

# **PERIYAR UNIVERSITY**

**SYLLABUS FOR**

**M.Sc ZOOLOGY**

**DEGREE OF MASTER OF SCIENCE**

**CHOICE BASED CREDIT SYSTEM**

**(For candidates admitted in the college affiliated to**

**Periyar University from 2020 – 2021 onwards)**

# REGULATIONS

## 1. AIM & SCOPE

- To educate knowledge across different area of Zoology.
- The topics included in different units of different papers would enable the students to develop technical skills in zoological and applied branches.
- Skill based subjects like poultry science, sericulture, diary science and fisheries have been included in order to provide opportunities in employment and research in government and private organizations.
- Practical's include in a syllabus will improve skills like drawing, observation, laboratory instruments handling and its techniques

2. **ELIGIBILITY:** Candidates who have passed the three year B.Sc., Examination with zoology will be eligible for admission to this course.
3. **DURATION OF THE COURSE:** The course for the degree of master of science shall consist of two years divided into four semesters, over a total of 2200 marks. Each semester consist of 90 working days.
4. **PASSING MINIMUM:** The candidate shall be declared to have, passed the examination if he/she secured not less than 50 marks.
5. A candidate shall eligible for appearing examination provided he/she secures percentage of attendance as specified by the university.
6. Examination (Theory and Practical) would be held for completion of curriculum at the end of the each semester.
7. A candidate should obtain at least 50% in each of the theory and practical course to qualify in each semester.

### **DISTRIBUTION OF MARKS: THEORY**

University examination = 75 marks

Internal assessment = 25 marks

### **INTERNAL ASSESSMENT STRUCTURE:**

Test = 10 marks

Attendance = 05 marks

Seminar = 05 marks

Assignments = 05 marks

Passing minimum for Internal Assessment = 12 marks

Passing minimum of University examinations= 38 marks

### **DISTRIBUTION OF MARKS: PRACTICALS**

University examinations = 60 marks

Internal Assessment = 40 marks

### **INTERNAL ASSESSMENT STRUCTURE:**

Practical Attendance = 10 marks

Practical Performance = 20 marks

Record Work = 10 marks

Passing minimum for internal assessment = 20 marks

Passing minimum for University examinations = 30 marks-

### **DISTRIBUTION OF MARKS: DISSERTATION**

Internal assessment = 20 marks

Viva – voce = 20 marks

Project Report = 60 marks

**M.Sc DEGREE EXAMINATION - THEORY**

**ZOOLOGY**

Time: 3 Hrs

Maximum: 75

**PART A (15 X 1 = 15 marks)**

Answer ALL questions. All questions carry equal marks.

**PART B (2 X 5 = 10 marks)**

Answer any TWO questions. Each answer should not exceed 300 words.

**PART C (5 X 10 = 50 marks)**

Answer ALL questions choosing either 'a' or 'b'. Each answer should not exceed 1200 words.

**Course Scheme and Scheme of Examination for M.Sc., Zoology Course  
(Academic Year 2020-2021 onwards)**

**Semester -I**

<b>Subject Code</b>	<b>Subject Title</b>	<b>Contact hours/Week</b>	<b>Credits</b>	<b>Internal</b>	<b>External</b>	<b>Total</b>
20PZC01	Structure and Function of Invertebrates	6	5	25	75	100
20PZC02	Comparative Anatomy of Chordates	6	5	25	75	100
20PZC03	Cell Biology and Molecular Biology	6	5	25	75	100
20PZE01	Elective I- Microbiology	5	3	25	75	100
20PZE02	Elective II- Vermiculture					
20PZP01	Practical I	5	4	40	60	100
	Test/ Library/ Seminar	2	-	-	-	-
		30	22	140	360	500

**Semester -II**

<b>Subject Code</b>	<b>Subject Title</b>	<b>Contact hours/Week</b>	<b>Credits</b>	<b>Internal</b>	<b>External</b>	<b>Total</b>
20PZC04	Genetics	5	5	25	75	100
20PZC05	Immunology	5	5	25	75	100
20PZC06	Biochemistry	5	5	25	75	100
20PZE03	Elective III – Poultry Science /	4	3	25	75	100
20PZE04	Elective IV - Aquaculture					
20PZP02	Practical II	5	4	40	60	100
20PZNM01 20PZNM02	NMC- Select any one paper Fishery Biology Nutrition and Dietetics	4	3	25	75	100
	Test/ Seminar/ Library	2	-	-	-	-
		30	25	165	435	600

### Semester -III

Subject Code	Subject Title	Contact hours/Week	Credits	Internal	External	Total
20PZC07	Comparative Animal Physiology	5	5	25	75	100
20PZC08	Developmental Biology	5	5	25	75	100
20PZC09	Research Methodology	5	5	25	75	100
20PZE05	Elective V- Entomology	4	3	25	75	100
20PZE06	Elective VI – Medical Parasitology					
20PZP03	Practical III	5	4	40	60	100
20PZNM03	NMC- Select any one paper Dairy Science/ Insect Pest Management	3	3	25	75	100
20PZNM04						
20PZIP01	Internship add on course – Sericulture/ Dairy / Poultry/Medical Lab Technique (MLT) – students should attend the course at the end of second semester	1	1	50	-	50
	Test/ Seminar/ Library	1	-	-	-	-
		30	26	215	435	650

### Semester - IV

Subject Code	Subject Title	Contact hours/Week	Credits	Internal	External	Total
20PZC10	Environmental Biology	5	5	25	75	100
20PZC11	Evolution	5	5	25	75	100
20PZP04	Practical IV	5	4	40	60	100
20PZPR1	Dissertation Work and <i>viva voce</i>	15	8	50	100	150
		30	22	140	310	450

I – Internal Examiner mark; E – External Examiner mark,

**SEMESTER - I**  
**CORE PAPER 1**  
**STRUCTURE AND FUNCTION OF INVERTEBRATES**  
**(20PZC01)**

Teaching Hours: 6 hrs/week

Credit Point: 5

**Course Objectives:**

- To gain knowledge about Zoological nomenclature and Animal taxonomy.
- To study the external morphology, physiology and affinity of Invertebrate with minor phyla.
- To understand the functional behaviour of protozoan to metazoans.
- Gain Knowledge about parasitic invertebrates, its larval stages and their mode of transmission from one stage to another.

**UNIT-I**

Principle of Animal Taxonomy: Species Concept, International Code of Zoological Nomenclature - Taxonomic Procedures. New Trends in Taxonomy – Animal Collection, Handling and Preservation – Organization of Coelom - Acoelomates, Pseudocoelomates, Coelomates; Protostomia and Deuterostomia.

**UNIT-II**

Locomotion: Pseudopodia, Flagella and Ciliary movement in Protozoa – Hydrostatic movement in Coelenterata, Annelida and Echinodermata.

Nutrition and Digestion: Patterns of Feeding and digestion in Lower Metazoan – Filter feeding in Polychaeta, Mollusca and Echinodermata.

**UNIT – III**

Respiration: Organs of Respiration – Gills, Lungs and Trachea – Respiratory Pigments – Mechanism of Respiration.

Excretion: Organs of Excretion – Coelom, Coelomoducts, Nephridia and Malphigian Tubules – Mechanisms of Excretion – Excretion and Osmoregulation.

## **UNIT – IV**

Nervous System: Primitive Nervous system – Coelenterata and Echinodermata – Advanced nervous system – Annelida, Arthropoda (Crustacean and Insecta), Mollusca (Cephalopoda) – Trends in Neural Evolution.

## **UNIT – V**

Invertebrate Larvae: Larval forms of free living Invertebrates - Larval forms of Parasites – Strategies and Evolutionary significance of Larval Forms - Minor Phyla (Structural Features and Affinities) – Concept and Significance – Organization and General Characters.

### **Suggested Reading Materials**

1. Hyman, L.H. The Invertebrates. Volume I. Protozoa through Ctenophora, McGraw Hill Co, New York.
2. Barrington, E.J.W. Invertebrate Structure and Function. Thomas Nelson and Sons Ltd., London.
3. Hyman, L.H. The Invertebrates Volume II. McGraw Hill Co., New York.
4. Hyman, L.H. The Invertebrates Volume VIII. McGraw Hill Co., New York.
5. Barnes, R.D. Invertebrate Zoology, III Edition. W. B. Saunders Co., Philadelphia.
6. Russels- Hunter, W.D. Biology of Higher Invertebrates. The MacMillan Co Ltd., London.
7. Jagerstein, G. Evolution of Metazoan life cycle. Academic Press, New York & London.
8. Read, C.P. Animal Parasitism. Prentice Hall Inc. New Jersey.
9. Sedgwick, A. A Student Text Book of Zoology. Vol. I - III. Central Book Depot, Allahabad.
10. Parker, T.J. and Haswell, W. A Text Book of Zoology, MacMillan Co., London.

### **Course Outcomes (CO):**

On successful completion of the course, the students will able to,

CO1: Classify the Animal species based on the Characteristics features.

CO2: Know the locomotion, feeding and digestion of all Invertebrates.

CO3: Know the structure and function of Respiratory and Excretory organs of Invertebrates.

CO4: Learn about the function of nervous system of Non-Chordates.

CO5: Gain Knowledge about various larval forms of Invertebrates.



## **CORE PAPER 2**

### **COMPARATIVE ANATOMY OF CHORDATES**

**(20PZC02)**

Teaching Hours: 6 hrs /week

Credit Point: 5

#### **Course Objectives:**

- Students will gain knowledge about the external characteristic features of Vertebrates in a detailed manner.
- Study the structure and function of integuments and its derivatives from Fishes to Mammals.
- Able to compare the structural modification of various organ systems in all Vertebrates – Evolution.
- Gain knowledge about evolution of Nervous co-ordination and Sense organs of various Classes of Chordates.

#### **UNIT – I**

Origin of Chordata: Concept of Protochordata – Nature of Vertebrate Morphology – Definition, Scope and relation to other disciplines – Importance of the study of Vertebrate Morphology.

#### **UNIT – II**

Origin and Classification of Vertebrates: Vertebrate integuments and its derivatives – Development, General structure and functions of Skin and its derivatives – Glands, Scales, Horns, Nails, Claws, Hoofs, Feathers and Hairs.

#### **UNIT – III**

General Plan of Circulation in Various groups: Blood – Evolution of Aortic arches and Portal systems – Respiratory system – Characters of respiratory tissues – Internal and External respiration – Comparative account of Respiratory Organs.

#### **UNIT – IV**

Skeletal System: Forms and Functions, Body size and skeletal elements of the body – Comparative account of Jaws suspension, Vertebral column – Limbs and Girdles - Evolution of Urino-genital system in Vertebrates.

## UNIT –V

Sense Organs: Simple receptors – Organs of Olfaction, Taste and Hearing – Lateral line system – Electroreception – Nervous system – Comparative anatomy of the Brain in relation to its functions – Comparative Anatomy of Spinal cord – Nerves – Cranial, Peripheral and Autonomous nervous system.

### Suggested Reading Materials

1. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinburgh.
2. Alexander, R.M. The Chordata. Cambridge University Press, London.
3. Carter, G.S. Structure and Habit in Vertebrate Evolution. Sedwick and Jackson, London.
4. Bourn. G.H. The Structure and Function of Nervous tissue. Academic Press, New York.
5. Kindgsley, J.S. Outlines of Comparative Anatomy of Vertebrates. Central Book Depot, Allahabad.
6. Eecles, J.C. The Under Standing of the Brain. McGraw Hill Co., New York and London.
7. Malcom Jollie, Chordate Morphology, East West Press Pvt, New Delhi.
8. Colbert, E.H. Evolution of Vertebrates. John Wiley and Sons INC. New York.
9. Romer, A.S. Vertebrate Paleontology, 3<sup>rd</sup> Edition, University of Chicago Press, Chicago.
10. Romer, A.S. Vertebrate Body, 3<sup>rd</sup> Edition, W. B. Saunders Co. Philadelphia.
11. Waterman, A.J. Chordata Structure and Function. Academic Press, New York.
12. Young, J.Z. Life of Mammals. The Oxford University Press, London.
13. Kingsely Nobel, G. The Biology of Amphibia. Dover Publications, New York.
14. Milton Hilderbrand. Analysis of Vertebrate Structure. 4<sup>th</sup> Ed. John Wiley and Sons Inc. New York.

### Course Outcomes (CO):

On successful completion of the course, the students will able to,

CO1: Classify the animal species based on the characteristics features into classes.

CO2: Know about the integuments and its derivates in the vertebrates.

CO3: Able to compare the structure and function of various systems in vertebrates.

CO4: Learn about the skeletal arrangements in the chordates.

CO5: Gain Knowledge about various types of sense organs in the vertebrates.

## CORE PAPER -3

### CELL BIOLOGY AND MOLECULAR BIOLOGY

(20PZC03)

Teaching Hours: 6 hrs /week

Credit Point: 5

#### Course Objectives:

- Provide relevant knowledge about the function of various cell internal organelles
- Acquire advanced knowledge of cell membranes in transportation of matters in and out
- To study the principles of cell communication and adhesion.
- To study the oncogenes, cellular morphology and ageing of cells.

#### UNIT – I

Introduction – Experimental systems in cell biology

Bio-membranes – Molecular composition and arrangement functional consequences – Transport across cell membrane – Diffusion, active transport and pumps and uniports, symports and antiport – membrane potential – Co-transport by symports or antiporters – transport across intestinal epithelia.

#### UNIT –II

Cytoskeleton

Microfilaments and microtubules – structure and dynamics – microtubules and mitosis – Cell movements – intracellular transport, role - kinesin and dynein, signal transduction mechanisms - cilia and flagella – Cell signalling – Cell surface receptors – Second messenger system- MAP kinase pathways – Signalling from plasma membrane to nucleus.

#### UNIT – III

Cell - Cell adhesion and cell cycle

Ca<sup>++</sup> dependent haemophilic cell – cell adhesion – Ca<sup>++</sup> independent haemophilic cell – Gap junctions and connections - Cell matrix adhesion – Integrins – Collagen – Non-collagen components – cell cycle – Cyclins and cyclin dependent kinases – Regulation of CDK – Cycline activity.

## **UNIT – IV**

### Genomic organization

Hierarchy in organization – Chromosomal organization of coding and non-coding DNA – Regulation of gene expression – Mobile DNA – Morphological and functional elements of eukaryotic chromosomes – Genetic analysis in cell biology. (Cancer cells and polyploidy)

## **UNIT – V**

### Intracellular protein traffic

Protein Synthesis on free and bound polysome – uptake into ER – Membrane proteins. Golgi sorting, post-translational modifications – Biogenesis of mitochondria and nuclei – Trafficking mechanism – Biology of cancer – Biology of aging – Apoptosis – definition, mechanisms and significance.

### **Suggested Reading Materials:**

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

### **Course Outcomes:**

On successful completion of the course the students can able to

CO1: The graduate will able to explain the functional eukaryotic cell at molecular level.

CO2: The students can explain briefly about the cytoskeleton system of a cell and its function.

CO3: The students can briefly describe the cell adhesion and its communications.

CO4: Graduate can describe the functions of nucleus which control the cell.

CO5: The student will able to perform the techniques employed by the cell organelles.

**ELECTIVE PAPER – 1**  
**MICROBIOLOGY (20PZE01)**

Teaching Hours: 4hrs / week

Credit Point: 3

**Course Objectives:**

- Key features of the structure and classification of bacteria, virus and fungi.
- Knowledge on lab cultivation, media and staining methods.
- To study the microorganism in related to human health aspects.
- To know the application of microorganism in Industrial and Dairy usage.
- To Under Stand the application of microorganisms in soil and aquatic as bio-fertilizer and bio-pesticides.

**UNIT – I**

Introduction to Microbiology–Structure classification of virus, bacteria and fungi.

**UNIT – II**

Sterilization, Disinfection, Tyndallisation, Pasteurization: Physical- dry heat, moist heat, UV light, filtration HEPA .Culture techniques Types of growth media- natural, synthetic, complex, enriched, selective and anaerobic Growth media .Pure culture methods (streak plate, spread plate, pour plate).Staining methods- simple and differential staining.

**UNIT – III**

Medical microbiology – Human Diseases, Bacterial Diseases -Tuberculosis, Diphtheria, Typhoid.Viral diseases-Polio, AIDS, Dengue, Chikungonia and COVID19. Fungal diseases-Athletes foot (*Tinea pedis*), Candidiasis in skin causative agents, Symptoms control and treatment.

**UNIT – IV**

Industrial and Dairy Microbiology – Definition of fermentation, Microbes producing antibiotics – Penicillin, Streptomycin – Probiotics – Role of micro organisms in production of cheese and curd.

## **UNIT – V**

Aquatic Microbiology – Microbial assessment for water quality, Microbial characters of sewage, microbial treatment of wastewater.

Microorganism in soil, Nitrogen fixing organism: Symbiotic and non symbiotic. Bio-fertilizer, Bio-pesticides.

### **Suggested Reading Materials**

1. Ananthanarayanan and Panicker, Text Book of Microbiology, Kanungo Reba (Ed) 10<sup>th</sup> Edition, Hyderabad.
2. Ghulam Hussan Dar, Soil Microbiology and Biochemistry, New Age Internationals, New Delhi.
3. Sharma, P.D. Environmental Microbiology, Rastogi Publications, Meerut.
4. Yadav, P.R. and Tyagi. Immuno-Biotechnology, Discovery Publications, New Delhi.
5. Larry. L. Barton, and Robert J. C. Mc Leon. Environmental Microbiology and Microbial Ecology. John Wiley and Sons.

### **Course Outcomes**

On successful completion of the course the student will be able to

CO1: To student will able identify microorganisms in our environment and classify them.

CO2: The student will acquire knowledge about how to culture different microbes.

CO3: The graduate can understand the pathogenic microbes and their control measures.

CO4: Gain knowledge about microbes in food industries, developing antibiotics from microbes.

CO5: Understand the application of microbial technology in the production of bio-fertilizers and bio-pesticides.

**ELECTIVE PAPER-2**  
**VERMICULTURE (20PZE02)**

Teaching Hours: 4hrs / week

Credit Point: 3

**Course Objectives:**

- To impart a detailed knowledge on vermiculture technology.
- To highlight the benefits of Eco-friendly agriculture by way of organic farming.
- To utilizing the byproducts of vermiculture.
- To create knowledge and avenues for self-employment.

**UNIT - I**

History of Indian Earthworm culture - Need for vermiculture - Earthworm types– Biology of *Lampito mauritii* and *Eudrilus eugeniae* – Trophic classification of Earthworm: epigeic, anecic and endogenic; clitellates and non-clitellates – morphology, anatomy and physiology of earthworms – Life cycle of earthworm.

**UNIT - II**

Role of earthworms in composting, raw materials and requirements of vermicomposting – Worms for vermiculture – Vermiculture practice – Vermi-bed preparation- Maintenance of composting - Collection of vermicompost – Natural enemies of earthworms, pests, parasites and pathogens.

**UNIT - III**

Types of vermicomposting – Worm casts – General problems in production of vermicompost - Physical, Chemical and Biological properties of vermicompost– Effects of vermicompost on soil properties - Vermiwash and their applications

**UNIT - IV**

Advantage of vermicompost – Vermicomposting from agricultural and urban solid wastes – Recycling of wastes through vermicomposting – Earthworms as bioreactors and bio-indicators - Organic farming - Vermicompost and its applications.

**UNIT - V**

Small Scale (or) Indoor vermicomposting unit – Large scale or Outdoor vermicomposting unit. Vermicompost – Quality and Economics - Application of vermicomposting in agriculture and horticultural practices- Prospects of vermiculture as a self-employment venture. Uses of earthworms in food and medicine – Ayurvedic and Unani.

### **Suggested Reading Materials**

1. Sultan Ahmed Ismail, The Earthworm, Others India Press, Mapura 403507, Goa,India.
2. Seethalakshmy, A Text book of Vermitechnology, Saras Publications. 3rd Edition,
3. Prakash Malhotra, Economic Zoology, Adhyayna Publishers & Distributors, New Delhi.
4. NIIR Board, The complete Technology Book on Vermiculture and Vermicompost.
5. Ismail. S. A. Vermitechnology. The Biology of Earthworms. Orient Longman, India.
6. Ranganathan. L.S. Vermicomposting Technology.
7. Gupta. P. K. Vermicomposting for sustainable agriculture. Agrobios, India.
8. Edwards, C.A. and Bother, B. Biology of Earthworms. Chapman Hall Public.Co. London.
9. Talashikar. S.C. Earthworms in Agriculture. Agrobios, India.

### **Course Outcomes:**

On successful completion of the course the student can able to

CO1: Gain knowledge about types of earthworms and life history of composting earthworms native and exotic.

CO2: Get adequate knowledge about various organic waste materials used to prepare vermicompost and how to overcome the problems during culture period.

CO3: Able explain the nutrients present in vermicompost and vermiwash, how it can be applied to the field.

CO4: The student will get knowledge to explain how vermicompost is important in Organic farming.

CO5: Gain knowledge about various types of composting methods, application mode and usage of earthworms in Ayurvedic and Unani medicinal practices.



## MAJOR PRACTICAL – I

### Structure and function of Invertebrates, Comparative Anatomy of Chordates, Cell and Molecular Biology (20PZP01)

Practical Hours – 5

Credit Point: 4

#### **Major:**

Dissection of Nervous system of Prawn.

Micrometry – Simple measurement of Cell (Ocular / Stage Micrometer)

Onion Root Tip – Mitosis (Any one stage)

Giant Chromosomes in Salivary gland of Chironomous Larva.

Preparation of Microscopic slide – Microtome (Demo only)

#### **Minor:**

Mouth parts of Insects – Mosquito, Honey Bee, Cockroach

Body setae of Earthworms

Placoid Scales in Shark

#### **Spotters:**

Protozoans – Entamoeba histolytica, Trypanosoma gambiense, Leishmania donovani

Helminthes – Ascaris sp., Taenia sp., Filarial worm, Fasciola sp.,

Identification and Study of Nauplius larva, Zoea larva, Bipinnaria larva.

Microtome – Knife, Embedding block, L Block, Hot Plate, Cuppling jars.

## **SEMESTER - II**

### **CORE PAPER - 4: GENETICS (20PZC04)**

Teaching Hours: 5 hrs /week

Credit Point: 5

#### **Course Objective:**

- To acquire basic knowledge about Mendelian principles about Genetics.
- To provide knowledge in structure and function of genes and mapping techniques.
- To study DNA and gain knowledge in Human Genome Project.
- To gain the graduates about various mutagens, a chromosomal aberration happens due to sudden changes.

#### **UNIT – I**

Basic Concepts of Genetics - Mendelian Principles: Dominance, Segregation, Independent Assortment. Concept of Gene: Allele, Multiple Alleles, Pseudo-allele, Complementation tests. Extensions of Mendelian Principles: Co dominance, Incomplete dominance, Gene interactions, Pleiotropy, Genomic imprinting, Penetrance and Expressivity, Phenocopy, Linkage and crossing Over, Sex Linkage, Sex limited and Sex influenced characters.

#### **UNIT – II**

Gene mapping methods: Linkage maps, Tetrad analysis, Mapping with molecular markers, Mapping by using somatic cell hybrids, DNA foot printing. Extra chromosomal inheritance: Inheritance of mitochondrial genes, Maternal inheritance.

#### **UNIT – III**

Microbial Genetics: Methods of genetic transfers – Transformation, Conjugation, Transduction and Sexduction. Mapping genes by interrupting mating, Fine structure analysis of genes. Human Genetics: Pedigree analysis, IOD score for linkage testing, Karyotypes, Genetic disorders- Human Genome Project (HGP). Quantitative Genetics: Polygenic Inheritance, Heritability and its measurements, QT mapping.

#### **UNIT –IV**

Mutation: Types, causes and detection, Mutant types – Lethal, Conditional, Biochemical, Loss of function, Gain of function, Germinal Verses Somatic mutants, Insertional mutagenesis.

Structural and Numerical Alternations of Chromosomes: Deletion, Duplication, Inversion, Translocation, Ploidy and their genetic implications.

Recombination: Homologous and Non-homologous recombination including Transposition.

Population Genetics: Genetic Equilibrium – Distinguishing forces – Natural Selection – Mutation and Genetic Drift.

### **UNIT –V**

Molecular Genetics – Structure of Gene – Genetic Code – Gene regulation – Genome Analysis – Functional genomics – RNA processing – Transcription : Factors and Regulations – Translation: Control and Regulations.

Molecular Population Genetics: Patterns and Change in Nucleotide and Amino acid sequences.

### **Suggested Reading Materials**

1. Griffith, Modern Genetic Analysis, WH Freeman & Co; Solution manual Edition, New York
2. Lewis, The Genes. Jones and Bartlett Publishers, Inc
3. Snustad and Simmons, Principles of Genetics, John Wiley and sons, Inc

### **Course Out comes:**

On successful completion of the course, the students will be able to

CO1: The Students will able to knowing and understanding the organization and functions of genetic materials in biosphere.

CO2: Graduates can able to explain type gene mapping techniques.

CO3: Students can develop knowledge on karyotyping and human genome project.

CO4: The students can explain the modification happens by mutation at gene level, chromosomal changes by various factors.

CO5: Graduates can evaluate the functions of nucleotides and amino acid changed in population genetics.

## **CORE PAPER – 5**

### **IMMUNOLOGY (20PZC05)**

Teaching Hours: 5hrs / week

Credit Point: 5

#### **Course Objectives:**

- To study the Innate and acquired immunity.
- To understand areas of immunity- antigens and antibodies.
- To study the host defense mechanism- Immunoglobulins.
- To acquire knowledge about immunological response in related to infection.

#### **UNIT – I**

Innate and Acquired Immunity: Phylogeny and Ontogeny of immune system – Organization and structure of lymphoid organs, Cell of the immune system and their differentiation – Lymphocyte traffic – Nature of immune response.

#### **UNIT - II**

Nature of Antigens: Antigenicity and immunogenicity – Factors influencing immunogenicity – Epitopes and Haptens – Super antigens – Structure and functions of antibodies – classes and subclasses – Gross and fine structure – Antibody mediated effectors functions – Antigen – Antibody interactions in vitro and in vivo.

#### **UNIT – III**

Complement system: Components, control proteins and activation pathways. Major Histocompatibility Complex (MHC) in mouse and HLA system in human. MHC haplotypes – class I and class II molecules – cellular distribution – peptide binding – expression and diversity – disease susceptibility and MHC/HLA. Organization and expression of Ig genes – models for Ig gene structure – multigene organization of Ig genes – DNA rearrangements and mechanisms – generation of antibody diversity – differential expression of Ig genes.

#### **UNIT – IV**

T- Cell generation, activation and differentiation : Isolation, molecular components and structure of T-cell receptor complex – T-cell maturation and thymus – T<sub>H</sub> cell activation mechanism – T – cell differentiation – cell death and T-cell population – B – cell generation, activation and differentiation – B – cell receptors – selection of immature self – reactive B- cells – B-cell activation and proliferation – T<sub>H</sub> – B-cell interactions.

## **UNIT – V**

Cytokines – definition and salient functional features – cytokine receptors – cytokines and immune response – cell-mediated effector functions – cell adhesion molecules – effectors cells and molecules – CTL and NK cells – mechanism of action – immunological tolerance and anti-immunity – delayed type hypersensitivity – hypersensitivity - types and immunological reactions and immune response to infection agents especially intracellular parasites.

### **Suggested Reading Materials**

1. Kuby. Immunology, W.H. Freeman. USA.
2. Paul. W. Fundamental of Immunology.
3. Roitt, I.M. Essentials of Immunology, ELBS Edition.

### **Course Out comes:**

On successful completion of the course the candidate will able to

The student can able to explain the immune system present in animal body and how it works against the pathogens / antigens.

CO1: Develop the immune system against pathogens.

CO2: Raise the monoclonal antibodies for the infections.

CO3: Easily understand the immune system and mode of action against infection.

CO4: The candidate can explain how immunological response activated against infection.

CO5: The student can describe briefly about the hypersensitivity response activated.

**CORE PAPER – 6**  
**BIOCHEMISTRY (20PZC06)**

Teaching Hours: 5hrs/week.

Credit Point: 5

**CourseObjective:**

- To Study of the function and structure biomolecules.
- To understand the various types of enzymes and its role in living cells/ organsystems.
- To study the structure and function of proteins, carbohydrates, lipids, vitamins in living organisms.

**UNIT – I**

Structure of atoms, molecules and chemical bonds. Principles of biophysical chemistry- pH, Buffer, Reaction kinetics, Thermodynamics, Colligative properties.

**UNIT – II**

Stabilizing interactions – Vander Waals, Electrostatic, Hydrogen bonding, Hydrophobic interactions, etc., Composition, nature of bonds / linkages, Structure of bio-molecules (Carbohydrates, Lipids, Proteins, Vitamins and Nucleic acids).

**UNIT – III**

Conformation of proteins – Ramachandran Plot, Primary, Secondary, Tertiary and Quaternary Structures, domains, motifs and folds.

Principles of Catalysis, Classification of enzymes and enzyme kinetics, enzyme regulation, inhibitors of enzymes – mechanism of enzyme catalysis, Isozymes.

**UNIT – IV**

Conformation of nucleic acids – Helix A, B ,Z; t-RNA, Micro RNA. Mechanism of Transcription-RNA modifications, translation (Prokaryotes and Eukaryotes), transcription. Regulation in Prokaryotes and Eukaryotes.

**UNIT- V**

Bioenergetics – Metabolism of aminoacids, carbohydrates (Glycolysis), lipids, nucleotides and vitamins, Oxidative phosphorylation, Coupled reaction, Group transfer, Biological energy transducers..

### **Suggested Reading Materials**

1. Freifelder, D. Physical Biochemistry. W. H. Freeman and Company.
2. Voet, D and Voet, J.G. Biochemistry, John Wiley and Sons.
3. Cooper, T.G. Tools of Biochemistry.
4. Creighton, T.E. Protein Structure and Molecular Properties, W. H. Freeman and Company.
5. Hawk. Practical Physiological Chemistry.

### **Course Outcomes:**

On successful completion of the course the student will be able to

CO1: Understand the chemical structure and function of various bio-molecules.

CO2: Learn about theories on Bio-molecules.

CO3: Easily explain enzymes and their role in living organism.

CO4: Learn about the conformation structure of proteins, lipids and nucleic acids.

CO5: Explain the metabolism of carbohydrates, proteins, lipids, vitamins and nucleic acids.

## **ELECTIVE PAPER – 3**

### **POULTRY SCIENCE (20PZE03)**

Teaching Hours: 4 hr/ week

Credit Point: 3

#### **Course objectives**

- To provide self employment opportunities and knowledge for students.
- To understand poultry industry based on the past, present and emphasis of future growth
- To make the students to develop knowledge on the history and the role of poultry in rural development and its structure.
- Students can learn the methods of rearing, breeding and production of poultry and marketing.

#### **Unit – 1**

History, Scope and importance of poultry farming – Poultry development in India – present status and future prospectus of poultry industry- Role of government/ private agencies in poultry development.

#### **UNIT-II**

Poultry Housing – Basic principles and location for construction - Types: backyard system, semi-intensive system, intensive system – cage, deep litter and slat system, floor space, lighting and watering.

#### **UNIT III**

Brooding of Poultry: Rearing, Sexing, Vaccination, Natural and artificial brooding - Objectives of poultry breeding for meat and egg production - Methods of mating –flock, pen, pair and artificial insemination. Breeding –common breeding programs practiced in industry.

#### **UNIT-IV**

Poultry nutrition – Feed ingredients and formulation – Types of feed: mash, pellet - Feeding methods - Poultry diseases and vaccination.

#### **Unit V**

Role of government and non-governmental agencies in promoting poultry entrepreneurship in India - objectives and functions –NABARD- Role of commercial banks.



### **Suggested Reading Materials**

1. Gnanamani,R, Modern Aspects of Commercial Poultry Keeping, Hytone Publication.
2. Das, S.K, Poultry Production, CBS Publication.
3. Singh, R. A. Poultry Production, Kalyani Publishers, New Delhi.
4. Prasad, J. Poultry Production and Management, Kalyani Publisher, New Delhi.
5. Hurd, L.M, Modern Poultry Farming, IBDC Publishers
6. Elye, N. The Poultry Science, Biotech books, New Delhi.
7. Poultry Farm Manual, A Reference Guide for Central & State Poultry Farms, Krishi Bhavan, New Delhi.
8. Hand Book of Poultry Farming and Feed Formulations, Engineers India Research Institute Board.
9. Jadhav, N.V. and Siddique, M.F, Handbook of Poultry Production and Management, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.
10. Wilson.K. A Hand Book of Poultry Practice, Agrobios (India), Jodhpur.
11. Jull, M.A.Successful Poultry Management, Biotec Books Publisher.
12. Charles, T.B. and Stuart, H.O, Commercial Poultry Farming, Biotec Books Publisher.

### **Course Outcomes:**

On successful completion of the course the students can able to

CO1: The graduate can explain the scope and future prospectus of poultry industry.

CO2: The student can brief about the daily work in poultry farm activities.

CO3: He will neatly explain the brooders, breeding methods and vaccinations in poultry farms.

CO4: The students are exposed to prepare poultry feed using different ingredients and symptoms of various diseases that affects poultry farms.

CO5: The graduate gain knowledge about getting bank and government funds regarding poultry farms.

**ELECTIVE PAPER – 4**  
**AQUACULTURE (20PZE04)**

Teaching Hours: 4 hr/ week

Credit Point: 3

**Course Objectives:**

- To provide self employment opportunities and knowledge for students.
- To learn the techniques of breeding, culturing, and marketing of aquatic animals.
- To explore the aquatic resources of the edible and economically important organisms.
- To understand the fish feed formulation techniques
- To learn the scope and importance of aquaculture

**UNIT –I**

Introduction to Aquaculture – Principle, Scope, Importance and needs of aquaculture - National and International status of aquaculture - Environmental problems caused by aquaculture.

**UNIT – II**

Site selection for aquaculture practices - Fish pond construction, Types of fish culture - Monoculture, Polyculture, Pen culture, Cage culture, Integrated fish farming, Brackish water prawn culture and Marine culture.

**UNIT – III**

Fish and prawn feed requirements and formulation of artificial feed – Live feed culture - Probiotics in aquaculture feed.

**UNIT – IV**

Common diseases of aquaculture: bacterial, fungal and viral infections - Fish diseases and Treatments - Host, pathogen and environment interaction.

**UNIT - V**

Development of new techniques in aquaculture: Cryopreservation and Vaccination - Aquaculture economics: Starting investments, Economic returns, Banking facility and Marketing.

### **Suggested Reading Materials**

1. Ahilan.B. and Felix, N. Text book of aquaculture. Daya publishing house, New Delhi.
2. Arumugam, N. Aquaculture, Saras publications, Nagercoil.
3. Venugopal, S Aquaculture, Pointer Publishers.
4. Reddy, M.S. A text Book of Aquaculture, Arjun publishing house.
5. Patel, A. and. Pathak, S.N, Textbook of aquaculture, Pacific books international.
6. Ahilan, B. Textbook on freshwater aquaculture. Daya publishing house, New Delhi.
7. S.H. Ahmad and A.K. Singh, Freshwater aquaculture, Daya publishing house, New Delhi.
8. Shanmugham, K. Fishery biology and aquaculture, Chennai.
9. Jhingran, V.G., Fish and fisheries of India, Hindustan publishing corporation, Delhi.
10. Pillay, T.V.R. and M.N. Kutty, Aquaculture: Principles and practices, Wiley India pvt. ltd.
11. Handbook of fisheries and aquaculture – ICAR publication, New Delhi.
12. Sinha,V.R.P. Fisheries research planning and management in developing countries, International books and periodicals services (IBS), New Delhi.
13. McEvoy, L.A. and Stottrup, J.G. Live feeds in marine aquaculture - L.A. Mc Evoy and J.G. Stottrup - Blackwell publishing company, UK.

### **Course Outcomes:**

On successful completion of the course the students are able to

CO1: Explain briefly the importance of aquaculture and its scopes.

CO2: The student can clearly know which type of culture and which aquatic organisms are suitable for culture in his locality.

CO3: The student can gain knowledge about probiotics, and live feed culture techniques.

CO4: The graduate can easily identify the symptoms of bacterial, viral and fungal diseases to culture fishes and its remedial measures.

CO5: The graduate can guide farmers to get loans from nationalized banks for fish farming.

**MAJOR PRACTICAL – II**  
**Genetics, Immunology and Biochemistry**  
**(20PZP02)**

Practical Hours: 5hr/ week

Credit Point: 4

**Major:**

Quantitative estimation of proteins, carbohydrate and lipids from animal tissues.

Enzyme kinetics – Influence of pH, temperature, substrate concentration and enzyme concentration on human salivary amylase activity.

Qualitative analysis of urine for proteins, glucose, acetone and ketone bodies.

Estimation of haemoglobin and ESR- Erythrocyte Sedimentation Rate.

Blood clotting time – bleeding time

Buccal smear – Barr bodies.

Demonstration of Amino acids in the body fluid of an insect (Cockroach/ grasshopper) using paper chromatography.

**Minor:**

Genetic and immunological basis of human blood grouping (A, B, AB and O).

Identification of mutant wings/eyes in drosophila.

Identification of lymphoid organs of Rat/ Mouse.

Demonstration – Culture of bacteria, Preparation of smear, Simple staining and gram staining.

**Spotters:**

Human karyotype, Down syndrome, Klinefelters syndrome, Turners syndrome.

Study of bacterial diseases in related to Human health – Vibrio cholera – Cholera,

Salmonella typhi - Typhoid, Mycobacterium tuberculosis – Tuberculosis,, Streptococcus

pneumoniae - Pneumonia, Staphylococcus aureus – Upper respiratory tract infection,

Yersinia pestis – Bubonic plague, Clostridium botulinum – Food borne disease.

**NON-MAJOR COURSE -1**  
**FISHERY BIOLOGY (20PZNM01)**

Teaching Hours: 4 hrs/ week

Credit Point: 3

**Course Objectives:**

- To learn the importance of aquaculture in nutritional and economical level.
- To learn about techniques in pond construction, farming managements, etc.,
- To explore the knowledge about rearing aquatic organisms in ponds.
- To gain knowledge about the infections and their remedial measures.

**UNIT – I**

Introduction - Importance of inland fisheries, Principles and aim of fish culture. Types of fish culture – Monoculture, Polyculture, Race way culture, Pen culture, Cage culture, Raft culture, Paddy cum fish culture, Integrated farming, Corporate farming.

**UNIT – II**

Site selection for fish farm, Pond construction, Pond preparation, Types of ponds in a typical fish farm, Water quality management, Feeding and types of feeds – Natural and artificial feed.

**UNIT – III**

Selection of cultivable species, Seed selection, Seed transportation techniques, Acclimatization of seeds to pond water, Routine farm activities, Harvesting methods.

**UNIT – IV**

Mariculture, Types of cultivable shrimps - Shrimp hatcheries, Transportation techniques of post larvae, Stocking types and rearing methods, Natural and artificial feeds, Shrimp harvesting methods.

**UNIT – V**

Fish diseases – bacterial, fungal and viral infections and their remedial methods. Post harvesting methods and types of fish processing methods.

### **Suggested Reading Materials**

1. Shanmugam, K. Fishery biology and aquaculture. Leo Pathipagam, Chennai.
2. Kamaleswar Pandey and Shukla, J.P. Fish and fisheries, Rastogi publications, Meerut.
3. Shukla, G.S and Upadhyay, V.B. Economic Zoology, Rastogi Publications, Meerut.
4. Handbook of Fisheries and Aquaculture, ICAR Publication, New Delhi.

### **Course Outcomes:**

On successful completion of the course the student will gain

CO1: Easy to get employment / self-employment opportunities in fish farms.

CO2: Able to design and construct aqua farms and know farm managements.

CO3: Learn knowledge how to select cultivable species, rearing and harvesting techniques.

CO4: Gain knowledge about hatchery operations and its managements.

CO5: Understand the fish diseases and its remedial methods.

## NON-MAJOR COURSE - 2

### NURTRITION AND DIETETICS (20PZNM02)

Teaching Hours: 4 hrs / week

Credit Point: 3

#### Course Objectives:

- To gain knowledge regarding various types of food sources.
- To understand nutritive value of food materials, balanced diet and deficiency of vitamins in food.
- Able to identify the nutritious food sources in related to infectious diseases.
- Gain knowledge to understand principles in related to diet therapy for Acute, chronic infections and diet requirement for pregnant women.

#### UNIT- I

Introduction - Food as a source of nutrition, intake and its regulations, Food and future, Food production and population

#### UNIT – II

Balanced Diet, Nutritive value of some common food, Diet in nutritional deficiency diseases, Malnutrition, Vitamin deficiency, etc

#### UNIT – III

Obesity and under weight, Diabetes mellitus - Diet in infectious diseases, Typhoid, Tuberculosis, Malaria and Pneumonia

#### UNIT – IV

Nutrition during pregnancy, Diet for allergy, common food allergies, Dietetic treatment. Nutrition for different age group

#### UNIT – V

Nutrition for heart patients – Coronary heart diseases, Atherosclerosis, Congestive heart failure, Hypertension – Sodium restricted diets

### **Suggested Reading Materials**

1. Srilakshmi, B. Food Science 3rd Edition. New Age International Publication.
2. Sakuntala Mary, N. Food facts and Principles. 2<sup>nd</sup> Edition. New Age International Publication.
3. William C.Frazier and C.Dennis Westhaf. Food Microbiology 4<sup>th</sup> Edition, Tata McGraw Hill Publication Co. Ltd.

### **Course Outcomes:**

On successful completion of the course the student able to

CO1: Gain knowledge about nutritional classification various food sources and their nutritive values.

CO2: Able to understand balanced diet and diet for malnutrition, vitamin deficiency persons.

CO3: Understand the nutritional requirement for various disease infected patients.

CO4: Students can understand the principle of nutrition for pregnant women.

CO5: Gain knowledge regarding diet for heart, coronary, hypertension patients.



## **SEMESTER - III**

### **CORE PAPER- 7**

#### **COMPARATIVE ANIMAL PHYSIOLOGY (20PZC07)**

Teaching Hours: 5hrs / week

Credit Point: 5

#### **Course Objectives:**

- To understand the physiological functions of animal parts in related to its habitat.
- To study the osmoregulatory mechanism of animals.
- To understand the respiratory physiology of both terrestrial and aquatic forms.
- To know the excretory and endocrine system in the animals.
- To learn the neuromuscular coordination in animals.

#### **UNIT – I**

Adaptation – levels of adaptation – mechanism of adaptation – significance of body size – adaptation, acclimation and acclimatization – concepts of homeostasis.

Physiological adaptations of different environments- marine – shores and estuaries – freshwater – extreme aquatic environments – terrestrial life – extreme terrestrial environments – parasitic habitats.

Stress physiology – basic concept of environmental stress and strain; concept of elastic and plastic strain, stress resistance, stress avoidance and stress and stress tolerance.

#### **UNIT –II**

Endothermic and Physiological mechanisms of regulation of body temperature – Physiological adaptation to osmotic and ionic stress; mechanism of cell volume regulation- Osmoregulation in aquatic and terrestrial environments.

#### **UNIT – III**

Respiratory Physiology – Structures – Respiratory gases- uptake-respiratory pigments – oxygen and carbon dioxide dissociation curve – transport of respiratory gases. Physiological response to oxygen deficient stress – Physiological response to body exercise – meditation, yoga and their effects.

#### **UNIT – IV**

Excretory physiology – Excretory organs – Mechanisms of excretion - physiology – Adaptations of excretion to environment – excretory products – synthesis and elimination

Endocrine glands – Feedback regulation – Pituitary – Gonadal axis – Role of reproductive hormones – gamete formation; Fertilization; Embryonic development; parturition; lactation; neuro-endocrine regulation.

## **UNIT – V**

Structure of neurons, Physiology of neurons – action potential – nerve impulse transmission – neurotransmitters – mechanism of neural transmission – neurodegenerative diseases

Muscle physiology – muscle contraction - theories – molecular mechanism of muscle contraction.

### **Suggested Reading Materials**

1. Eckert, R. Animal Physiology: Mechanisms and Adaptation, W.H. Freeman and Company, New York.
2. Hochachka, P.W and Somero, G.N. Biochemical Adaptation, Princeton, New York.
3. Hoar, W.S. General and Comparative Animal Physiology, Prentice Hall, India.
4. Strand, F.L. Physiology: A regulation system approach, Macmillan Publishing Co., New York.
5. Pummer, L. Practical Biochemistry, Tata McGraw-Hill.
6. Prosser, C.L. Environmental and Metabolic Animal Physiology, Wiley-Liss Inc., New York.
7. Wilson, K and Walker. J. Practical Biochemistry.
8. Schiødt Nielsen. Animal Physiology - Adaptation and Environment. Cambridge.

### **Course Outcomes:**

On successful completion of the course the student will be able to

CO1: Adaptive nature of animals in relation to their habitat.

CO2: Osmoregulatory behaviour of animals in relation to stress, changes in environmental conditions.

CO3: Basic mechanism of respiratory organs

CO4: Learn about the excretory and endocrine system in animals.

CO5: Understand the neuromuscular interactions in animals.

## CORE PAPER – 8

### DEVELOPMENTAL BIOLOGY (20PZC08)

Teaching Hours: 5hrs/ week

Credit Point: 5

#### Course Objectives:

- To understand the basic concepts of developmental biology.
- To learn the cellular and tissue level events happens in gametogenesis.
- To acquire basic knowledge on organogenesis in related to development and differentiation.
- To understand the regeneration in development of immune system in vertebrates.
- To gain knowledge about various modern reproductive techniques in related to male and female infertility.

#### UNIT – I

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenic in analysis of development.

#### UNIT –II

Gametogenesis - Fertilization and early development: Production of gametes, cell surface molecules in sperm- egg recognition in animals; zygote formation, cleavage, blastula formation, embryonic fields, Gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry.

#### UNIT – III

Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibian and chick; organogenesis-vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development in amphibia and regeneration in vertebrates; differentiation of neurons, post embryonic development – larval formation, metamorphosis; environmental regulation of normal development; sex determination.

#### UNIT – IV

Neoteny: Occurrence and significance – regeneration; regenerative capacity in the animal kingdom – factors influencing regeneration – stimulation and suppression – polarity and gradients – development of immune system in vertebrates.

## **UNIT – V**

Programmed cell death, aging and senescence – Asexual reproduction – assisted reproductive technology (ART) – male infertility – sperm abnormalities – super ovulation – IVF, ICSI, and GIFT – screening of genetic disorders.

### **Suggested Reading Materials**

1. Balinsky. Introduction to embryology.
2. Grant. Biology of developing system.
3. Austen, C.R. Reproduction in animals.
4. Schatten and Schatten. Molecular biology of fertilization.
5. Longo. Fertilization. Chapman and Hall.
6. Edwards, Human reproduction.

### **Course Outcomes:**

On successful completion of the course, the students will able to

CO1: Understand the cellular and molecular level developments of organisms.

CO2: Students will gain knowledge on gametogenesis and embryological development.

CO3: Students will acquire knowledge about organ formation and their development during embryology.

CO4: Know various stages of regeneration mechanism happen in embryo and adults.

CO5: To understand the modern embryological techniques in related to male and female infertility.

## **CORE PAPER – 9**

### **RESEARCH METHODOLOGY (20PZC09)**

Teaching Hours: 5 hrs/week

Credit Point: 5

#### **Course Objectives:**

The students gain knowledge on

- Identifying research problem and the basic methods of experimentation
- Methods of preparation of articles and its publication ethics
- Instrumentation and its applications in research work.
- Statistical packages and their application

#### **Unit - I**

Scope – Identification and selection of research problem – Methods of literature collection: online, Internet and website, reviews, monographs and abstract services - Experimental approach - Designing of methodology – Planning and execution of investigations – Methods of editing and abstracting, Preparation of manuscript and proof reading – Research ethics - Plagiarism - Thesis writing.

#### **UNIT - II**

Preparation and presentation of research papers for journals - Refereed journals - Symposia and conferences– Impact factor – H-index – Citation index – Patents, Copyright – Preparation of research proposals - Funding agencies: TNSCST, UGC, DST, DBT, ICMR and CSIR.

#### **Unit - III**

Microscopy: Principles and applications - Phase contrast microscope, Electron microscopy: SEM, TEM, Chromatography: Principles and Applications - TLC, HPLC, Electrophoresis: Principles and Applications – Agarose Gel and SDS-PAGE

#### **UNIT - IV**

Tracer techniques: Radiation measuring devices – Geiger Muller counter, Scintillation Counter - Principles and Applications. Spectroscopy: UV-Vis, FTIR, NMR, – Principles and applications.

## Unit - V

Statistical methods and application:—Test of significance – Student’s ‘t’ test , Chi – Square test, ‘F’ test – ANOVA – one way, two way and multiple way – Correlation - regressions. SPSS Package -Statistical analysis using Microsoft EXCEL program

### Suggested Reading Materials

1. Anderson, Durston and Polle. Thesis and Assignment Writing, Wiley Easter Limited.
2. Allen, H. Benton, William, E. And Verner. Field Biology and Ecology, McGraw Hill Book Co., New York.
3. King, B. Cell Biology. London, Allen and Unwin Boston, London.
4. Kumar, H.D. Modern concepts of Biotechnology. Vikas Publishing House Pvt. Ltd., New Delhi.
5. Ramakrishnan. S and Swamy, R. Text book of clinical (Medical) Biochemistry and Immunology, TR. Publications, Chennai.
6. Gurumani, N. Research methodology for biological sciences, MJP Publishers.
7. Veerakumari, L. Bio-instrumentation. MJP Publishers, Chennai.

### Course Outcomes:

On successful completion of the course the student will able to

CO1: Choose the appropriate research design and develop research hypothesis for a research work.

CO2: Develops the ability to apply methods to present, prepare research article for publications.

CO3: Student can acquire knowledge to handle various instruments in related to his research work.

CO4: Gain knowledge regarding tracer techniques.

CO5: Develops appropriate statistical methods required for research work design.

**ELECTIVE PAPER 5**  
**ENTOMOLOGY (20PZE05)**

Teaching Hours: 4hrs/ week      Credit Point: 3

**Course Objectives:**

- To study the external morphology, anatomy, physiology and behaviour of insects and their position in animal kingdom by studying their taxonomic characters up to order.
- To know about the economic entomology and special adaptation of insects

**UNIT - I**

Taxonomy: Basics of insect classification. Classification up to order – Key characteristics of insects orders with common south Indian examples.

**UNIT - II**

Morphology: External features and their articulation. Comparative study of head, antennae, mouth parts; thorax, legs, wings; abdominal appendages, genitalia.

Integumentary system – structure and chemistry. Digestive system: Structure and physiology of digestive system. Respiration: Aerial respiration – aquatic respiration – respiration in endoparasites. Circulatory system: Structure of heart, mechanism of haemolymph circulation – Haemolymph and its composition – A study of haemocytes and their functions.

**UNIT - III**

Excretory system: Malpighian tubules and their functions – Role of rectum in water and ion regulation. Nervous system: Structure – Neurotransmitters – Structure and function of compound eye – stridulatory organ. Reproductive system: Male and female reproductive systems – types of ovaries – vitellogenesis – mating - oviposition – viviparity – accessory reproductive glands – their secretions and functions. Endocrine system: Endocrine control of moulting and metamorphosis – Role of hormones in male and female reproduction. Neuro - endocrine system of insects.

## **UNIT - IV**

**Sericulture:** History of Sericulture, Life cycles of Mulberry and Non-mulberry, Silkworms, Rearing technology of mulberry silkworm, Diseases and pests of mulberry silkworm, Moriculture and cultural practices, Diseases and pests of mulberry.

**Apiculture:** The honey bee, Social organization of honey bees, Life history of honey bees, Methods of bee keeping.

**Lac culture:** Lac insect- Taxonomy, distribution and life history, Host plants and lac insects, Strains of lac insect and their propagation.

## **UNIT - V**

**Insect Pest Management:** Pest- definition, Pests in agro ecosystem, Pest of cereals, vegetables, cotton, sugarcane and grains. Integrated pest management – Pest control – quarantine, physical, chemical, biological, genetic and biotechnological methods of control. Pesticides – structure and function of Organochlorine, Organophosphorus, carbamate, pyrethroid – Plant origin pesticides, fumigants.

### **Suggested Reading Materials**

1. Mani, M.S. General Entomology, Oxford and IBH publishing Co., New Delhi.
2. Snodgrass, R.E. Principles of Insect Morphology, McGraw Hill and Co. New York.
3. Wigglesworth, V.B. Physiology of insects, IX Ed., Chapman and Hall, London.
4. Borror, D.H. and De Long, An introduction to the study of insects, Holt Reinhart & Winston Inc., New York.
5. Chapman, R.F. The insects: Structure and Function, Hodder and Broughton Ltd., Kent, U.S.A.
6. Nayar, K.K., Ananthkrishnan, T.N and David, M. General and applied Entomology, Tata McGraw Hill Publishing Co., Ltd., New York.
7. Richards, O.W and R.G. Davies. General Text Book of Entomology, X Ed., Vols.I and II, Chapman and Hall, New York.
8. Vasantharaj David, B. Elements of Economic Entomology, Popular Book Depot, Chennai.
9. Nayar, K.K. Economic Entomology and Applied Entomology, Oxford and IBH Publishing co. New Delhi.



10. Nayar, K.K., T.N. Ananthakrishnanj and David B.V. General and Applied Entomology, Tata McGraw Hill Publications, New Delhi.
11. Rathinaswamy, T.K. Medical Entomology, S. Viswanathan and Co. Madras.
12. Chapman – The Insects: Structure and Function 4th edn ELBS.
13. Imms A.D. – A General Text Book of Entomology 2 vol
14. Dorothy Gennard, Forensic Entomology: An Introduction, 2nd Edition Wiley-Blackwell

**Course Outcomes:**

On successful completion of the course the student can able to

CO1: Classify the insects up to order level.

CO2: Explain the morphology and system of insects.

CO3: Understand the various internal systems of the insects.

CO4: Students can acquire knowledge about Sericulture, Apiculture and Lac culture techniques.

CO5: Briefly gain knowledge on pest and its management methods.

**ELECTIVE PAPER –6**  
**MEDICAL PARASITOLOGY (20PZE06)**

Teaching Hours: 4hrs/ week

Credit Point: 3

**Course Objectives:**

- Recognize significant morphological characteristics for identification of parasites to taxonomic group and the life history stage.
- Present the life history of the parasitic group as well as that of genera or species including:
  - The infective agent for each host and their means of invasion
  - Each host in the life cycle and type of development, multiplication, etc., which occurs in each host
  - Movement routes and sites of development within hosts, free living stages.
- Understand the treatment, prevention, and control of the parasitic genera and species presented.

**UNIT - I**

Introduction to parasites of man: Scope and definition of parasites/parasitology – Classification of parasites, types of hosts, inter relationship between host and parasite. Responses and hosts to parasitic infection, mode of transmission of parasite, host specificity and parasitic adaptation.

**UNIT - II**

Protozoa and cestoda: Geographical distribution, Morphology, Life-cycle, Transmission, Pathogenesis and control measures, Treatment and Prophylaxis of 1. Protozoan parasites: Entamoeba Sp, 2. Intestinal flagellates: Giardia Sp, Trichomonus Sp, 3. Cestodes: Taenia Sp, Diphilobothrium Sp.

**UNIT - III**

Trematoda and nematoda: Classification, Geographical distribution, Morphology, Life-cycle, Transmission, Pathogenicity, Treatment and Prophylaxis of 1. Trematodes: Schistosoma Sp, Fasciola Sp, Echinococcus Sp. 2 Nematodes: Wuchereria Sp, Ancylostoma Sps, Dracunculus Sp. 3 Plant & Soil nematodes: Cyst nematode, citrus nematode.

## **UNIT - IV**

Vectors - definition, types of vector. Arthropod vector of medical and veterinary parasitic diseases and their importance – Sand flies (Leishmaniasis); Mosquitoes (Dengue and Malaria); Tse Tse fly (Trypanosomiasis) and Rat flea (Flea borne typhus). Ticks and mites diseases & different methods of vector control measures.

## **UNIT - V**

Diagnostic methods of parasitology: Examination of the human samples for parasitic isolation and identification: Blood, Stool and Sputum. Methods of Diagnosis: Immuno diagnosis, Skin Method, Molecular methods, Xeno-diagnosis, Culture methods of parasites and animal inoculation.

### **Suggested Reading Materials**

1. Anderson, O.R, Comparative protozoology, Ecology, Physiology, Life history. Springer-Verlag, Berlin.
2. Cheng T. C. General Parasitology, Academic Press.
3. Cox F.E.G., Modern Parasitology, Eds. Parasitology in focus, facts & trends, Melhorn Eds., Spriger Verlag, Berlin.
4. Piakarsky G. L., Medical Parasitology, Springer Verlag, Berlin.
5. Wyler D. J., Eds. W. H. Freeman, NY, Modern Parasitology, Cellular immunological & Immunological aspects,
6. Soulsby, E. J. L., Helminths, Arthropods and Protozoa of domesticated animals. ELBS and Bailliere Tindall. London.
7. Kelkar S.S. and Rohini S, Kelkar, A Text Book of Parasitology, Bombay Popular Prakashan.
8. Chandler, Parasitology. S. Chand Publication.
9. Ramnik Sood, Parasitology, C.B.S. Publisher, New Delhi.
10. K.D. Chatterjee, Parasitology, Medical Publisher Calcutta.
11. Hober, E.R. and Noble, G.A. Parasitology 2nd Edition, Lea & Febieger U.S.A

12. Smit. D.G. Introduction Animal Parasitology 2nd Edition, Johns Willey Sons, New York.
13. Soulsby, E.J.L. Helminthes, Arthropods & Protozoa of Domesticated Animals, ELBS  
Publication London Ed
14. L. S. Roberts, J. Janovy, Jr. Foundations of Parasitology 8th ed., W.C. Brown, Dubuque, IA  
(required).
15. Dailey, M. D. Meyer, Olsen & Schmidt's Essentials of Parasitology, 6th ed., W.C. Brown,  
Dubuque, IA (required).

**Course Outcomes:**

On successful completion of the course the student can able to

CO1: Describe the morphology and classification of parasites of medical importance.

CO2: Acquire knowledge about the life history, mode of transmission, and pathogenesis of various human parasites.

CO3: Explain the parasitic mode of infection by trematodes and nematodes.

CO4: Gain knowledge about many vector borne infections in Human beings.

CO5: Outline the treatments for various parasitic infections, prevention and control measures.

**MAJOR PRACTICAL – III**  
**VComparative Animal Physiology, Developmental Biology, Research Methodology**  
**(20PZP03)**

Practical Hours: 5hr/ week

Credit Point: 4

**Major:**

Determination of Salt loss and Salt gain in Fish / Crab.

Determination of Respiratory Quotient in aquatic animal in relation to Light (Fish /crab).

Blastoderm Mounting of Chick embryo.

Problems related to Mean, Standard Deviation, Chi-square test.

**Minor:**

Types of Placenta.

Estimation of Haemoglobin using Sahli haemocytometer.

Application of Sphygmomanometer/ Kymograph.

Qualitative analysis of Excretory products.

**Spotters:**

Developmental Stages of Frog – Egg, Cleavage (2 cell, 4 cell, 8 cell, Morula), Blastula, Gastrula.

Developmental Stages of Chick – Egg, 24 hrs embryo, 48 hrs embryo, 72hrs embryo, 96hrs embryo.

Types of Placenta (Images/ Photograph)

Simple Muscle Twitch, Summation, Treppe, Tetanus - Kymographic recordings.

Spectrophotometer, pH meter, Phase contrast Microscope.

## **NON-MAJOR COURSE – 2**

### **DAIRY SCIENCE (20PZNM03)**

Teaching Hours: 3hrs / week

Credit Point: 3

#### **Course Objectives:**

- To acquire knowledge about milk formation and components.
- To explain the production of milk and pre-treatment of milk and importance of UHT and Pasteurization processes.
- To depict the detection of adulterants in milk.
- To gain knowledge on dairy processing, sterilized milk and fermented milk products.

#### **UNIT – I**

Introduction to livestock products technology, Distinguishing characteristics of Indian and exotic breeds of dairy animals and their performance. Types of livestock farming, dairy farming systems, Traditional systems of cattle keeping. General dairy farm practices- identification, dehorning, castration, exercising, grooming, weighing. Care of animals at calving and management of neonates.

#### **UNIT – II**

Common disease problems in dairy animals, their prevention and control management of lactating and dry cows and buffaloes. Methods of milking, milking procedure and practices for quality milk production. Systems of housing dairy animals and maintenance of hygiene and sanitation at dairy farm premises.

#### **UNIT - III**

Composition of Milk, Food and Nutritive value of milk, Physicochemical characteristics and factors affecting milk, Production collection, testing quality, cooling, storage, and transportation of liquid milks. Receiving and quality assessing of liquid milk in dairy industry for detection of adulteration, decision for acceptance / rejection, and determination of price of the milk. Elementary knowledge about indigenous and modern dairy products.

## **UNIT – IV**

Milk processing operations - Reception, Chilling, Clarification and Storage, Thermal Processing of Milk; Standardization and /or processing (pasteurization, homogenization, sterilization and UHT processing), storage, packaging and distribution of liquid milk. Classification of Milk - Standardized Milk, Toned, Doubled Toned, Reconstituted, Recombined, Flavored Milk.

## **UNIT – V**

Milk quality control: sanitation in the dairy plant, dairy equipment maintenance and waste disposal, Dairy development; major aided dairy projects; public sector milk supply schemes; co-operative dairy organizations.

### **Suggested Reading Materials**

1. Petersen, W.E. Dairy science, Lippincott & Company.
2. Sukumar, Outlines of dairy technology, Oxford university press.
3. Rangappa, K.S and Acharya, KT, Indian dairy products, Asia Publishing House.
4. Ananthakrishnan, C.P., Khan, A.Q. and Padmanabhan, P.N, The technology of milk processing –. – Shri Lakshmi Publications.
5. Winton A, L and Winton, K.B, Milk and milk products. Agrobios, India.
6. Kuty, C.L and Khamer, S, Milk production and processing. Daya Publishers, Delhi.
7. Milk Testing – The Laboratory Control of Milk. Davis, J.G. Agro Botanical, Bikaner.

## **Course Outcome**

On successful completion of the course, the students will able to

CO1: Understand the processes related to storage, processing and milk products.

CO2: To perceive the different properties of milk and milk products.

CO3: The students will gain knowledge regarding various processing of milk and varieties of milk products.

CO4: The student can acquire hygiene and sanitation practices in utensils and machineries in dairy industry.

## NONMAJOR COURSE -2

### INSECT PEST MANAGEMENT (20PZNM04)

Teaching Hours: 3hrs / week

Credit Point: 3

#### Course Objectives:

- Gain knowledge about various pests and their status.
- Mode of pest migration and damages caused by them in agroecosystem.
- Various types of control measures and their application methods.
- Latest trend of pest management applied in the present situation.

#### UNIT – I

Pest - Definition and its ecology, Pest status – factors responsible for achieving the status of pest, Pest complex and carrying capacity, Pest surveillance and sampling.

#### UNIT – II

Population dynamics of pests in agro-ecosystem, Pest population and size, factors responsible for population fluctuation. Pests of cereals, Pulse crops, Cotton, Vegetables, Oil seeds, Fruit crops, Sugarcane and grains.

#### UNIT – III

Locust – different species, phase transition, periodicity, migration, biology and control measures. Integrated Pest Management (IPM) – History, different phases of pest control, Quarantine, Physical, and Chemical, Biological control, Genetic and biotechnological methods of control.

#### UNIT- IV

Definition of pesticides, brief history, pesticides registration, pesticide industries and markets. Dose - response relationship; mode of action of insecticide, carcinogenic, mutagenic and teratogenic effects and evaluation of toxicity. Group characteristics of insecticide, structure and function of organochlorine, organophosphorus, carbamate, pyrethrod, other plant origin as well as bio-insecticides, neo -nicotinoids and nitrogenous insecticides, fumigants.

#### UNIT – V

Pheromones – production and their use in pest control, Management of plants resistance to Insects, Transgenic plants. *Bacillus thuriensis* (Bt) and its mode of action on insect, different species of Bt sub species, Resistance management of Bt crops.



## **Suggested Reading Materials**

1. Speight, M. R., Hunter, M. D. and Watt, A. D, Ecology of insects, Wiley-Blackwell, UK
2. Schoonhoven, L. M., van Loon, J.A. and Dicke, M., Insect plant biology, Publisher Oxford University Press, USA
3. Jolivet, P., Interrelationship between insects and plants, CRC Press, USA
4. Carde, R. T and Bell, W. J, Chemical ecology of insects, Chapman & Hall, New York, USA
5. Pedigo, L. P. Entomology & Pest management, Prentice hall, New Jersey, USA
6. Norris, Caswell-Chen and Kogan, Concepts of IPM, Prentice-Hall, USA
7. Agricultural insect pests of the tropics and their control, Hill, D. S., Cambridge University Press, UK
8. Whitford, F., The Complete Book of pesticide management, Wiley Inter science, John Wiley and Sons, UK
9. Hodgson, E and Kuhr, R. J., Safer insecticides, Marcel Dekker Inc., New York, USA
10. Matthews, G, A., Pesticide application methods, Blackwell Science, London, UK
11. Wilkinson, C. F., Pesticide biochemistry and physiology, Plenum Press, New York, UK
12. Roberts, T. R., and Hutson, D. H. Metabolic pathways of agrochemicals Part II, The Royal society of chemistry, UK
13. Mullen, G. and Durden, L, Medical and Veterinary Entomology Academic Press, USA
14. Kettle, D. S, Medical and veterinary entomology, Cabi Press, USA
15. Medical entomology for students, Cambridge university press, UK.

### **Course Outcomes:**

CO1: Create awareness about pest, its surveillance and sampling methods.

CO2: Gain knowledge about pests in agro-ecosystem.

CO3: Understand the role of IPM in sustainable agriculture as the future of modern plant protection.

CO4: Learn about the use of different pest control methods.

CO5: Gain knowledge on latest pest control measure by pheromones and BT crops.

## **SEMESTER - IV**

### **CORE PAPER- 10**

#### **ENVIRONMENTAL BIOLOGY (20PZC10)**

Teaching Hours: 5hrs / week

Credit Point: 5

#### **Course Objectives:**

- To introduce specific examples and cases, and explain how chemical, biological and molecular sciences can apply to identify and address issues of environmental concerns.
- To understand the nature of environmental influences on individual organisms, their populations, and communities, on eco scopes and ultimately at the level of the biosphere
- To describe behavioral and physiological mechanisms by which organisms interact with other organisms and with their physical environment.
- To study biotic and abiotic factors that influences the dynamics of populations.
- To explain the biogeochemistry, energy flow, or biodiversity of ecosystems responds to climate change or another disturbance.

#### **UNIT – I**

The environment - physical environment, biotic environment – abiotic and biotic interactions.

Habitat and Niches: Concept of habitat and niche, niche width and overlap; fundamental and realized niche, resources partitioning, Character displacement.

#### **UNIT – II**

Population Ecology: Characteristics of population, Population growth curves, Population regulation, Life history and strategies (r and k selection); Concept of metapopulation – demes and dispersal, Interdemic extinctions, age structured population.

Species Interactions: Types of interactions, Inter specific competition, Herbivory, Carnivory, Pollination, Symbiosis.

#### **UNIT – III**

Community Ecology: Nature of communities, Community structure and attributes; Levels of species diversity and its measurement, edges and ecotones. Ecological Succession: Types, mechanisms, changes involved in succession, concept of climax.

## UNIT – IV

Ecology of Ecosystem: Ecosystem structure – function, energy flow and mineral cycling (C, N, P); Primary production and decomposition; Structure and function of some Indian ecosystems; Terrestrial (Forest, Grassland) and Aquatic (Freshwater, Marine and Estuarine).

Biogeography: Major terrestrial biomes, Theory of Island bio-geography; Bio-geographical zones of India.

## UNIT-V

Applied Ecology: Environmental pollution and Bioremediation; Global Environmental Changes; Biodiversity – Status, monitoring and documentation; Major drivers of biodiversity change; Biodiversity management approaches.

Conservation Biology: Principles of conservation, Major approaches to management, Indian case studies on conservation/ management strategy (Project Tiger, Biosphere reserves).

### Suggested Reading Materials

1. Perman, R., Y. Ma and J.Mc Gilvray. Natural Resource and Environmental Economics..Longman Singapore Publishers Ltd. Singapore.
2. Srivastava, D.C. Readings in Environmental Ethics: Multidisciplinary Perspectives, Rawat Publications, Jaipur.
3. Rao, C.S. Environmental Pollution Control Engineering, 3rd Ed., Wiley Eastern Ltd. New Age International Pvt. Ltd.
4. Raymond W. Miller and Roy L. Donalvee, Soils in Our Environment, 7th Ed, Prentice Hall of India Pvt. Ltd.
5. Sharma.B.K. (2001). Water Pollution. Goel Pub. House. Meerut. 11. Wadhwa Y. Air Pollution: Causes and Control. Cyber Tech Publications, New Delhi.
6. Glasson, J; Therivel, R and Chadwick, Al.Introduction to environmental impact assessment. UCL Press. 496p.
7. 7.Abbasi,S. Wetlands of India: Ecology and threats; Discovery Publishing House, New Delhi
8. Daniel,D. Chiras and Reganold,John,P. Natural Resource Conservation: Management for a Sustainable Future, Addison Wesley, Boston.

## **Course Outcomes**

On successful completion of the course the students can able to

CO1: An Environmental biology will be able to recognize the physical, chemical, and biological components of the earth's systems and show how they function.

CO2: Environmental Biology shall demonstrate the scientific method and quantitative techniques to describe, monitor and understand environmental systems.

CO3: Students will apply knowledge of the sciences within an interdisciplinary context in solving environmental issues such as environmental health, food and agriculture, energy, waste and pollution, climate change, population, resource management, and loss of biodiversity.

CO4: Students will carry out an applied research project in the natural sciences.

## **CORE PAPER -11**

### **EVOLUTION (20PZC11)**

Teaching Hours: 5hrs/ week

Credit Point: 5

#### **Course Objectives:**

- The course will give the student knowledge about evolutionary processes and skills in evolutionary analysis
- To study molecular evolution and the history of life
- To emphasize the historical nature of evolutionary biology and the evolutionary concepts.

#### **UNIT – I**

Emergences of evolutionary theories – Lamarck – Darwin – Concept- Evolutionary synthesis- Geological time scale- Eras- Periods – Epoch. Human evolution: Stages of primate evolution including homosapiens.

Behavioral evolution: Altruism and evolution – Group selection and Kin selection.

#### **UNIT – II**

Molecular Evolution: Role of gene in evolution – Evolution of gene families, Molecular drive - Assessment of molecular evolution. Origin of higher categories: Phylogenetic gradualism and punctuated equilibrium – Major trends in the origin of higher categories- Micro and macro evolution – Speciation.

#### **UNIT – III**

Molecular phylogenetics: Construction of phylogenetic tree, Phylogenetic inference – Distance methods, Parsimony methods, Maximum like hood method, Immunological techniques.

#### **UNIT – IV**

Amino acid sequences and phylogeny – Nucleic acid phylogeny – DNA - DNA hybridizations, Restriction enzyme sites, Nucleotide sequence comparisons and homologies – Molecular clocks.

#### **UNIT – V**

Metapopulations – monitoring natural populations – Justify the extinction of small populations – Loss of genetic variations – Conservation of Genetic Resources in diverse taxa – artificial evolution (In vitro).

## **Suggested Reading Materials**

1. Arumugam, N, Organic Evolution, Saras Publications, Taminadu.
2. Arora, MP, Evolution, Himalaya Publishing House Pvt. Ltd. Publication.
3. Paul Amos Moody, Introduction to Evolution. Harper, New York, ed. 2'
4. Dobzhansky, The Genetics And The Origin of Species, Columbia University Press.
5. Dobzansky, T. Genetics and the origin of species. Oxford and TBH Publishing Co. New Delhi.
6. Savage, J.M. Evolution. Aravind Publishing Co. Pvt. Ltd. New Delhi.
7. Elic. Minkoff, Evolutionary Biology, Addison Wesley.
8. Life, Origin, Evolution and adaptation – Sanjiv Chattopadhyay. Books and Allied (P) Ltd.
9. Bishop, B. A., and Anderson, C. W. Students' conceptions of natural selection and its role in evolution. Journal of Research in Science Teaching, 27, 415-427.
10. Hafner, M.S. Evolution laboratory: Laboratory exercises and discussions in evolutionary biology. Baton Rouge, LA: Louisiana State University.
11. Hartl, D. L. A Primer of population genetics (2nd edition). Sunderland, MA: Sinauer Associates.
12. Minkoff, E. C. Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company.
13. Sober, E. Conceptual issues in evolutionary biology. Cambridge, MA: MIT Press.

## **Course Outcomes:**

CO1: Students learn how evolution is the central theoretical explanation for all of life, for all its diversity of form and function.

CO2: Students learn that evolution is a significant part of understanding who we are as humans.

CO3: Students learn practical skills like constructing phylogenetic trees.

CO4: Describe the molecular methods to study genetic variation within and between species.

**MAJOR PRACTICAL – IV**  
**ENVIRONMENTAL BIOLOGY AND EVOLUTION (20PZP04)**

Practical Hours: 5 hrs/ week

Credit Point: 4

**Major:**

Hydro-biological studies of water samples Fresh water/ Effluent / Sewage with special reference to Oxygen, CO<sub>2</sub> and Salinity.

Identification of any five Zooplanktons – (Fresh water or Marine)

**Minor:**

Study of Fossils – Trilobites, Archeopteryx

Living fossils – Peripatus, Limulus.

Animal Associations – Parasitism, Commensalism, Mutualism

**Spotters:**

Secchi disc, Maximum and Minimum Thermometer, Hygrometer, Rain gauge,

Field trip Report on Ecological aspect – Sandy, Muddy and Rocky shores