growth and Development of silkworms - Physiology of molting in different varieties (Uni, bi and multivoltine) - Endocrinology of reproduction and development. Genetics - mutation breeding and development of new strains.

UNIT-IV: PATHOGENIC DISEASES AND PEST

Pathology - Viral, bacterial, fungi and protozoan diseases - control mechanisms. Uzifly menace.

UNIT-V: SILKWORM REARING AND SILK REELING

Rearing operations - Selection and construction of rearing house Incubation - Hatching - brooding, Harvesting etc. Reeling techniques - lacing skinning. Re-reeling etc.

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PAPER -4

B. MICROBIOLOGY

OBJECTIVES

To acquire a basic knowledge of the microbes in general and of the environmental, medical and industrial important microbes in particular in order to have an integrated approach in biology. Also, to know the basics of sterilization and culture methods.

UNIT-I: STRUCTURE AND CLASSIFICATION

Structure and classification of virus, bacteria and fungi.

UNIT-II: STERILIZATION AND CULTURE

Sterilization: Principles - dry heat, moist heat, filtration, Tantilization, pasteurization, Radiation - disinfection.

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

UNIT-III: ENVIRONMENTAL MICROBIOLOGY

Microbial ecology, role of microorganisms in the productivity of ecosystems - Interactions between microorganisms and plants and animal . Microbiology of soil, water and air.

UNIT-IV: MEDICAL MICROBIOLOGY

Pathogenic microbes of bacterial, viral, fungal and protozoan diseases - cure, control and prevention. Antimicrobial chemotherapy - Antibiotics - Source - Classification Mode of action.

UNIT-V: INDUSTRIAL MICROBIOLOGY

Industrial microbiology - Industrial uses of microbes - fermentation products, bioconversions - bioremediation. Products of industrial microbiology - Penicillin, fuel ethanol, vinegar, vitamin B12, citric acid, glutamic acid, protease. Food and Dairy microbiology - Microbes in food - Role of microbes in food production. Dairy and non-dairy products - fermented foods and alcoholic beverages. Pharmaceuticals (antibiotics, vaccines etc.)

REFERENCE BOOKS

1. Tortora, G.J., Funke, R.B. and Case, C.L. 1992. Microbiology - An Introduction. The Benjamin / Cummings Publishing Co., Inc. Sydney.
2. Black, J.G. 1999. Microbiology - Principles and Explorations. John Wiley and Sons Inc. New York.
3. Atlas, R.M. 1995. Principles of Microbiology. Mosby - Year Book Inc.
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MAIN PRACTICAL 3

ANIMAL PHYSIOLOGY, DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

PHYSIOLOGY

1. Estimation of RQ in Fish with reference to Light and temperature.
2. Salt loss and salt gain in fish
3. Estimation of Proteins, Carbohydrates and Lipids in the tissues of Fish
4. Estimation of Blood Urea and Cholesterol.
5. Blood Clotting Time, Bleeding Time, Rouleaux Formation, Preparation of Haemin Crystal.
6. Principle and Application of Sphygmomanometer, Kymograph, Electrophoresis, Haemoglobinometer, ESR.
7. Estimation of Haemoglobin and ESR.

DEVELOPMENTAL BIOLOGY

1. Different stages in development - frog (egg, cleavage, Blastula, Yolk plug stage 24,48,72,96 h Gastrula)
2. Development of chick stage - slide showing C.S.of heart, kidney lens and limb.
3. Slides showing the uterine cycles in a mammal (Rat).
4. Study of slides showing of larval forms: Nauplius, Zoea, Bipinnaria, Leptocephalus.

IMMUNOLOGY

1. Haemagglutination - Quantitative analysis - haemagglutination titration.
2. Preparation of Antigen - RBC - Demonstration.
3. Ouchterlony technique - Demonstration.
4. Immunoelectrophoresis - Demonstration.
5. Slides showing T.S of Spleen, Thymus, lymphnodes and Bones

MAIN PRACTICAL 4

RESEARCH METHODOLOGY, EVOLUTION AND ENTOMOLOGY

RESEARCH METHODOLOGY

1. Problems relating to test of significance (Chi - square test and t - test)
2. Problems relating to correlation, regression and ANOVA.
3. Familiarization of biological and bioinformatics web sites.
4. BLAST search for similar nucleotide sequences.
5. Spectrophotometric estimation of any biological constituent.
6. Electrophoresis - Paper / Agarose gel / PAGE
7. Preparation of index and reference cards.

EVOLUTION (Slides / Specimens / Xerox)

1. Observation of forelimbs and hindlimbs of vertebrates (Frog, Calotes, Bird and Mammal) to study the common pattern of pentadactyl limb and common ancestry of vertebrates.
2. Observation of fossils to study paleontological evidences of evolution.
3. Observation of leaf insects and stick insects in the museum to study adaptation by cryptic colouration and natural selection.
4. Observation of Monarch and Viceroy butterflies to study Batesian mimicry.

ENTOMOLOGY

1. Study of morphology of an insect (local insects to be used).
2. Dissection of digestive, nervous, excretory, reproductive systems of any two insects of different orders.
3. Mounting of different types of mouthparts.
4. a. Field study to collect insect species
b. Identification of at least 10 insects belonging to different orders.
5. a. Field study for various methods of pest management.
b. Field visit to warehouses and Plant protection centres.

ELECTIVE

PRACTICAL-2

(to choose either A or B)

A.SERICULTURE

1. Study of external morphology of silkworm moth, larvae and pupae.
2. Dissections of digestive and nervous systems in *Bombyx mori* larvae.
3. Mounting of Silk glands of Silkworm.
4. Study of silkworm rearing and reeling operations (Field visit)
5. Study of silkworm pathology: viral - bacterial - fungal diseases (Field visit - Slides/Specimens /Xerox)

ELECTIVE

PRACTICAL-2

B. MICROBIOLOGY

1. Microscopic observation and identification of microorganisms in Pond water.
2. Types of bacteriophage, bacteria, fungi and algae from the prepared slides / photographs from the book.
3. Collection and Identification of fungus: Bread mould and Coconut mould.
4. Identification of parasitic protozoans (e.g. Plasmodium, Entamoeba, Trypanosoma, Leishmania donovani)
5. Identification of bacteria - staining methods - Gram positive and Gram negative bacteria.
6. Demonstration of
 - a. Isolation of single colonies streak plate and serial dilution.
 - b. Enumeration of microorganisms spread plate and pour plate methods.
 - c. Preparation techniques of culture medium for bacterial growth
