

# A N D H R A U N I V E R S I T Y



## **M.Sc. DEGREE EXAMINATION IN ZOOLOGY - SYLLABUS (Effective from 2014-2015 Academic year)**

1. Candidates for M. Sc. Zoology Degree examination shall be required : (a) To have passed the qualifying examination of this University as detailed in AUCET (Andhra University Common Entrance Test) regulations or an examination of any other University recognized by the Academic Council as equivalent thereto; and (b) To have undergone subsequently a further course of studies extending over a period of two academic years. As the case may be, in this University, each academic year consisting of two semesters ordinarily consecutive.

2. The course and scope of instruction shall be defined in the syllabus prescribed :

3. (a) The candidate shall be required to take at the end of each semester, an examination as detailed in the scheme of examination. Each paper of the examination shall unless otherwise prescribed be of three hours duration and for a maximum of 100 marks (15 + 85). An external papersetter shall set the question paper. There shall be double valuation. Similarly, there shall be one semester-end examination of 2-3 hours duration in each practical course. Paper-setting and evaluation shall be done jointly by two examiners, one internal and one external. Evaluation of the performance of the

candidates in respect of each paper shall be carried out only by the semester-end examination.

(b) A candidate appearing for the whole examination shall be declared to have passed the examination if he/she obtains not less than 50% of the total marks in all papers including practical and records put together. And, also not less than 40% in each paper/practical at the semester-end and 40% marks for a maximum of 100 marks for each paper. All other candidates shall be deemed to have failed in the examination. Candidates who have completed the first semester course and have earned the necessary attendance and progress certificate shall be permitted to continue the second semester course irrespective of whether they have appeared or not at the first semester examination. Such candidates may be permitted to appear for the examination of the earlier semester with the examination of the later semester simultaneously.

Candidates shall put in attendance at the college for not less than 75% of the total number of working days. Condonation of shortage of attendance may be granted on the recommendation of the Principal of the College concerned provided that no condonation shall be recommended in the case of candidates who have not put in attendance at the college for at least 50% of the total number of working days. If a candidate represents the University officially at games, sports or other officially organized extra curricular activities, it will be deemed that he/she has attended the college on the days he/she is absent for the purpose.

4. The names of the successful candidates at the examination shall be arranged in order in which they are registered for the examination as follows. On the basis of the total marks obtained by the each candidate at the I-IV Semester-end examination put together.

I Class with Distinction : Those who obtain 70% and above I Class

I Class : Those who obtain 60% and above but less than 70%

II Class : Those who obtain 50% and above but less than 60%

Only those candidates who appear and pass examination in all the papers of the four semesters at first appearance are eligible to be placed in the first class with distinction. However, no candidate who has not passed all the papers relating to any semester at the first appearance shall be eligible for any medals, or prizes by the University and to receive certificates of rank, obtained by them in the examination.

### **Marks Schedule for Each Semester**

Semester Duration : 16 weeks (Excluding holidays and time for Semester-end examination)

Theory : Number of periods of theory per paper : 4 – 5 periods per week. Each period of 50 minutes duration.

Practical : Students will be distributed into 4 – 5 batches per practical. Each practical class shall be of 3 periods (3 x 50 minutes) duration/batch.

## Scheme of Examination

Title of the Paper	Marks allocated		
	Mid-Sem.	Sem. End	Total
<b>I Semester</b>			
1. Biosystematics and Taxonomy	15	85	100
2. Quantitative Biology	15	85	100
3. General & Comparative Physiology	15	85	100
4. Molecular Cell Biology	15	85	100
5. Laboratory Course (4 Practical Courses, each for 50 marks)	--	--	200
6. Seminar	--	--	50
<b>II Semester</b>			
7. Population Genetics and Evolution	15	85	100
8. Gamete Biology	15	85	100
9. Tools and Techniques for Biology	15	85	100
10. General and Comparative Endocrinology.	15	85	100
11. Laboratory Courses (4 Practical Courses, each for 50 marks)	--	--	200
12. Viva-voce	--	--	50
<b>III Semester</b>			
13. Comparative Anatomy and Functional organization of Invertebrates and Vertebrates	15	85	100
14. Population Ecology and Animal Behaviour.	15	85	100
15. Immunology and Immuno-Technology.	15	85	100
16. Molecular Biology and Cytogenetics	15	85	100
17. Laboratory Courses (4 Practical Courses, each for 50 marks)	--	--	200
18. Seminar	--	--	50

## IV Semester

19. Aquaculture	15	85	100
20. Medical Parasitology	15	85	100
21. Principles of Biotechnology	15	85	100
22. Cell Physiology and Toxicology	15	85	100
23. Laboratory Course (4 Practical Courses each for 50 marks)	--	--	200
24. Viva-voce	--	--	50

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### Course Structure and Scheme of Examination

- The degree shall be called M.Sc. (Zoology)
- The course shall be based on semester system. The recommended duration is 4 Semesters
- A student shall have to take the suggested courses for the four semesters. Each paper shall carry four to five hours of contact period between teacher and taught per every week for 12 weeks. This amounts to 48 lectures duration of 50 minutes each.
- Admission shall be based on entrance examination
- Laboratory courses/practical shall be chosen from the list suggested for first year or for first two semesters
- Practical examinations shall be conducted at the end of each semester.
- In the present curriculum, it is resolved to award marks while evaluating the student. Each course (theory) shall be evaluated for 100 marks. Practical examination for 50 marks and seminars/Viva-voce for 50 marks

- Total maximum marks for evaluation in all (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>) semesters are 2600 (i.e., 650 marks for each semester). The candidate should obtain a minimum of 50% to qualify for the degree

Paper-setting shall be by external examiner

Evaluation of theory and practical by both external and internal examiners

Seminar evaluation is by a committee or internal examiner

- On the basis of total marks obtained by each candidate at the end of all semester-end examinations put together, they will be awarded

First class with distinction : those who obtain 70% and above

First Class : Those who obtain 60% and above but less than 70%

Second Class : Those who obtain 50% and above but less than 60%

## **SYLLABUS – I SEMESTER**

### **Paper 1: BIOSYSTEMATICS & TAXONOMY**

#### **Unit – I :**

- 1.0. Definition and basic concepts of biosystematics and taxonomy
  - 1.1. Historical resume of systematics
  - 1.2. Importance and applications of biosystematics in biology
  - 1.3. Material basis of biosystematics – different attributes

#### **Unit – II :**

- 2.0. Trends in biosystematics – concepts of different conventional and newer aspects
  - 2.1. Chemotaxonomy
  - 2.2. Cytotaxonomy
  - 2.3. Molecular taxonomy
- 3.0. Molecular perspective on the conservation of diversity
  - 3.1. Diversity and ecosystem process: Theory, achievements and future directions

#### **Unit – III :**

- 4.0. Dimensions of speciation and taxonomy characters
  - 4.1. Dimensions of speciation- types of lineage changes, production of additional lineage
  - 4.2. Mechanisms of speciation in panmictic and apomictic species
  - 4.3. Species concepts – species category, different species concepts: sub-species and other infra specific categories
  - 4.4. Theories of biological classification, hierarchy of categories
  - 4.5. Taxonomic characters – different kinds, origin of reproductive isolation – biological mechanism of genetic incompatibility

#### **Unit – IV :**

- 5.0. Procedure keys in taxonomy

- 5.1. Taxonomic procedures – taxonomic collections, preservation, curation process of identification
- 5.2. Taxonomic keys – different kinds of taxonomic keys, their merits and demerits
- 5.3. Systematic publications – different kinds of publications
- 5.4. Process of typification and different Zoological types
- 5.5. International Code of Zoological Nomenclature (ICZN) – its operative principles, interpretation and application of important rules, Zoological nomenclature, formation of scientific names of various taxa

**Practical :**

1. A practical approach towards Biosystematics and taxonomy
2. Examples representing the different taxa in the order of evolution
3. Molecular perspective of diversity – Identification of species by molecular separation of proteins by examples
4. Diversity and similarity index.
5. Methods of collection, preservation and identification of plankton and representative forms of terrestrial and aquatic fauna

**Suggested Reading Material :**

1. M. Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise. Molecular Markers. Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson. Biodiversity, Academic Press, Washington.
4. G.G. Simpson. Principle of Animal Taxonomy. Oxford IBH Pub. Co.
5. E. Mayer. Elements of Taxonomy.
6. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
7. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.



## **MSc – Zoology, I<sup>st</sup> Semester**

### **Paper 2 : Quantitative Biology**

#### **Unit – I: Biostatistics**

1. Introduction – Scope and application of statistics in Biology
2. Sampling – Characteristics, advantages and methods of sampling and sampling errors
3. Frequency distribution : Preparation of ordered, discrete and continuous tables
4. Diagrammatic presentation of data : Data presentation by diagrams, graphs and curves
5. Skewness and Kurtosis

#### **Unit – II:**

6. Measures of central tendency : Mean, median and mode
7. Measures of dispersion : Standard deviation, variance and coefficient of variance
8. Analysis of Variance
9. Correlation and regression

#### **Unit – III:**

10. Probability : Measurement, terminology and laws
11. Probability distributions : Binomial, Poisson and normal distributions
12. Tests of significance : Chi-square test, t-test

#### **Unit – IV:**

13. Concepts and dynamics of ecosystem – components, energy flow models
14. Ecosystem Modeling : Types, properties, concepts – approaches
15. Cycling of nutrients in an ecosystem – Concept of eutrophication.

### **Practical:**

1. Sampling – Lottery method and Random digits
2. Frequency distribution
3. Graphical presentation of the data
4. Measures of Central Tendency – Mean, median and mode
5. Measures of Dispersion – S.D. & C.V. (Standard deviation and Coefficient of variation)
6. Probability
7. Coefficient of Correlation
8. Ecological modeling – Case study.

### **Suggested Reading Material:**

1. Gupta and Kumar: Statistics.
2. W.W. Daniel: Biostatistics – A foundation for analysis in the Health Sciences.
3. J.Zar: Biostatistics.
4. Sokal, R.R. & F.J. Rohlf. Biometry. Freeman, San Francisco.
5. Snedecor, G.W. and W.G. Cochran. Statistical methods for environmental biologists. John Wiley & sons. New York.
6. Murray, J.D. Mathematical Biology. Springer – Verlag, Berlin.
7. Pielou, E.C. The Interpretation of Ecological data. A Primer on Classification and Ordination.
8. Eugene P. Odum. Fundamentals of Ecology.
9. Sharma P.N. Ecology and Environment.

## **Paper 3: GENERAL AND COMPARATIVE PHYSIOLOGY**

### **Unit – I :**

- 1.0. Muscle : Historical background
  - 1.1. Types of muscles and classification
  - 1.2. Light and Electron microscopic structure of skeletal muscle
  - 1.3. Molecular basis of muscle contraction, Sliding filament theory
  - 1.4. Energetics and thermal aspects of muscle contractions
  - 1.5. Twitch, Summation, Tetanus and Fatigue
- 2.0. Nerve : Structure of the nerve, Excitability, conductivity, Refractory period, summation, Chronoxie and Rheobase, All or None principle
  - 2.1. Nerve Impulse, Ionic basis of resting and action potentials
  - 2.2. Synaptic transmission, Neurotransmitters

### **Unit – II :**

- 3.0. Blood : Structure and properties of Blood
  - 3.1. Blood cells and their origin, haemopoises, hemoglobin, functions of erythrocytes and leucocytes
  - 3.2. Blood coagulation – Factors affecting coagulation
- 4.0. Defense mechanism :
  - 4.1. Reticulo Endothelial system : Macro phages, Lymphocytes
  - 4.2. Immunoglobulins, origin, properties and functions
  - 4.3. Humoral Immunity and Cell- Mediated Immunity
  - 4.4. Primary and secondary immune mechanisms
  - 4.5. Blood groups and tissue antigens

### **Unit – III :**

- 5.0. Physiological adaptation of animals to different environments
  - 5.1. Marine environment
  - 5.2. Shores and Estuaries
  - 5.3. Freshwater environment

- 5.4. Extreme aquatic environment
- 5.5. Terrestrial life
- 5.6. Extreme terrestrial environment
- 5.7. Parasitic habitats

#### 6.0. Stress Physiology

- 6.1. Basic concept of environmental stress and strain, concepts of elastic and plastic strain; stress resistance, stress avoidance and stress tolerance
- 6.2. Adaptation, Acclimation and Acclimatization

### **Unit – IV :**

#### 7.0. Concept of homeostasis and homeostatic mechanisms of the body

- 7.1. Thermoregulation, Exothermic and Endothermic organisms
- 7.2. Endothermy and physiological mechanism of body temperature regulation

#### 8.0. Physiological adaptation to osmotic and ionic stress; mechanism of cell volume regulation

- 8.1. Osmoregulation in aqueous and terrestrial environments
- 8.2. Physiological response to oxygen deficient stress
- 8.3. Physiological response to body exercise
- 8.4. Meditation, Yoga and their effects

### **Practical :**

1. Oxygen consumption Vs. temperature
2. Estimation of Urea, Ammonia, etc.
3. Calculation of  $Q_{10}$  values
4. Determination of digestive enzymes
5. *Trichiurus* laterline sense organs
6. Demonstration of chromatophore
7. Osmotic regulation – Earthworm experiments

**Suggested Reading Material :**

1. C.L. Prosser, Comparative Animal Physiology. W.B. Saunders & Company
2. R. Eckert. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman & Company
3. Hoar, W.S. General and comparative Animal Physiology. Prentice Hall of India.
4. Schiemdt Nielsen. Animal Physiology. Adaptation and Environment, Cambridge.
5. Strand, F.L. Physiology : A regulatory systems approach. Macmillan Publishing Co., New York.
6. Prosser, C.L., environmental and Metabolic Animal Physiology. Wiley-Liss Inc., New York.

## **Paper 4: MOLECULAR CELL BIOLOGY**

### **Unit – I :**

- 1.0. Introduction : Experimental system in Cell Biology
- 2.0. Biomembranes
  - 2.1. Molecular composition and arrangement, functional consequences
  - 2.2. Transport across cell membrane: diffusion, active transport and pumps, uniports, symports and antiports
  - 2.3. Membrane potential
  - 2.4. Co-transport by symporters or antiports
  - 2.5. Transport across epithelia: Transport of macromolecules

### **Unit – II :**

- 3.0. Cytoskeleton
  - 3.1. Microfilaments and microtubules – structure and dynamics
  - 3.2. Microtubules and mitosis
  - 3.3. Cilia and flagella
  - 3.4. Cell movements – intracellular transport, role and kinesin and dynein, signal transduction mechanisms

### **Unit – III :**

- 5.0. Cell-Cell Signaling
  - 5.1. Cell surface receptors
  - 5.2. Second messenger system
  - 5.3. MAP kinase pathways
  - 5.4. Apoptosis: Definition, mechanism and significance
- 6.0. Cell-Cell adhesion and communication
  - 6.1.  $\text{Ca}^{++}$  dependent homophilic cell-cell adhesion
  - 6.2.  $\text{Ca}^{++}$  independent homophilic adhesion
  - 6.3. Gap junctions and connections
  - 6.4. Integrins
  - 6.5. Collagen

## **Unit – IV :**

### 7.0. Cell cycle

- 7.1. Cyclins and cyclin dependent kinases
- 7.2. Regulation of CDK-cyclin activity

### 8.0. Genome organization

- 8.1. Hierarchy in organization
- 8.2. Chromosomal organization of genes and non-coding DNA
- 8.3. Mobile DNA
- 8.4. Morphological and functional elements of eukaryotic chromosomes
- 9.0. Intracellular protein traffic
- 9.1. Protein synthesis on free and bound polysomes
- 9.2. Uptake into ER
- 9.3. Membrane proteins, Golgi sorting, post-translational modifications
- 9.4. Biogenesis of mitochondria and nuclei
- 9.5. Trafficking mechanisms

## **Practical :**

1. Light microscopic examination of tissues
2. Preparation of different cell – types Hepatic parenchymal cells, adipocytes, macrophages, neuronal cells, epithelial cells
3. Stages of Mitosis and Meiosis
4. Squash preparation
5. Sub-cellular fractionation – separation of macromolecules

## **Suggested Reading Material :**

1. Molecular Cell Biology, J. Darnell. H. Lodish and D. Baltimore, Scientific American Book INC, USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson Garland Publishing INC, New York.

## II SEMESTER

### Paper 7: POPULATION GENETICS AND EVOLUTION

#### Unit – I :

1. Introduction to Evolutionary Theory, Darwin and the Theory of Evolution, Natural Selection, The Modern Synthesis, Evolution of populations
2. Hardy -Weinberg law of genetic equilibrium and estimating allele frequencies, Assumptions and Testing Hardy-Weinberg principle, An introduction to Bayesian inference, Factors affecting human diseases frequency

#### Unit – II :

- 3.0. Quantifying genetic variability
  - 3.1. Genetic structure of natural populations
  - 3.2. Phenotypic variation
- 4.0. Genetics of quantitative traits in populations
  - 4.1. Analysis of quantitative traits
  - 4.2. Quantitative traits and natural selection
  - 4.3. Estimation or heritability
  - 4.4. Genotype – environment interactions
  - 4.5. Inbreeding, depression and Heterosis

#### Unit – III :

- 5.0. Genetics of speciation
  - 5.1. Phylogenetic and biological concept of species
  - 5.2. Patterns and mechanisms of reproductive isolation
  - 5.3. Models of speciation (Allopatric, Sympatric, Parapatric)
- 6.0. Molecular evolution
  - 6.1. Gene evolution
  - 6.2. Evolution of gene families, Molecular drive



## **Unit – IV :**

### 7.0. Origin of higher categories

- 7.1. Phylogenetic gradualism and punctuated equilibrium
- 7.2. Micro- and macro-evolution

### 8.0. Molecular Phylogenetics

- 8.1. How to construct Phylogenetic trees?
- 8.2. Immunological techniques, Restriction Enzyme sites
- 8.3. Amino acid phylogeny-DNA-DNA hybridizations, Nucleotide sequence comparisons and homologies

## **Practical :**

1. Population genetics : Calculating gene frequencies and genotype frequencies for Autosomal dominant traits, Autosomal recessive traits. Using Binomial distribution
2. Quantitative Genetics : Mean, Standard Deviation, Chi-Square & Variance
3. Problems on related topics
4. Multifactor inheritance

## **Suggested Reading Material :**

1. Dobzhansky, Th. Genetics and origin of Species. Colombia University Press
2. Dobzhansky, Th., F.J. Ayala. G.L. Stebbens and J.M. Valentine. Evolution , Surjeet Publication, Delhi.
3. Futuyama, D.J. Evolutionary Biology. Suinuaer Associates, INS Publishers, Dunderland
4. Hartl, D.L. A Primer of population genetics. Sinauer Associates, INC, Massachusetts
5. Jha, A.P. Genes and Evolution, John Publication, New Delhi
6. King, M. Species Evolution – the role of chromosomal change. The Cambridge University Press, Cambridge.
7. Merrel, D.J. Evolution and genetics. Oxford University Press, New York
8. Strikberger, M.W. Evolution. Jones and Bartett Publishers, Boston, London.

## Paper 8: GAMETE BIOLOGY

### Unit – I :

- 1.0. Heterogamy in eukaryotes
- 2.0. Comparative account of differentiation of gonads in a mammal and an invertebrate
- 3.0. Spermatogenesis
  - 3.1. Morphological basis in Rodents
  - 3.2. Morphological basis in any invertebrates
- 4.0. Biochemistry of semen
  - 4.1. Semen composition and formation
  - 4.2. Assessment of sperm functions

### Unit – II :

- 5.0. Ovarian follicular growth and differentiation
  - 5.1. Morphology
  - 5.2. Endocrinology
  - 5.3. Molecular Biology
  - 5.4. Oogenesis and Vitellogenesis
  - 5.5. Ovulation and ovum transport in mammals
- 6.0. Fertilization
  - 6.1. Pre-fertilization
  - 6.2. Biochemistry of fertilization
  - 6.3. Post-fertilization
- 7.0. Collection and cryopreservation of gametes and embryos

### Unit – III :

- 8.0. Multiple ovulation and embryo transfer technology (MOETT)
  - 8.1. *In vitro* oocyte maturation
  - 8.2. Superovulation
  - 8.3. *In vitro* fertilization

9.0. Transgenic animals and knock-outs

- 9.1. Production
- 9.2. Applications
- 9.3. Embryonic stem cells

**Unit – IV :**

10.0. Assisted reproduction technologies

- 10.1. Embryo sexing and cloning
- 10.2. Screening for genetic disorders
- 10.3. ICSI, GIFT etc.
- 10.4. Cloning of animals by nuclear transfer

11.0. Teratological effects of Xenobiotics

12.0. Immuno contraception

- 12.1. Gamete specific antigens
- 12.2. Surgical methods
- 12.3. Hormonal methods
- 12.4. Physical methods
- 12.5. IUCD

**Practical :**

1. Types of eggs
2. Cleavage, Blastulation, Gastrulation, Frog/Amphioxus/Chick
3. Testis Section Human  
Ovary Section Human
4. Mounting spermatozoa – Grasshopper/Frog/Chick/Rat
5. Demonstration class : Pregnancy test using commercial kit

**Suggested Reading Material :**

1. Austen, C.R. and Short, R.V. Reproduction in animals
2. Schatten and Schatten. Molecular biology of fertilization
3. F.T. Longo. Fertilization, Chapman & Hall
4. R.G. Edwards. Human Reproduction

## **Paper 9: TOOLS AND TECHNIQUES FOR BIOLOGY**

### **Unit – I :**

#### 1.0. Assay

- 1.1. Definition
- 1.2. Chemical assay
- 1.3. Biological assay
- 1.4. Computer aided techniques.

#### 2.0. Principles and uses of analytical instruments

- 2.1. pH meter
- 2.2. Spectrophotometer
- 2.3. Ultra-centrifuge
- 2.4. Radio activity counter
- 2.5. N.M.R. Spectrophotometer

### **Unit – II :**

#### 3.0. Microscopy

- 3.1. Principles of light, dark field, phase contrast, fluorescence, transmission electron, scanning EM

#### 4.0. Micro-biological Techniques

- 4.1. Media preparation & sterilization
- 4.2. Inoculation & Growth monitoring
- 4.3. Use of fermentors
- 4.4. Biochemical Mutants & their uses
- 4.5. Microbial assays

### **Unit – III :**

#### 5.0. Cell culture techniques

- 5.1. Laboratory facilities
- 5.2. Substrates on which cells grow
- 5.3. Treatment of substrate surfaces
- 5.4. Feeder layers
- 5.5. Culture Media

## **Unit – IV :**

### 6.0. Separation Techniques in biology

- 6.1. Molecular separation by chromatography and electrophoresis
- 6.2. Organelle separation by centrifugation, density gradient separation

### 7.0. Radio Isotopes

- 7.1. Sample preparation for radio active counting
- 7.2. G-M-Counter
- 7.3. Auto-radiography

## **Practical :**

1. Spectrophotometer – Estimation of biomolecules
2. Centrifugation – Demonstration and working
3. Separation Techniques - Paper chromatography
4. Electrophoresis – Demonstration and usage
5. Demonstration and working of :
  - a) Atomic Absorption Spectrophotometer
  - b) High Pressure Liquid Chromatography
  - c) ELISA Reader, d) Liquid Scintillation counter
6. PH Meter – Preparation of Phosphate buffer
7. Microscope –
  - a) Demonstration of oil immersion – WBC & RBC
  - b) Preparation of tissue for SEM & TEM procedure
8. Cell culture -
  - a) Preparation of media
  - b) Inoculation
9. Biological application of computer techniques.

## **Suggested Reading Material :**

1. Animal cell culture – A practical approach, Ed. John R.W. Masters, IRI Press
2. Introduction to Instrumental Analysis. Robert Braun. McGraw Hill International Editions
3. A Biologist Guide to Principles and Techniques of Practical Biochemistry. K. Wilson & K.H. Goulding, ELBS Edn.

## **Paper 10: GENERAL AND COMPARATIVE ENDOCRINOLOGY**

### **Unit – I :**

- 1.0 Aims and scope of endocrinology
  - 1.1. Hormones as messengers
  - 1.2. Hormones and eukaryotic metabolic regulation
  - 1.3. Classification of hormones
  - 1.4. Discovery of hormones
  - 1.5. Experimental methods of hormone research
- 2.0. Phylogeny of endocrine glands (Pituitary, pancreas, adrenals, thyroid)
- 3.0. Ontogeny of endocrine glands

### **Unit – II :**

- 4.0. Concept of Neurosecretion and Neuro-endocrine system in invertebrate groups
  - 4.1. Neuro-endocrine mechanisms of moulting and growth in crustaceans
  - 4.2. Hormonal control of reproduction and moulting in insects
  - 4.3. Hormonal control of reproduction in Mollusca and Echinodermata

### **Unit – III :**

- 5.0. General principles of hormone action
  - 5.1. Concept of hormone receptors
  - 5.2. Nature of hormone action, Steroid and protein hormones
  - 5.3. 1<sup>st</sup> messenger, 2<sup>nd</sup> messenger concept
  - 5.4. Hormonal control of homeostasis
  - 5.5. Hormonal regulation of carbohydrate metabolism
  - 5.6. Hormonal regulation of nitrogen and lipid metabolism

### **Unit – IV :**

- 6.0. Hormone structure and Biosynthesis of hormones

- 6.1. Chemical nature and gross features of hormones
- 6.2. Hormone levels in circulation and other body fluids
- 6.3. Biosynthesis of steroid hormones *de novo*
  
- 6.4. Biosynthesis and amino acid derives small size hormones (eg: T4 Epinephrine, etc.)
  
- 6.5. Biosynthesis and simple peptide hormones, Pre- and Pro-hormones
  
- 6.6. Co-translational and post-translational modifications of hormone structure

Hormones and behaviour

Hormonal control of growth and reproduction in vertebrates

Neuro-endocrine integration in vertebrate

### **Practical :**

1. Cockroach – *Carpura cardiaca* & *Carpura allata*
2. Prawn – Nervous system, Y-organ and androgenic organ, ovaries
3. Crab – Nervous system, Y-organ & androgenic organ, ovaries
4. Sepia – Optic glands
  
5. Fish – Endocrine glands: Pituitary, Pancreas, adrenals, testis and ovaries

### **Suggested Books :**

1. E.J.W. Barrington, General and Comparative Endocrinology, Oxford, Clarendon Press.
  
2. P.J. Bentley, Comparative Vertebrate Endocrinology, Cambridge University Press.
  
3. R.H. Williams, Textbook of Endocrinology, W.B. Saunders
  
4. C.R. Martin, Endocrine Physiology, Oxford University Press
  
5. A Gorbman et. al. Comparative endocrinology, John Wiley & Sons.

## M Sc. Zoology, III SEMESTER

### **Paper 13: COMPARATIVE ANATOMY AND FUNCTIONAL ORGANIZATION OF INVERTEBRATES AND VERTEBRATES**

#### **Unit – I :**

##### 1.0. Origin of coelom

1.1. Acoelomates, Pseudocoelomates

1.2. Coelomates : Protostomia and Deuterostomia

##### 2.0. Excretion

a. Organs of excretion: Coelom, Coelomoducts, Nephridia and Malpighian tubules.

b. Mechanism of excretion.

#### **Unit – II :**

##### 3.0. Invertebrate larvae

3.1. Larval forms of free living invertebrates

3.2. Larval forms of parasites

3.3. Strategies and Evolutionary significance of larval forms

##### 4.0. Minor Phyla.

4.1. Concept & significance

4.2. Organization and general characters

#### **Unit – III :**

##### 5.0. Vertebrate integument and its derivatives

5.1. Development, general structure and function of skin and its derivatives

5.2. Glands, scales, horns, claws, nails, hoofs, feathers and hairs

6.0. General plan of circulation in various groups



- 6.1. Blood
- 6.2. Evolution of heart
- 6.3. Evolution of aortic arches and portal systems

#### **Unit – IV :**

#### 7.0. Urino-genital and Nervous system.

- 7.1. Evolution of urino-genital system in vertebrates.

#### 8.0. Nervous system.

- 8.1. Comparative anatomy of the brain in relation to its functions
- 8.2. Nerves-cranial, peripheral and autonomous nervous systems
- 8.3. Simple receptors
- 8.4. Organs of Olfaction and taste
- 8.5. Lateral line system and lateral line organs of fish.
- 8.6. Electric organs & Electroreception

#### **Practical :**

1. Nervous system : Prawn, Crab, Sepia / Loligo
2. Mounting : Nephridium and Spermatotheca in Earthworm.
3. Dissections : *Trichiurus/Scoliodon* – Digestion, Reproductive, Arterial, venous systems.
4. Respiratory system : Mounting of Gills, Trachea and Booklungs
5. Parasitic larval forms.
6. Museum specimens of minor phyla Phoronis, Dendrostoma  
Fossil specimens – Aurelia – Planula, Redia, Cerceria, Filiform of strongyloides, Trochophore,
7. Nauplius, Zoea, Mysis, Phyllosoma, Trilobite larvae of Limulus, Antion, Velliger, Bipinaria, Ophio and Echinopluteus, Auricularia, Tornaria.
8. Electric rays.
9. Types of vertebrae of Procoelus, Opisthocoelus, Amphicoelus, Amphiplatins, Heterocoelus, Axis and atlas vertebrae.
9. Mounting of placoid scales.

### **Suggested Reading Material :**

1. Hyman, L.H. The invertebrates. Vol. Protozoa through etenophora, McGraw Hill Co., New York.
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London.
3. Jagerstein, G. Evolution of metazoan life cycle, Academic Press, New York
4. Hyman, I.H. The invertebrates. Vol.2, McGraw Hill Co., New York
5. Hyman, I.H. The invertebrates. Vol.8 McGraw Hill Co., New York
6. Barnes, R.D. Invertebrate Zoology. III Edition. W.B. Sanuders Co., Philadelphia
7. Russel-Hunter, W.D.A. Biology of higher invertebrates. The Macmillan Co. Ltd., London.
8. Hyman, I.H. The invertebrates smaller coelomate groups. Vol.V. McGraw Hill Co., New York.
9. Read, C.P. Animal Parasitism. Prentice Hall Inc., New Jersey.
10. Sedgwick, A.A. Student textbook of Zoology. Vol.II and III. Central Book Depot. Allahabad.
11. Parker, T.J., Haswell, W.A. Textbook of Zoology, Macmillan Co., London.
12. Alexander, R.M. The Chordata. Cambridge University Press,Lond.
13. Barrington, E.J.W. The biology of Hemichordata and protochordata. Oliver and Boyd, Edinborough.
14. Bourne, G.H. The structure and functions of nervous tissue. Academic Press, New York.
15. Carter, G.S. Structure and habit in vertebrate evolution. Sedwick and Jackson, London.
16. Eccles, J.C. The understanding of the brain. McGraw Hill Co., New York and London.
17. Kingsley, J.S. Outlines of comparative autonomy of vertebrates. Central Book Depot, Allahabad.
18. Kent, C.G. Comparative anatomy of vertebrates.
19. Malcom Jollie. Chordata morphology. East-West Press Pvt. Ltd.,
20. Milton Hilderbrand. Analysis of vertebrate structure. IV Ed. John Wiley and Sons Inc., New York.
21. Monieli A.R. The chordates. Ambridge University Press, London.
22. Smith, H.S. Evolution of chordate structure. Hold Rinehart and Winstoin Inc., New York.
23. Sedwick, A.A. Students textbook of Zoology, Vol.II.

24. Tansley, K. Vision in vertebrate. Chapman and Hall Ltd., London.
25. Torrey, T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York.
26. Walters, H.E. and Syles, L.D. Biology of vertebrates. Macmillan & Co., New York.
27. Wolstenholmf, E.W. and Knight, J. (Ed.). Taste and smell in vertebrates. J & A Churchill, London.
28. Romer, A.S. Vertebrate Body, III Ed. W.B. Saunders Co., Philadelphia
29. Young, J.Z. Life of vertebrates. The Oxford University Press, London
30. Young, J.Z., Life of mammals, The Oxford University Press, London
31. Colbert, E.H., Evolution of the vertebrates. John Wiley and Sons Inc., New York.
32. Romer, A.S. Vertebrate Paleontology. 3<sup>rd</sup> Edn. University of Chicago Press, Chicago
33. Clark, W.E. History of the Primates, IV Edn. University of Chicago Press, Chicago.
34. Weichert, C.K. and Presch, W. Elements of Chordate anatomy. 4<sup>th</sup> Edn. McGraw Hill Book Co., New York.
35. Messers, H.M. An introduction of vertebrates anatomy
36. Montagna, W. Comparative anatomy. John Wiley and Sons Inc.
37. De Deer, S.G. Embryos and Ancestors. Clarendon Press, Oxford
38. Andrews, S.M. Problems in vertebrate evolution. Academic Press, New York.
39. Waterman, A.J. Chordata structure and function. Macmillan Co., New York.
40. Joysey, K.A. and T.S. Kemp. Vertebrate evolution. Oliver & Boyd, Edinborough.
41. Lovtrup, S. The phylogeny of vertebrate. John Wiley & Sons, London.
42. Barbiur, T. Reptiles and Amphibians: Their habits and adaptations. Hongton Miffin Co., New York.
43. Kingsley Noble, G. The biology of the Amphibia. Dover Publications, New York.
44. Smyth. Amphibia and their ways. The Macmillan Co., New York.
45. Andrevos, S.M. Miles, R.S. and Walker A.D. Problems in vertebrate evolution. Academic Press, New York.

## **Paper 14: POPULATION ECOLOGY & ANIMAL BEHAVIOUR**

### **Unit – I :**

- 1.0 Population group properties- population dispersion- population density – estimation of fish population density - natality- mortality- age structure- age pyramids- survival ship curves- Biotic potential- environmental resistance – carrying capacity
- 1.1 Population regulation- density dependent factors- density independent factors- effects of increased numbers- harmful effects- beneficial effects
- 1.2 Population – Inter-specific relationships – Positive interactions – Commensalism- Mutualism – Negative interactions – Predation – Parasitism – Antibiosis

### **Unit II**

- 2.0 Population growth – Assumptions of Logistic and exponential growth models – population fluctuations –population cycle- -Lotka-Volterra equations
- 2.1 Demography – Life Tables – Net Reproductive rate- Reproductive strategies.
- 2.2 Habitat and Ecological Niche – Ecological Equivalents – Sympatry and Allopatry- Community concept – Community dominance – Ecotone – Community composition

### **Unit – III :**

- 3.0 Animal psychology – classification of behavioural patterns, analysis of behaviour (ethogram)
- 3.1. Innate behaviour.
- 4.0. Ecological & Social aspects of behaviour

- 4.1. Habitat selection, food selection, Optimal foraging, theory, antipredator defenses
- 4.2. Aggression, homing, territoriality, dispersal, Schooling in fishes, flocking in birds, herding in mammals
- 4.3. Group selection, kin selection, altruism, reciprocal altruism, inclusive fitness
- 4.4 Social organization in insects and primates

**Unit – IV :**

5. 0. Biological rhythms

- 5.1. Circadian and circannual rhythms
- 5.2. Orientation and navigation
- 5.3. Migrations of fish, turtle and birds

6.0. Perception of the environment & communication

- 6.1. Mechanical
- 6.2. Chemical
- 6.3. Auditory
- 6.4. Visual.

**Practical :**

- 1. Enumeration and identification of phytoplankton
- 2. Enumeration and identification of Zooplankton
- 3. Enumeration of phytal fauna
- 4. Enumeration of Rocky shore fauna
- 5. Creation of Life Table
- 6. Calculation of net reproductive rate ( $R_0$ ), Generation time (T), Rate of intrinsic growth and optimal age for sexual maturity
- 7. Calculation of logistic and exponential growth of a given population
- 8. An introduction to animal behaviour – Animal Psychology – Classification of behavioural patterns
- 9. Perception of the environment – Examples
- 10. communication – Examples from invertebrates and vertebrates (Terrestrial, Aerial, Aquatic habitats)

11. Ecological aspects – Food selection, optimal foraging, prey and predator.
12. Social behaviour – Aggregations – Examples from fishes, birds and mammals, social organization - insects
13. Reproductive behaviour – mating systems, sexual selection, parental care
14. Biological rhythms – examples – migration of fish, turtle and bird.

**Suggested Reading Material :**

1. Begon, M., J.L. Harper and C.R. Townsend. Ecology, Individuals, Populations and Communities. Blackwell Science, Oxford, UK.
2. Koromondy, E.J. Concepts of ecology. Prentice Hall, New Delhi.
3. Clarke, G.L. Elements of Ecology, John Wiley & Sons, New York.
4. Odum, E.P. Fundamentals of Ecology. W.B. Saunders, Philadelphia.
5. Krebs, C.J. Ecology. Harper & Row, New York.
6. Jorgensen, S.E. Fundamentals of Ecological modeling. Elsevier, New York.
7. Alcock, J. Animal behaviour : An evolutionary approach. Sinauer Assoc., Sunderland, Mass, USA
8. Bradbury, J.W. and S.I. Vehrencamp, Principles of animal communication. Sinauer Assoc.
9. Clutton-Brock, T.H. The evolution of parental care. Princeton Univ. Press, Princeton, N.J., USA.
10. Eibl-Eibesfeldt, I. Ethology. The biology of behaviour. Holt, Rinehart & Winston, New York.
11. Gould, J.L. The mechanisms and evolution of behaviour.
12. Hauser, M. The evolution of communication. MIT Press, Cambridge, Mass, USA.
13. Hinde, R.A. Animal behaviour : A synthesis of ethology and comparative psychology. McGraw Hill, New York.
14. Krebs, J.R. and N.B. Davies. Behavioural ecology. Blackwell, Oxford, UK.
15. Wilson, E.O. Sociobiology. The new synthesis. Harvard Univ. Press, Cambridge, Mass, USA.

## **Paper 15: Immunology and Immuno-Technology**

### **Unit I**

- 1.0** Immunology
  - 1.1** Historical Perspective
  - 1.2** Scope and Over view of the Immune System
- 2.0** Innate and Adaptive Immunity
- 3.0** Cells and Organs of the Immune System
  - 3.1** Primary and Secondary Lymphoid organs
  - 3.2** Cells of the Immune system

### **Unit II**

- 4.0** Nature of antigens and Super-antigens
  - 4.1** Immunogenecity and Antigenecity
  - 4.2** Factors influencing immunogenicity
  - 4.3** Epitopes and Haptens
- 5.0** Antibodies – Structure and Function
  - 5.1** Gross and Fine structure of Immunoglobulin molecule
  - 5.2** Antibody Classes and their effector functions
  - 5.3** Monoclonal antibodies - Hybridoma Technology
- 6.0** Antigen – Antibody reactions and Diagnostic Procedures
  - 6.1** Ag. – Ab. binding mechanism
  - 6.2** Ag. – Ab. reactions – Precipitation, Agglutination, Immuno-diffusion, ELISA, RIA, Immno-flourescence.

### **Unit III**

- 7.0** Major Histocompatibility Complex
  - 7.1** MHC Haplotypes
  - 7.2** Class I and Class II MHC molecules
  - 7.3** MHC – Immune responsiveness and disease susceptibility
- 8.0** T- Cells - Maturation, activation and differentiation
  - 8.1** T-Cell maturation and Thymus
  - 8.2** T<sub>H</sub> - Cell activation and differentiation
  - 8.3** Effector Cells and Mechanism of Action: T<sub>DTH</sub>, CTLs and NK cells
- 9.0** B- Cells: Development, Activation and Differentiation
  - 9.1** B-Cell activation and Proliferation

- 9.2 T<sub>H</sub> - B - Cell interaction
- 9.3 Humoral Immune response – Kinetics

## **Unit – IV**

- 10.0 Hypersensitivity Reactions
  - 11.1 Gell and Coombs Classification
  - 11.2 IgE Mediated (Type I) and Ab - mediated (Type II) Hypersensitivity Reactions
  - 11.3 Immune - complex mediated (Type III) and T<sub>DTH</sub> mediated (Type IV) Hypersensitivity Reactions
- 11.0 Immunology and Health
  - 12.1 Immunodeficiency Diseases
  - 12.2 Autoimmunity

### **Practical :**

Organs :

1. Lymphoid organs in Rat - Dissection
2. Lymphoid organs – Histology slides
3. Cells – Differential count of blood cells – Staining with Giemsa
4. Lymphocyte separation – Gradient methods
5. Antigen – Antibody reactions – Kits
  - a) Determination of blood groups
  - b) Diagnostic test for typhoid
  - c) Quantitative precipitin assay teaching kit
  - d) Test for HBS Ag.
  - e) Estimation of serum proteins

### **Suggested Reading Materials :**

1. Kuby, W.H., Freeman, Immunology, USA
2. W. Paul, Fundamentals of immunology
3. I.M. Roitt, Essential immunology, ELBS ion.



## **Paper 16: MOLECULAR BIOLOGY AND CYTOGENETICS**

### **Unit – I :**

#### **1. Biology of chromosomes**

- 1.1. Molecular anatomy of eukaryotic chromosomes
- 1.2. Metaphase chromosome: centromere, kinetochore, telomeres and its maintenance
- 1.3. Heterochromatin and euchromatin
- 1.4. Giant chromosomes: polytene and lampbrush chromosome

#### **2. Nucleic acids structure and replication**

- 2.1 Prokaryotic and eukaryotic DNA replication
- 2.2 Mechanism of DNA replication
- 2.3 Enzymes and accessory proteins involved in DNA replication
- 2.4 Types of RNA and molecular structure of RNA

### **Unit – II :**

#### 3.0. Transcription

- 3.1. Prokaryotic Transcription
- 3.2. Eukaryotic Transcription
- 3.3. RNA Polymerases
- 3.4. Post-transcriptional modifications

#### 4.0. Translation

- 4.1. Genetic Code
- 4.2. Prokaryotic and eukaryotic Translation
- 4.3. Mechanisms of initiation, elongation and termination
- 4.4. Regulation of translation
- 4.5. Antisense and Ribozyme technology

### **Unit – III :**

#### 5.0. **Recombination and repair**

- 5.1 Holliday junction, gene targeting and gene disruption

- 5.2 RecA and other recombinases
- 5.3 DAN repair mechanisms

## **6. Molecular mapping**

- 6.1 Genetic and physical maps
- 6.2 FISH
- 6.3. DNA finger printing

### **Unit – IV :**

## **7. Microbial genetics**

- 7.1 Bacterial transformation, transduction. Conjugation, bacterial chromosomes
- 7.2 Bacteriophages: types, structure and morphology and life cycles

## **8. Human cytogenetics**

- 8.1 Techniques in human chromosome analysis, molecular cytogenetic approach
- 8.2 Human karyotype-banding-nomenclature
- 8.3 Numerical and structural abnormalities of human chromosomes- syndromes- cytogenetic implications

### **Practical :**

- 1. Fuelgen reaction method for DNA localization
- 2. Localization of RNA by methylgreen pyronin – ‘Y’
- 3. Staining of metaphase chromosomes – chromosomal banding – stain with giemsa – fluorescent dye – demonstration
- 4. Polytene chromosome – banding – *Chironomus* / *Drosophila* larva
- 5. Microbial genetics – diagrams and models
- 6. Human chromosomes – karyotyping

7. Fuelgen reaction method for DNA localization
8. Localization of RNA by methylgreen pyronin – ‘Y’
9. Staining of metaphase chromosomes – chromosomal banding – stain with giemsa – fluorescent dye – demonstration
10. Polytene chromosome – banding – *Chironomus* / *Drosophila* larva
11. Microbial genetics – diagrams and models
12. Human chromosomes – karyotyping

**Suggested Reading Material :**

1. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular Biology of cell. Garland Publishing Inc., New York
2. Meyers, R.A. (Eds.) Molecular Biology and Biotechnology : A comprehensive desk reference. VCH Publishers Inc. New York.
3. David freifeldes, "Molecular Biology", publishing Jones and Bartlett publishers, Inc. ISBN 0-86720-069-3.
4. David freifelder, " Microbial Genetics", Jones and Bartlett publishers, Inc. ISBN-0 -86720-076-6.
5. Atherly A.G., J.F. Girton and J.F. Mc Donald. The Science of genetics. Saunders college publishing. Harcourt Brace College publishers, NY.
6. Gardner, E.J., M.J. Simmons and D.P. Snustads. Principles of genetics, John Wiley and Sons Inc., NY.
7. Griffith, A.J.f., J.H. Miller, D.T. Suziki, R.C. lewontin and W.M. Gellbart. An inrtodution to genetic analysis. W.H. Freeman and Company, New York.

## **MSc. Zoology, IV SEMESTER**

### **Paper 19: AQUACULTURE**

#### **Unit – I :**

- 1.0. Concept of Blue Revolution- History, General principles and economics of different kinds of aquaculture and productivity of culture ponds
- 2.0. Freshwater Aquaculture :
  - 2.1. Construction of fish farm and reclamation of swamps
  - 2.2. Selection of species for culture – Biological principles
  - 2.3. Preparation and management of nursery ponds, rearing ponds and stocking ponds along with control of weeds, pests and predators

#### **Unit – II :**

- 3.0. Fish seed resources :
  - 3.1. Procurement and transportation of seed from natural resources
  - 3.2. Transportation of brood stock and induced breeding
  - 3.3. Construction of hatcheries and their management
- 4.0. Freshwater fish culture :
  - 4.1. Common carp; Indian Major carps; Air breathing fishes; Composite Fish Culture; Freshwater prawn culture
  - 4.2. Integrated Fish Farming – Paddy cum Fish Culture and Fish cum Livestock Culture

#### **Unit – III :**

- 5.0. Brackish water Aquaculture :

- 5.1. Selection of site, principles of pond design; traditional, extensive, modified extensive, semi-intensive, intensive and super intensive culture of shrimps and their management and economics
  - 5.2. Crab culture – Pond design, management of crab farm, fattening process of crab, economics – cage culture and pen culture
  - 5.3. Finfish culture – Mulletts (Mugil), Milk fish (Chanos) and sea bass (Lates)
- 6.0. Mariculture :
- 6.1. Lobster culture
  - 6.2. Mussel culture
  - 6.3. Pearl oyster culture
  - 6.4. Edible oyster culture, and
  - 6.5. Sea weed culture

#### **Unit – IV :**

- 7.0. Hatchery management :
- 7.1. Principles of shrimp hatchery establishment : Site selection, water source, water management, maturation section, larval and post larval sections, feed management
  - 7.2. Principles of establishment of crab and lobster hatcheries; site selection, water source and management, larval and post larval sections, feed management
- 8.0. Brackish water farm management :
- 8.1. Water quality management – pH, turbidity, dissolved oxygen, BOD, COD, Nitrates, Phosphates, Ammonia etc.
  - 8.2. Feed management: Feed schedules, protein requirements at different ages of finfish and shellfish, feed formulations, wet and dry feeds

### **Practical :**

1. Analysis of water : Turbidity, pH, Dissolved oxygen, Alkalinity etc.
2. Primary productivity, Estimation by Light and Dark bottle method
3. Spotters : cultivable species of finfish and shellfish based on the theory
4. Dissecting out the pituitary gland and preparing the extract
5. Visits to aquaculture farms, finfish and shellfish hatcheries

### **Suggested Reading Material :**

1. Pillay, T.V.R. 1990. Aquaculture – Principles and Practices. Fishing News Books Survey, U.K.
2. Jhingran, V.G. 1993. Fish and fisheries of India. Hindustan Publishing Corporation (India), New Delhi.
3. Ravishankar Piska, 1999. Fisheries and Aquaculture. Lahari Publications, Hyderabad.
4. Santanam, R., Ramanathan, N. and Jegatheesan, G. 1990. Coastal Aquaculture in India. CBS Publishers & Distributors, Delhi.
5. Bardach, J.E., Ryther, J.H. and McLarney, W.O. 1972. Aquaculture. John Wiley & Sons Inc., USA.
6. Ghosh, S., Palanisamy, K. and Pathak, S.C. 1994. Shrimp and Freshwater Hatchery Public Relations Division, National Bank for Agriculture and Rural Development, Bombay.

## Paper 20: MEDICAL PARASITOLOGY

### Unit – I :

1. Introduction to parasites of man, scope and definition of parasites/parasitology
2. Protozoa :
  - 2.1. General characters of parasitic protozoa
  - 2.2. Morphology, life cycle and pathogenecity of *Entamoeba histolytica*, *Giardia*, *Trichomonas* *Naeglaria*
  - 2.3 Haemoflagellates : *Trypanosoma*, *Leishmania*
  - 2.4 Apicomplexa : *Plasmodium*, Differential diagnosis : *Toxoplasma Pneumocystis*

### Unit – II :

3. Trematodes :
  - 3.1. General characters and classification of digenetic trematodes
  - 3.2. Identification characters, life cycle, pathogenecity and control of human parasitic, digenetic trematodes : *Chlonorchis sinensis*, *Paragonimus westermani* and *Schistomes*

### Unit – III :

4. Cestodes :
  - 4.1. General characters and classification of cestodes
  - 4.2. Larval cestodes pathogenic to man

4,3, Identification characters, life cycle, pathogenecity and control of *Diphyllobothrium latum*, *Taenia solium*, *T. saginata*, *Hymenolepis nana*

**Unit – V :**

5. Nematodes :

5.1. General characters of Nematodes

5.2. Identification, life cycle, pathogenecity and control of *Ascaris lumbricoides*, *Enterobius vermicularis*, *Ancylostoma duodenale*

5.3. Filarid worms : *Wuchereria bancrofti* and *Brugia malayi*

5.4. *Trichinella spiralis* and *Trichiuris trichiura*.

**Practical :**

1. Smear preparation for protozoa
2. Preparation of whole mounts for helminths
3. Spotters based on theory

**Suggested Reading Material :**

1. Manson's Tropical disease by Cook
2. Concepts and Principles of Epidemiological studies
3. Parasitology in Focus



## **Paper 21: PRINCIPLES OF BIOTECHNOLOGY**

### **Unit – I :**

1. Concepts of Biotechnology: Scope and importance. Biotechnology in India
2. Recombinant DNA and gene cloning : Cloning and expression vectors Chimeric DNA. Gene Libraries

### **Unit – II :**

3. Polymerase chain reaction (PCR)
4. Gene amplification : Basic PCR and its modifications, Applications of PCR in Biotechnology and genetic engineering

### **Unit – III :**

5. Animal cell and tissue culture : Laboratory facilities, culture media and procedures, primary culture, cell lines, cloning tissue and organ culture
6. Biotechnology in Medicine : animal and human health care, genetic counseling, forensic medicine

### **Unit – IV :**

7. Biotechnology and Environment : Pollution control environment and energy, biodiversity and conservation
8. Biotechnology and intellectual property :
  - 8.1. Intellectual Property Rights (IPR)
  - 8.2. Intellectual Property Protection (IPP)

### **Practical :**

1. Determination of DNA, RNA, Glucose, Proteins and Lipids. Polyacrylamide gel electrophoresis (PAGE), Southern Blotting and Northern Blotting. PCR demonstration.

### **Suggested Reading Material :**

1. Gupta, P.K. Elements of Biotechnology
2. Singh, B.D. Biotechnology
3. Balasubramanian. Concepts in Biotechnology

## **Paper 22: CELL PHYSIOLOGY AND TOXICOLOGY**

### **Unit – I :**

1.0. Thermodynamic Principles and Steady state condition of living organisms.

- 1.1. Organization and Methods to study metabolism.
- 1.2. Degradation and synthesis of glucose, palmitic and phenylalanine.
- 1.3. Oxidative phosphorylation.

### **Unit – II :**

2.0. Nature of Enzymes

- 2.1. Classification and Nomenclature of enzymes.
- 2.2. Enzyme inhibition and kinetics.
- 2.3. Immobilized enzymes and their application.

### **Unit – III :**

3.0. General Principles of Toxicology.

- 3.1. Areas of toxicology.
- 3.2. Toxic dose tolerance.
- 3.3. Risk and safety.
- 3.4. Routes and sites.
- 3.5. Routes and sites of transportation.

### **Unit – IV :**

4.0. Toxic effects of Pesticides.

- 4.1. Organochlorines.
- 4.2. Organophosphates.
- 4.3. Carbamates.

### **Practical :**

1. Protein estimation.
2. Glucose estimation.
3. Lipid estimation.
4. Effect of pesticides on oxygen consumption of fish.
5. Effect of pesticides on opercular rate of fish.
6. Evaluation of LC50 values by probit method.
7. Effect of pesticides on total proteins, carbohydrates and lipids.
8. In vitro effect of pesticides on ATPases and Acetyl choline esterase.

### **Suggested Reading Material :**

1. Voet, D. and J.G. Voet. Biochemistry. J. Wiley & Sons
2. Foster, R.L. Nature of Enzymology
3. Lodish et. al. Molecular Cell Biology
4. Annual Reviews of Biochemistry
5. Garrett and Grisham. Biochemistry
6. Marguis, J.K. A guide to General Toxicology
7. Casseret & Doull. Toxicology : The basic series of poisons
8. Robert G. Tardiff and Joseph V. Rodricks. Toxic substances and human risk.
9. Ernest Hodgson and Patricia Levi. Modern Toxicology.