

# HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)

Re-Accredited with "A" Grade by NAAC (CGPA of 3.26 out of 4.00)

Uthamapalayam - 625 533



## DEPARTMENT OF ZOOLOGY

### M.Sc., Zoology

### Syllabus

### Academic Year 2017 – 2018 onwards

### (I, II, III & IV Semesters)

#### PROGRAMME SPECIFIC OUTCOMES:

- PSO1.** Competence on using the evidence of comparative biology for unity and diversity of life on earth
- PSO2.** Elucidate the ecological interconnectedness of life and able to relate the physical features of the environment to various factors
- PSO3.** Application of scientific method to questions in biology by formulating testable hypotheses and prove them
- PSO4.** Presentation of scientific hypotheses and data both orally and in writing in the prescribed formats
- PSO5.** Accession of primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works
- PSO6.** Demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology

**Course Scheme, Scheme of Examinations & Syllabus**  
**Effective from the academic year 2017 – 2018 onwards**

**Eligibility**

A candidate who has passed B.Sc., Zoology as the major subject with physics as one ancillary. The other ancillary subject may be Mathematics or Botany or Chemistry is eligible for the **Master of Science – Zoology Degree**.

**Duration of the Course:** M.Sc., Zoology – 2years (4- Semesters)

**Medium of instruction:** English

**For Programme Completion**

A Candidate shall complete:

- Part III – Core papers in semesters I, II, III & IV respectively
- Part IV – Elective papers in semesters I, II, III and IV respectively
- Part IV – Non- Major Elective papers in semester III

**Scheme of Examinations under Choice Based Credit System**

Term End Examination (TEE)	– 75 Marks
Continuous Internal Assessment Examination (CIAE)	– 25 Marks
Total	– 100 Marks

**Pattern of Continuous Internal Assessment Examination (CIAE)**

Average of Two Internal Tests (each 20 marks)	– 20 Marks
Seminar	– 05 Marks
Total	– 25 Marks

**Pattern of Term End Examination**

***(Max. Marks: 75 / Time: 3 Hours)***

External Examination Question Paper Pattern for Part III & IV

(Core, Non- Major Elective & Elective)

***Section – A (10 X 1 = 10 Marks)***

Answer ALL questions.

- Questions 1 – 10
- Two questions from each Unit
- Multiple choice questions and each question carries four choices

***Section – B (5 X 7 = 35 Marks)***

Answer ALL questions choosing either A or B.

- Questions 11 – 15
- One question from each Unit
- Descriptive Type

11 A or 11 B

12 A or 12 B

13 A or 13 B

14 A or 14 B

15 A or 15 B

***Section – C (3 X 10 = 30 Marks)***

Answer any THREE out of five questions.

- Questions 16 – 20
- One question from each Unit
- Descriptive and Analytical Type

**Practical Examination**

- Internal – 40 marks (Observation note –10 and Model exam–30)
- External – 60 marks
- Total – 100 marks

Passing minimum is 40%

**HAJEE KARUTHA ROWTHER HOWDIA COLLEGE (AUTONOMOUS),  
M. Sc., DEGREE COURSE STRUCTURE FROM 2017 - 2018  
DEPARTMENT OF ZOOLOGY**

SEM	COURSE CODE	COURSE	TITLE OF THE COURSE	HRS/ WK	CRDT	Int.M ar	Ext. Mar	Total Mar ks
I	17PZYC11	CORE I	BIOLOGY. OF INVERTEBRATES, CHORDATES & PALEONTOLOGY	6	4	25	75	100
	17PZYC12	CORE II	GENETICS	6	4	25	75	100
	17PZYC13	CORE III	CELL & MOLECULAR BIOLOGY	6	4	25	75	100
	17PZYE11	ELECTIVE I	BIOTECHNOLOGY	6	4	25	75	100
	17PZYE12	ELECTIVE II	STEM CELL BIOLOGY					
	17PZYP11	CORE IV	PRACTICAL for CC I – III ; E-I	6	4	40	60	100
			<b>Total</b>	<b>30</b>	<b>20</b>	<b>140</b>	<b>360</b>	<b>500</b>
II	17PZYC21	CORE V	MICROBIOLOGY& IMMUNOLOGY	6	5	25	75	100
	17PZYC22	CORE VI	ANIMAL PHYSIOLOGY	6	5	25	75	100
	17PZYC23	CORE VII	ECOLOGY& BIODIVERSITY	6	5	25	75	100
	17PZYE21	ELECTIVE III	NANOTECHNOLOGY	6	5	25	75	100
	17PZYE22	ELECTIVE IV	VERMI TECHNOLOGY					
	17PZYP21	CORE VIII	PRACTICAL for CC V – VII; E-III	6	4	40	60	100
			<b>Total</b>	<b>30</b>	<b>24</b>	<b>140</b>	<b>360</b>	<b>500</b>

III	17PZYC31	CORE IX	DEVELOPMENTAL BIOLOGY. & EVOLUTION	6	5	25	75	100
	17PZYC32	CORE X	BIOCHEMISTRY & BIOPHYSICS	6	5	25	75	100
	17PZYN31	NON MAJOR ELECTIVE	MEDICAL LAB TECHNIQUES	6	4	25	75	100
	17PZYE31	ELECTIVE V	BIOSTATISTICS & BIOINFORMATICS	6	4	25	75	100
	17PZYE32	ELECTIVE VI	CANCER BIOLOGY					
	17PZYP31	CORE XI	PRACTICAL for CC IX & X; E-V	6	5	40	60	100
<b>Total</b>				<b>30</b>	<b>23</b>	<b>140</b>	<b>360</b>	<b>500</b>
IV	17PZYC41	CORE XII	GENERAL & APPLIED ENTOMOLOGY	6	5	25	75	100
	17PZYC42	CORE XIII	MEDICAL PARASITOLOGY	6	4	25	75	100
	17PZYE41	ELECTIVE- VII	CLINICAL LAB TECHNIQUES	6	4	25	75	100
	17PZYE42	ELECTIVE- VIII	AQUACULTURE & FARM MANAGEMENT					
	17PZYP41	CORE XIII	PRACTICAL (for CC-XII)	6	5	40	60	100
	17PZYC43	CORE -XIV	PROJECT WORK	6	5	25	75	100
<b>Total</b>				<b>30</b>	<b>23</b>	<b>140</b>	<b>360</b>	<b>500</b>
<b>GRAND TOTAL</b>				<b>120</b>	<b>90</b>	<b>500</b>	<b>1500</b>	<b>2000</b>

**Semester I**

**M. Sc., (Zoology)**

**Hrs. 6**

**Core Course I**

**Credits 4**

**Code: 17PZYC11**

**Marks 100**

**BIOLOGY OF INVERTEBRATES, CHORDATES AND  
PALAEONTOLOGY**

**Course Outcomes:**

**CO1:** To study the animals without backbone

**CO2:** Learn and identify the major groups within the phylum Chordata

**CO3:** To develop the understanding of fossilization process of biological taxonomy

**UNIT: I Biology of Invertebrates**

Symmetry in animal organization – Significance of Coelom - Significance of Metamerism – Evolution of Metamerism – Locomotion in Annelids, Nutrition in Polychaetes, Molluscs and Echinoderms.

**UNIT: II**

Respiration in Arthropods and Molluscs

Different types of excretory organs in Invertebrates and their structure and function – Nervous system in Arthropods and Echinoderms.

**UNIT: III Biology of Chordates**

Integumentary system – Skin of Mammals - Glands – Hairs – Scales – Horns – Skin pigments. Comparative study of Digestive system and Circulatory system of Chordates.

Dentition in Mammals, Stomach in Mammals, Evolution of Aortic arches.

**UNIT: IV**

Respiration in Fishes – Pulmonary respiration in Tetrapods.

Excretory system – types and Evolution of Kidneys

Reproductive system – Accessory reproductive glands

Appendicular skeleton – Pectoral and Pelvic girdles of different classes.

**UNIT: V**

Minor Phyla: Rotifers, Phoronids and Chaetognatha

Invertebrate fossils - Evolutionary trends and Phylogenetic importance of Trilobites, Ammonoids, Belemnoids, Nautiloids and Echinoid fossils.

Vertebrate fossils: Dinosaurs and Archaeopteryx

**References:**

1. Ayyar, E.K., and Ananthakrishnan. T.N. (1992). A Manual of Zoology, Vol.I(Chordata), Visvanathan Publishers.
2. Barnes, R.D. (1982) Invertebrate Zoology, IV Ed., Holt Saunders – International Edition.
3. Barrington, E.J.W (1979) – Invertebrate Structure and Function, II Ed., ELBS and Nelson.
4. Hyman, G.H., The Invertebrates, Vols. I to VII, McGraw Hill Book Co. Inc. New York.
5. Kent. G.C., (1976), Comparative Anatomy of the Vertebrates, McGraw Hill Book Co., Inc., New York.
6. Kotpal, R.L., (2002), Minor Phyla., Rastogi Publication, Meerut.
7. Vasantika Kashyap (1997), Life of Invertebrates, Vikas Publishing House Pvt.Ltd., New Delhi.
8. Waterman, A.J. (1971), Chordate Structure and Function, The Macmillan Company.

**Semester I**

**M. Sc., (Zoology)**

**Hrs. 6**

**Core Course II**

**Credits 4**

**Code: 17PZYC12**

**Marks 100**

## **GENETICS**

### **Course Outcomes:**

**CO1:** To understand the Mendelian and non mendelian modes of inheritance

**CO2:** To govern passage of genetic traits across generation

**CO3:** To describe chromosome behaviour and changes in the chromosome structure

### **UNIT: I**

Gene interaction and types: Epistasis, Additivity, Modifiers, Lethality – Linkage – linkage in human beings – Lod score for linkage testing-somatic cell hybridization – Mechanism of crossing over – Gene mapping in chromosome by crossing over method. Structure of gene – cistron, muton, recon, introns, and exons – overlapping genes.

### **UNIT: II**

Gene families – RNA Splicing – Cis-trans splicing – tRNA processing – DNA recombination at the molecular level – Role of RecA and Rec B C D enzymes. Gene regulation: The Operon Concept *lac* operon *trp* operon and *ara* operon system in bacteria – Lytic cascade and lysogeny regulation in Lambda phage – Gene regulation in eukaryotes: Short term regulation and Long term regulation.

### **UNIT: III**

Bacteria: Genetic material – Parasexual processes in bacteria: transformation, conjugation, sexduction, and transduction – Mapping of bacterial chromosomes – Biology of plasmids – Transposon – types and mechanism of transposition. Phages : Genetic material – recombination in phages – Fine structure of *rII* locus in T4 phage.

### **UNIT: IV**

Chromosomal aberrations – DNA Damage and repair mechanisms – Molecular basis of mutations. Carcinogens – Genetic basis of cancer: Oncogenes and cancer, Oncoproteins and their roles – Genes in populations - Hardy-Weinberg principle and gene frequency – Factors affecting Hardy-Weinberg equilibrium.

### **UNIT: V**

Inborn errors of metabolism: Phenylketonuria, alkaptonuria, albinism, Lesch-Nyhan syndrome, ADA deficiency, galactosemia, G6PD deficiency, Tay Sachs's disease, and Gaucher's disease. Human karyotype: preparation and analysis - chromosomal syndromes in man. Detecting genetic diseases – genetic counseling, prenatal diagnosis, genetic diseases - Treating genetic diseases - Altering genetic traits. Human Genome Project – Features, methods and future prospects.



**Reference Books:**

1. Benjamin Levin (2005) Genes VIII, Oxford University Press, New York.
2. Daniel L. Hartl (1996) Genetics, III Ed., Jones Bartlett Publishers. Boston.
3. David Friefelder (1998) Microbial Genetics, Narosa Publishing House, New Delhi.
4. Elaine Johansen Mange and Arthur P. Mange (1994) Basic Human Genetics, SinourAssociates, Inc., Sunderland, Massachusetts.
5. Jenkins, J. B. (1983) Human Genetics, The Benjamin Cummings Publishing Co.,
6. John D. Hawkins (1996) Gene Structure and Expression, III Ed., Cambridge University Press.
7. Robert H. Tamarin (1996) Principles of Genetics, WCB Publishers.
8. StrickbergerMonnroe, W. (1996) Genetics, Prentice Hall of India Pvt. Ltd., New Delhi.
9. Ursula Goodenough (1984) Genetics, Saunders College Publishing Co., London.
10. Watson J D *et. al.* (1987) Molecular Biology of Gene, IV Ed., The Benjamin PublishingCompany Inc., UK.

**Semester I**

**M. Sc., (Zoology)**

**Hrs. 6**

**Core Course III**

**Credits 4**

**Code: 17PZYC13**

**Marks 100**

## **CELL AND MOLECULAR BIOLOGY**

### **Course Outcomes:**

**CO1:** To demonstrate cell organization

**CO2:** To study about DNA replication, transcription, and protein synthesis

**CO3:** To demonstrate molecular tools for studying gene and gene activity

### **UNIT I: METHODS OF CELL STUDY**

Cell study: Micrometry - Cell culture methods - Cell fractionation techniques – Cytophotometry- Immunocytochemistry – Autoradiography; Cytochemical staining and detection methods of Carbohydrates, Protein, Lipids, DNA and RNA.

### **UNIT II: CELL STRUCTURE AND FUNCTION**

The nuclear envelope and traffic between the nucleus and cytoplasm:- Structure of nuclear envelope- Nuclear pore complex-selective transport of proteins to and from the nucleus-Nuclear protein- Nucleolus. Mitochondria- Energy Transduction. Protein sorting and transport: The endoplasmic reticulum- Golgi apparatus and lysosomes.

### **UNIT III: DNA, RNA AND PROTEIN SYNTHESIS**

DNA replication- Unidirectional and Bidirectional DNA replication - Role of RNA primers in DNA replication- Satellite DNA - DNA damage and repair. Types of RNA- Mechanism of prokaryotic transcription and eukaryotic transcription. Role of ribosome's and RNAs in protein synthesis.

### **UNIT IV: CANCER BIOLOGY**

Characteristics of cancer cells- Types of tumors-Apoptosis and its relevance in cancer- Cellular oncogenes- Tumor viruses-Environmental carcinogens- Tumor suppressor genes: RB genes and P53 - Application of molecular biology to cancer prevention and treatment.

### **UNIT V: GENE EXPRESSION AND REGULATION**

Regulation of gene expression in prokaryotes and eukaryotes - Attenuation and antitermination- DNA methylation - Heterochromatization, Transposition - Regulatory sequences and transacting factors - Environmental regulation of gene expression.

### **TEXT BOOKS:**

- 1) Powar C.B. 1997. Essentials of cytology, Himalayan Publishing House, New Delhi.
- 2) Verma P.S and Agarwal V.K. 1998. Concept of Molecular Biology, Chand & Co. Ltd. Delhi
- 3) Gupta, P.K. 1999. A Text Book of Cell and Molecular Biology, Rastogi publication, Meerut
- 4) De Robertis, E.D. P. and De Robertis, E.M.F. 1987. Cell and Molecular Biology, VIII Ed. Lea and Febiger, Philadelphia.

### **REFERENCE BOOKS:**

- 1) Bruce Alberts and Dennis Brey 1994. Molecular biology of the cell .3rd Edition. Garland Publishing , Inc. New York and London.
- 2) Becker and Deamer, 1991. The world of the Cell .2nd Edition. The Benjamin and Cumming publishing Company, Inc California.
- 3) Geoffrey M. Cooper and Robert E. Hausman, 2004. The Cell –A Molecular approach. 3<sup>rd</sup> Edition. ASM Press, Washington D.C. USA.
- 4) Alberts et al., 2002. Molecular biology of the Cell . 4TH Edition , Garland Science, a member of the Taylor and Francis group, New York, USA.

**Semester I**

**M. Sc., (Zoology)**

**Hrs. 6**

**Elective I**

**Credits 4**

**Code: 17PZYE11**

**Marks 100**

## **BIOTECHNOLOGY**

### **Course Outcomes:**

**CO1:** To develop industrial processes for production of antibiotics, enzymes.

**CO2:** To develop techniques for tissue culture, cell culture and organ transplantation

**CO3:** To develop biological process of plant disease control

### **UNIT: I**

rDNA technology in animal based systems: Scope – methods of introduction of genes – Isolation of genes – gene fragments and amplification – cloning vectors – enzymesystems – expression vectors – genome analysis – Human Genome Project – transgenicanimals and applications.

### **UNIT: II**

Animal cell culture technology – methods involved – applications – cell lines - Genetransfer techniques used in animal cells and eggs – stem cell culture and preservation –cell culture based processes and products - hormones, enzymes, regulatory moleculesand therapeutics.

### **UNIT: III**

Industrial Biotechnology: Fermentation – types of fermentation – Fermenter designs –Upstream and downstream processing – product recovery and purification – Productionof alcohol, enzymes, vitamins, and single cell proteins – Improvement of inoculumsource for better production.

### **UNIT: IV**

Biotechnology in medicine: Production of monoclonal antibodies, Hybridoma technology: Production of insulin, growth hormone, interferon, recombinant vaccines,subunit vaccines and live vaccines – Diagnosis of genetic disorders by RFLP, PCR,OLR assay and Western blotting – Treatment of cancer – Bone marrow transplantation –GVH diseases - Gene therapy : *Ex vivo* and *In vivo* gene therapy, Embryonic stem cellmethods.

### **UNIT: V**

Biotechnology in Sericulture – production of hybrid silk varieties – production oftransgenic silk worm - genes of silk production – application of silk worm as bioreactorfor culturing cells.

## REFERENCE BOOKS

1. Babiuk, L.A., John, P. Phillips and Murray (1989) Animal Biotechnology, Pergamon Press, Oxford.
2. Brown, C.M., Campbell, I. and Priest, F.G. (1988) Introduction to Biotechnology. Blackwell Scientific Publications, U.K.
3. GorDard and Lucassen, E. (1993). *In vitro* culture of Animal Cells, Butterworth – Heinemann Publications.
4. Higgins, I.J., Best, D.J. and Jones, J. (1988) Biotechnology – Principles and Applications. Blackwell Scientific Publications, Oxford, London, Edinburgh.
5. KeshavTrehan (1996), Biotechnology, New Age International Pvt. Ltd. Publishers, New Delhi.
6. Marx, J.L. (1989) A Revolution in Biotechnology, Cambridge University Press.
7. Mc Neil and Harvey L.M. (1990) Fermentation, Blackwell Scientific Publications.
8. Old, R. W and Primrose, S B. (1989) Principles of Gene Manipulation, Blackwell Scientific Publications.
9. Primrose, S. B (1989) Modern Biotechnology. Blackwell Scientific Publications, Oxford, London.
10. Prentis , S. (1985) Biotechnology New Industrial Revolution, Orbis, London.
11. Smith John, E. (1988) Biotechnology. Edward Arnold, London.
12. Watson, J.D. *et al.*, Recombinant DNA . Scientific American Books, W. H Freeman and Company, New York.
13. Mathavan, S., 1998. Production of foreign protein in Silk worm larvae. Madurai Kamaraj University, Madurai, pp 1- 95
14. Ganga, G. and J. SulochanaChetty, 1999. An Introduction to Sericulture, Oxford & IBH Publishing Co., Pvt. Ltd.

**Semester I**

**M. Sc., (Zoology)**

**Hrs. 6**

**Elective II**

**Credits 4**

**Code: 17PZYE12**

**Marks 100**

## **STEM CELL BIOLOGY**

### **Course Outcomes:**

**CO1:** To Study the unit of tissue growth, repair and regeneration process

**CO2:** To know the process of pathological alternation and contribution of stem cells to tissue and organ development.

### **Unit-1:**

Introduction to Stem cell biology – Stem cell definition, origin and hierarchy; stem cell properties, Identification and Characterization- potency and differentiation; niche of stem cell; overview of different stem cell types (embryonic stem cell, adult stem cell and induced pluripotent stem cells)

### **Unit-2:**

Embryonic stem (ES) cell - Characterization and properties of ES cells - pluripotency and self-renewal of ES; molecular mechanisms regulating pluripotency and maintenance of the stem state; progressive differentiation of ES into ectoderm lineage organs ( skin, brain and nerve), mesoderm lineage organs (Heart, kidney, muscle, bone and blood), and endoderm lineage organs ( Lung, liver, stomach, pancreas and intestine).

### **Unit-3:**

Adult stem cell – Mesenchymal stem cell (MSC) – sources, properties (plasticity, homing and engraftment), potency and characterization; Haematopoietic stem cell (HSC) – sources, properties, potency and characterization; steps involved in production of induced pluripotent stem cell (iPSC); role of yamanaka factor in iPSC.

### **Unit-4:**

Stem cell and aging – aging theory; cell cycle; telomere and telomerase ; senescence of stem cell; role of stem cell in aging; tissue repair and regeneration of adult stem cell.

### **Unit-5:**

Current stem cell therapies – advantages and disadvantages of ES and adult stem cell (MSC and HSC) therapy; Ethical concern on stem cell therapy; current stem cell therapy for various diseases; clinical outcome of stem cell therapy; state of clinical trials in adult stem cell for various disease.

**Reference Books:**

1. Kiessling, A.A. 2006. Human Embryonic Stem Cells (Second Ed.) Jones & Barlett Publishers.
2. Lanza, R. 2005. Essentials of stem cell biology. Academic Press.
3. Turksen, K. 2004. Adult stem cells. Humana Press, Inc.
4. Thomson, J et al. 2004. Handbook of stem cells: Embryonic/Adult and fetal stem cells (Vol. 1 & 2). Academic Press.
5. Institute of Medicine 2002. Stem cells and the future of regenerative medicine. National Academy Press.

**BIOLOGY OF INVERTEBRATES, CHORDATES, GENETICS,  
CELL AND MOLECULAR BIOLOGY AND BIOTECHNOLOGY**

**Course Outcomes:**

**CO1:** To demonstrate cell organization

**CO2:** To study about DNA replication, transcription, and protein synthesis

**CO3:** To demonstrate molecular tools for studying gene and gene activity

**CO4:** To Study the unit of tissue growth, repair and regeneration process

**CO5:** To know the process of pathological alternation and contribution of stem cells to tissue and organ development.

**1. INVERTEBRATES & CHORDATES**

a. TAXONOMY : 30 representative species :20 Invertebrates - 8 Invertebrate Phylum upto class level (identifying features)

10 Vertebrates - 5 classes upto order level (identifying features)

b. MOUNTING : Teleost – Scales, Honey bee –Mouth Parts, Honey Stomach, Sting, Wings,& Legs.

c. SPOTTERS: Invertebrate larval forms

Invertebrate fossils – Ammonoids, Belemnoids, Nautiloids and Echinoid.

Minor Phyla – Rotifera, Phoronida, Chaetognatha

d. DISSECTIONS: Frog – V Cranial and Spinal nerves using virtual laboratory

e. Crab: Nervous System. F. Prawn- Appendages.

**2. GENETICS**

Drosophila culture – Identification of mutants and sexes

ABO Blood groups & Rh - Genetic significance

Human Karyotyping and Pedigree analysis

Hardy-Weinberg Law and Calculation of gene frequency - Co-dominance and multiple alleles.

**3. CELL BIOLOGY & MOLECULAR BIOLOGY**

Micrometry, Human Buccal smear

Blood smear – Fish, Insect and Man- A comparative study

Isolation of DNA from animal tissue.

Isolation of plasmid DNA from Bacteria (Demo)



## **5. BIOTECHNOLOGY**

Isolation of Plasmid DNA from Escherichia Coli.

Isolation of Bacterial/ Cell DNA .

Isolation of Human DNA & Estimation.

Demonstration of Agarose Gel Electrophoresis.

Staining Gels with Coomassie Brilliant Blue.

SDS(Poly Acryl Amide Gel Electrophoresis.

Isolation of DNA From Chick liver cells.

Spotters : Models of PCR, Southern blotting,

**Semester II**  
**Core Course V**  
**Code: 17PZYC21**

**M. Sc., (Zoology)**

**Hrs. 6**  
**Credits 5**  
**Marks 100**

## **MICROBIOLOGY & IMMUNOLOGY**

### **Course Outcomes:**

**CO1:** Identification of students with safety guidelines & sterilization methods

**CO2:** To study the types of bacterial media and cultural characteristics for bacteria

**CO3:** The principles and techniques of staining methods and studying of microscopic properties for microorganism

**CO4:** To study structure and the functional organization of immune system

**CO5:** To study the chemical nature of antigen

### **UNIT: I MICROBIOLOGY IN EVERYDAY LIFE**

Microbiology of air, water and soil .Food microbiology – Microbes of milk and food -methods of detection, pasteurization and food poisoning; food preservation. Environmental Microbiology – role of microbes in Environment protection and Management.

### **UNIT: II INDUSTRIAL AND AGRICULTURE MICROBIOLOGY**

Fermentation process – Microbial role in fermentation production of Alcohol, Vinegar, Pharmaceuticals, Organic acids, Amino acids, Enzymes and Fuels. Agriculture: Biological nitrogen fixation; *Nif* genes, Nitrogen fixers- Biofertilizers- Bio pesticides (Bt, NPV).

### **UNIT: III MEDICAL MICROBIOLOGY**

Causative agents - Modes of transmission – Control measures of Bacterial diseases - Diphtheria, Tetanus, TB, Typhoid, Gonorrhea, Syphilis. Viral Diseases-Polio, AIDS, Hepatitis A & B. Fungal Diseases- Candidiasis.

### **UNIT IV IMMUNE ACTIONS AND PROPHYLAXIS**

Immune response: Primary and secondary Lymphoid organs. Humoral and cell mediated immune response; immunity to infections – bacterial and viral; Immunoprophylaxis: toxoids and vaccines; Production and application, immunization schedule.

## **UNIT V IMMUNOLOGICAL TECHNIQUES**

Haemagglutination test, Ouchterlony technique, Precipitation test, Immunodiffusion, Immunoelectrophoresis – qualitative & quantitative- Immunofluorescence, Hybridoma technology, radioimmunoassay, enzyme linked immunosorbent assay (ELISA), Immunoblotting – Western blotting

### **TEXT BOOKS:**

Pelczar, Chan and Krieg, (1993). Microbiology, Tata McGraw Hill Pub. Co. Ltd. New Delhi.

Chakravarty, A.K., (1993) Immunology, Tata McGraw Hill Publishing Company, New Delhi.

### **REFERENCES:**

1. Sulia, S.B & Santhanam, S. (2001) General Microbiology, Oxford and IBH.
2. Thomas, C.G.A. (1988) Medical Microbiology, ELBS Publications.
3. Ananthanarayanan, R and Jayaram Panicker, C.K. (2000). Text Book of Microbiology, Orient Longman, Chennai and Hyderabad.
4. Pelczar, M.J. & Reid, R.D. (1965). Microbiology McGraw Hill Company. New York.
5. Powar, C.B. and Diginawala. H. F. (1987) General Microbiology - Vol. I & II. Himalaya Publishing House, Bombay.
6. Sharma, P.D. (1993) Microbiology - Rastogi Publications, Meerut. Roitt, ( 3rd Edition) Immunology, Crover Medical Publishing Company, London
2. Barret, J. T. (1983) Text Book of Immunology (5th Edition), The C.V. Mosby Company.
3. Richard, H.M. (1992), Immunology (2nd Edition), Williams and Wilkins, Baltimore Maryland.
4. Hidemann, W.H. (1980) Essentials of Immunology, Elsevier Science Publishing Co. Inc.
5. Wein, D.M. and Steward, L. (1993), Immunology, Singapore Publishers Private Limited.

**Semester II**

**M. Sc., (Zoology)**

**Hrs 6**

**Core Course VI**

**Credits 5**

**Code: 17PZYC22**

**Marks100**

### **ANIMAL PHYSIOLOGY**

#### **Course Outcomes:**

**CO1:** To provide basic understanding of the fundamental processes and mechanism that serve and control the various functions of the body

**CO2:** To study about the simple cellular mechanism as well as more complex interactions between whole organ system

**CO3:** To study about several biological systems including respiratory, circulatory, digestive, metabolic, thermoregulatory, osmoregulatory, nervous, neural, renal, hormonal and sensory system

#### **UNIT: I**

Homeostatic mechanisms: Thermoregulation: Temperature compensation in poikilotherms- Temperature regulations in homeotherms- Tolerance to high temperature- tolerance to cold and freezing- physiology of hibernation and aestivation. Osmotic and ionic regulation: Response to hyperosmotic and hypoosmotic media with reference to crustaceans and fish, Adaptation to Pressure, High altitude- buoyancy.

#### **UNIT: II**

Excretion: Ammonia toxicity – detoxification pathways – excretion to different habitat. Nervous co-ordination: Ionic basis of excitability – resting membrane potential – electrogenesis, propagation of action potential – interneuron transmission – electrical synapses – chemical synapses – neurotransmitters.

Animal electricity: Electric organs – production of electric discharge – functional significance.

#### **UNIT: III**

Receptor mechanism: Mechano reception, Muscle receptors, Pressure receptors – Gravity receptor - phonoreception. Tactile receptor Photoreception: Retinal pigments – photochemistry of vision.

#### **UNIT IV**

Bioluminescence: Occurrence – physical aspects – chemistry of light production – functional significance. Animal behavior: Biological clock – endogenous rhythm – circadian rhythm – circannual and lunar periodicity – Zeitgeber – entrainment – physiological basis of learning and memory

## **UNIT V**

Endocrine system: structure and functions of Pituitary – Thyroid – Pancreas – Adrenal. Mammalian reproductive physiology. Endocrine mechanism of invertebrates. Eg: Insects and Crustaceans.

### **TEXT BOOKS:**

1. Hoar, W.S., 1987. General and comparative Physiology, Prentice Hall
2. Turner, C.D. and Bagnara, J.T. 1976. General Endocrinology, 6th Edn. WB Saunders Co.,

### **REFERENCE BOOKS:**

1. Beck, 1971. Human Design, Harcourt Brace Jovanovich Inc.
2. Dawson, H. 1964. General Physiology, Little Brown Co. Boston.
3. Echert, R. and Randall, D. 1987. Animal Physiology, CBS Publishers and Distributors
4. F.N. 1971. Animal function, Principles and Adaptation, Macmillan Co., London.

**Semester II**

**M. Sc., (Zoology)**

**Hrs. 6**

**Core Course VII**

**Credits 5**

**Code: 17PZYC23**

**Marks 100**

## **ECOLOGY AND BIODIVERSITY**

### **Course Outcomes:**

**CO1:** Distinguish between species, population, communities, ecosystem and biomes

**CO2:** Understand the factors that affect population size, density, distribution and dynamics

**CO3:** Distinguish about habitat, niche and symbiosis

### **UNIT I CONCEPTS IN ECOLOGY**

Scope of Ecology, its relevance to mankind Habitat Ecology: Marine habitat, Freshwater habitat. Mangrove habitat; Ecosystem: Concepts and ecosystem management - Fresh water ecosystem (Pond & River) and Marine ecosystem – Food chain – Food web – Tropic levels – Energy flow.

### **UNIT II SOCIAL ISSUES & ENVIRONMENT**

Space Ecology-Urban Problems related to energy-Rain Water Harvesting-environmental ethics, issues-Possible solutions-climate change-Global Warming-Acid Rain- Ozone Depletion-Waste Water Pollution-Environmental Protection Act (1972) Amendments-Forest conservation Act- Issues involved in Enforcement of Environmental legislation.

### **UNIT III POPULATION ECOLOGY & NATURAL RESOURCES**

Population – Density, Growth, population fluctuation and regulation, dispersal, Age. Community ecology – types of Communities – characteristics and structure of community – Ecological succession- structure and types.

Energy resources and disaster management- Renewable & Nonrenewable resources, exploitation of non renewable resources, Flood warning system-Earth quake- Droughts, Famine & Heat waves- Cyclones-Wild fires-Landslides-disaster Management information system(DMIS)

### **UNIT IV**

Biodiversity – convention on biological diversity, patterns of diversity – genetic, species, ecosystem and guild diversity – alpha, beta and gamma diversity- diversity indices – dominance and evenness, landscape and its elements, endemism and hotspots, indicator species, key stone species, value of biodiversity, ecotourism.

## **Unit V**

Biodiversity loss: Causes; IUCN categories of threaten species, red data book, Environmental Impact Assessment, Remote sensing in EIA – In situ conservation – biosphere reserves, national parks, wildlife sanctuaries, ex situ conservation – zoological and botanical gardens, sacred grooves; cryopreservation.

### **Text Books**

1. Agarwal, K.C. 1999. Biodiversity. Agrobotanical Publishers. New Delhi.
2. Odum, E.P. 1996. Fundamentals of Ecology. Nataraj Publishers, Dehradun.

### **Reference:**

1. Clarke, G.L., 1954. Elements of Ecology. John Wiley & Sons, N:y.
2. Kendeigh, S.C. 1961. Animal Ecology. Prentice Hall
3. Odum, E.P. 1971. Fundamentals of Ecology, W.B. Saunder's Co. Philadelphia
4. Odum, E.P. and Barrett, G.W. 2005. Fundamental of Ecology. Thomson Brooks/Cole (EWP) 5th Ed.
5. Rastogi, V.B. and M.S. Jayaraj 1989, Animal Ecology and distribution of animals, Kedarnath Ramnath.
6. Sharma, P.D. 1990. Ecology and Environment. Rastogi Publications. Meerut.
7. Southwick, C.H. 1976. Ecology and the quality of Environment. D. Van Nostrand Co.
8. Verma, P.S. and V.K. Agarwal, 1996 Principles of Ecology. S. Chand & Co. New Delhi.

**Semester II**

**M. Sc., (Zoology)**

**Hrs. 6**

**Elective- III**

**Credits 5**

**Code: 17PZYE21**

**Marks 100**

## **NANO TECHNOLOGY**

### **Course Outcomes:**

**CO1:** In depth understanding of nano scale phenomena

**CO2:** To study about the nano particles used in medicine, food, drug, fuel cells

**CO3:** To study about the applications of nanotechnology

### **UNIT – I: FUNDAMENTALS AND OVERVIEW OF NANO SCIENCE**

Definitions and scaling. Length and measurement, Force measurement. Properties at nano scale (optical, electronic and magnetic). Metal and Semiconductor Nano materials, Quantum Dots, Wells and Wires, Bucky balls and Carbon Nano tubes.

### **UNIT – II: NANO BIOMATERIALS**

Introduction-Biocompatibility – anti bacterial activity – principles involved – Biomaterial nanocircuitry; Neurons for network formation. DNA nanostructures for mechanics and computing

### **UNIT – III: BIOMEDICAL APPLICATIONS**

Nanoparticles in Drug delivery - Nanotechnology in Diagnostics applications: Biochips analytical devices, Biosensors- Natural nanocomposite systems as spider silk, bones, shells; nanomaterials in cancer treatment.

### **UNIT – VI : NANOTECHNOLOGY AND ENVIRONMENT**

Application of nanotechnology in Green energy, sustaining Natural resources, Global climate changes. Nanotechnology and energy production: Fuel Cells — applications in power and transportation.

### **UNIT – V : NANO TOXICOLOGY**

Nanomaterials in Environment - Toxicology of Airborne and Manufactured nanomaterials in the environment - Nanoparticles and Living Organisms: Portals of entry and target tissues- Mechanisms and Health Effects - Risk assessment – Ethical – Legal and Social Implications. Current public awareness, Nanotechnology- An upstream issue.



## References

### TEXT BOOKS

1. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
2. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers
3. Hari Singh Nalwa, “*Nanostructured Materials and Nanotechnology*”, Academic Press, 2002
4. Yuliang Zhao and Hari Singh Nalwa, ‘Nanotoxicology: Interactions of Nanomaterials with Biological Systems, American Scientific Publishers, 2007
- 5 . "Nanotoxicology - Interactions of Nanomaterials with Biological Systems", Ed Yuliang Zhao and Hari Singh Nalwa, June 2006
6. Springer handbook of nanotechnology by Bharat Bhushan
- 7 .MEMS and nanotechnology – Based sensors and devices communication, Medical and Aerospace applications - A.R.Jha.

**Semester II**

**M. Sc., (Zoology)**

**Hrs. 6**

**Elective- IV**

**Credits 5**

**Code: 17PZYE21**

**Marks 100**

## **VERMI TECHNOLOGY**

### **Course Outcomes:**

**CO1:** To Identify the different species of earth worms

**CO2:** To study the basic culture techniques.

### **Unit 1**

Soil edaphology – Geography of soil – Soil groups – Soil genesis – Soil profile – Soil complex – Soil texture – structure – Physical properties –Organic matter – Humus – Soil water, aeration, temperature, pH and buffer action and Electrical conductivity – Soil bioreactive system – fauna, microflora and its role – Soil pollution – erosion and conservation – sustaining of soil fertility – fertilizer – organic and inorganic.

### **Unit 2**

Vermibiology – Introduction – Historical perspectives – Taxonomy – Systemic position – Ecological types of earthworms, commonly occurring Indian Earthworms – Exotic earthworms – Earthworm as a natural bioreactor – Heavy metals uptake in earthworms.

### **Unit 3**

Vermiculture – Introduction – State of Art of Vermiculture techniques (Laboratory and field) –Working model of typical vermiculture bed – Maintenance, monitoring and harvest – Vermiwash – Preparation and application – Vermibiotechnology for solid waste management.

### **Unit 4**

Vermicomposting – Introduction - Vermicomposting methods – Earthworm cast – its importance in soil amelioration – Physico – Chemical properties – Casts of different species – Green waste, animal waste composting – Evaluation of the best suited worm – Advantages of vermicompost over natural Farm Yard Manure.

### **Unit 5**

Economic importance of Earthworms- Earthworm as a source of food – Live feed – Vermimeal preparation method – Chemical composition of vermimeal - earthworm as a source of drugs – Pharmacologically active materials derived from worms – Antipyretic and Anti-inflammatory activity of earthworm.

**References:**

1. Biology and ecology of Earthworms (1996) – Edwards and Bohlen, Chapman and Hall, London.
2. Vermiculture Biotechnology (1995) – Bhawalkar and Bhawalkar, BERI, Puner
3. Vermicology- Sultan A. Ismail, Orient Longman.
4. Earthworms (1985) – K. L. Lee, Academic Press, London.
5. Earthworm Ecology from Darwin to Vermiculture (11983) – Ed. J. Esatchell, Chapman and Hall, London.
6. Bioconversion of waste materials to industrial products (1991) – Ed: A.M. Martin, Elserveir Applied Science, London, New York.
7. Vermiculture Ecotechnology (1996) – U.S Bhawalkar, BERI, London.

**Semester II.**  
**Core course -VIII**  
**Code: 17PZYP21**

**M. Sc., (Zoology)**

**Practical –II Hrs. 6**  
**Credits 4**  
**Marks 100**

**MICROBIOLOGY, ANIMAL PHYSIOLOGY, ECOLOGY,  
NANOTECHNOLOGY AND MICROTECHNIQUE.**

**Course Outcomes**

**CO1:** In depth understanding of nanoscale phenomena

**CO2:** To study about the nanoparticles used in medicine, food, drug, fuel cells

**CO3:** To study about the applications of nanotechnology

**CO4:** Distinguish between species, population, communities, ecosystem and biomes

**CO5:** Understand the factors that affect population size, density, distribution and dynamics

**CO6:** Distinguish about habitat, niche and symbiosis

**MICROBIOLOGY**

Culture techniques - Culture of bacteria- Bacterial growth curve

Differential staining- Gram staining- IMVIC (Indole-MethylRed- Voges Proskauer- Citrate Utilization) Test- Bacterial growth curve

Antibiotic sensitivity.

**ANIMAL PHYSIOLOGY**

Quantitative estimation of amylase activity, ammonia and urea

Rate of salt loss and salt gain in fish using different experimental media

Estimation of blood chloride.

**ECOLOGY**

Report on ecological collection representing different habitats – sandy, muddy, rocky shores.

Hydrological studies of water samples with reference to pollution:

Chlorides, Silicates, Calcium, Total Hardness, Phosphates, Nitrates, pH, DO & BOD – water, quality index

Qualitative & Quantitative estimation of plankton (marine sample)

**NANOTECHNOLOGY**

Spotters: Nano biochips, carbon nano tube; nanoparticles; Fuel cells

**MICROTECHNIQUE**

Preparation of permanent serial sections of tissues (10 slides) and embryos (10 slides) of Frog and Chick respectively. Preparation of tissue sections for histochemical tests.

**EDUCATIONAL TOUR**

Visit to R & D labs and different natural habitats related to the above subjects and submission of report is compulsory. A record of laboratory work shall be submitted at the time of practical examination

**Reference :**

Cappuccino, J. G and Sherman. 1999. Microbiology – A Laboratory Manual, Addison Wesley Pub.,

**Semester III.**

**M. Sc., (Zoology)**

**Hrs. 6**

**Core course IX**

**Credits 5**

**Code: 17PZYC31**

**Mark 100**

## **DEVELOPMENTAL BIOLOGY AND EVOLUTION**

### **Course Outcomes:**

**CO1:** To understand the basic concept of growth, regeneration and aging

**CO2:** To study about the living organism that is developed from earlier forms during the history of the earth

**CO3:** To study about the evolution of population

**CO4:** To study about the evolution of man and future evolution of man

### **UNIT: I**

Structure of gametes – sperm – Spermatogenesis and oogenesis– The motile apparatus of sperm – crosssection of sperm tail – structure of mammalian egg - super ovulation, ICSI, GIFT Artificial insemination - In vitro fertilization. The sperm – binding protein of the mouse zona pellucida. Induction of the mammalian acrosome reaction by ZP3

### **UNIT: II**

Early development of the Nematode *Caenorhabditis elegans* – cleavage & axis formation – gastrulation in *C. elegans* Genetic regulations of early embryonic development in *Drosophila*. Homeotic selector genes. Origins of anterior – posterior polarity of the egg of *Drosophila* – protein gradients in the early embryo Embryonic induction – organizers – Spemann and Mangold experiments – molecular biology of the Nieuwkoop center – functions of the organizer – Induction.

### **UNIT :III**

Influence of hormones on growth and metamorphosis of insects and amphibians – Formation of the limb bud in amphibian – specification of the limb fields – induction of the early limb bud – cell death and the formation of digits and joints. Regenerative ability of various invertebrates and vertebrates – mechanism of regeneration in amphibians – blastema formation – factors affecting regenerations.

### **UNIT :IV**

Evolutionary developmental biology – (“evo devo”) – Unity of Type and conditions of existence – Hox genes and atavisms – Homologous pathway of development – modularity as a principle of evolution – Heterochromy in evolution – Generating. Evolutionary Novelty – A new evolutionary synthesis explaining biodiversity.

## **UNIT : V**

Evolution of population – from races to species, adaptation pattern, behavioural adaptations and strategies, natural selection, isolating mechanisms, mode of speciation –Evolution of man and future evolution of man.

### **REFERENCE BOOKS:**

1. Balinsky, B.L. 1981. An introduction to Embryology V Ed. Saunders Co. Philadelphia.
2. Berrill, N.J. 1986 Developmental Biology, Tata McGraw Hill, New Delhi.
3. Browder, L.N., 1980. Developmental Biology, Saunders co., Philadelphia.
4. Gilbert, S.F., 1995. Developmental Biology, II Edn. Sinamer Associates Inc. Publishers Sanderland, Massachusetts, USA.
5. Saunders, A.W. 1982. Developmental Biology, Patterns, principles, problems. Macmillan publishing Co., New York.
6. Stevan, B and Oppenheimer 1980. Introduction to Embryonic development, Alley and Bern.
7. Sharma, B.K. and Kaur, H. (1997). Environmental chemistry Goel Pub. House, Meerut
8. Tacconi, L. (2000). Biodiversity and Ecological Economics Participation, values and resource management. Earthscan Pub. Ltd. London.
9. Castri, F.D. and Younes, T. (1996). Biodiversity: Science and development. CAB Int, Wallingford, U.K.
10. Strickberger, M.W. (1996). Evolution. Jones and Barlett Pub. Inc., London.
11. Dobzhansky, T., Ayala, F.J., Stebbins, G.L. and Valentine, J.W. (1975). Evolution. Surjeet Pub. and Co., New York.

**Semester III.**

**M. Sc., (Zoology)**

**Hrs. 6**

**Core Course X**

**Credits 5**

**Code: 17PZYC32**

**Marks 100**

## **BIOCHEMISTRY & BIOPHYSICS**

### **Course Outcomes:**

**CO1:** To demonstrate the molecular & functional organization of a cell

**CO2:** To explain biochemical basis of inherited disorders

**CO3:** To use the methods of physics to study biological system

### **UNIT – I :**

Carbohydrate : Monosaccharide's – general structure and properties; oligosaccharides; Polysaccharides; Protein: Amino acids – Peptides – Protein configuration – classification– properties; Lipids : general structure, classification – properties of fats and fatty acids.

### **UNIT – II :**

Nucleic Acids : Chemistry –nucleosides- nucleotides- variance of DNA - DNA and RNA types – Bio synthesis of Purines – Pyrimidines; Enzymes; nomenclature – classification– three dimensional structure –mechanism of action.

### **UNIT – III :**

Glycolysis- alcoholic fermentation – pyruvate oxidation – citric acid cycle – HMP pathway – glyoxylate cycle – electron transport – oxidative phosphorylation; oxidation of even chain fatty acids (oxidation), unsaturated fatty acids and odd chain fatty acids; amino acid metabolism – amino group metabolism – nitrogen excretion .

### **UNIT –IV :**

Thermodynamic principles in biology – Concept of free energy – Energy rich bonds Bioenergetics – Role of ATP –Biological energy transducers – Oxidation and reduction and redox potential. respiratory chain and oxidative phosphorylation – high energy compounds

### **UNIT V**

Chromatography: Thinlayer, affinity, gas, HPLC and Principles applications - Electrophoresis – Ultracentrifugation (Velocity and buoyant). Principles and applications of light, Phase contrast, Fluorescence, Scanning and Transmission electron microscopy. Principles of X-ray diffraction- fluorescence –UV- NMR and ESR spectroscopy.

## **References**

### **TEXT BOOKS**

1. Lehninger, L., 1993. Principles of Biochemistry CBS publishers and distributors, New Delhi.
2. Stryer, Lubert, 1975. Biochemistry W.H. Freeman & Company, San Francisco

### **REFERENCE BOOKS:**

1. Frunton J.S. & S. Simmonds, G. General and R.H. Dol. 1987. Outlines of Biochemistry John Wiley & Sons.
2. Baldwin, E. 1964. An introduction to comparative Biochemistry, CUP, London.
3. Beck, 1971. Human Design, Harcourt Brace Jorano rich Inc.
4. Giese, A.C. 1979. Cell Physiology and Biochemistry, Prentice Hall
5. Gordon, M.S., Bartholomew, G.A. Grilnell, A.D., Jorgensen, C.B., and White,
6. Jain, J.L. 2003. Fundamentals of Biochemistry, S. Chand & Compnay Ltd. New Delhi.
7. Shan, V.C. (1985) Elements of Radiation Biology, Todays & Tomorrows Printers & Publishers, New Delhi.
8. Merrill Eisenbud (1997) Environmental Radioactivity, Academic Press, California.
9. Sharma, B.K., (1990) Environmental Chemistry, Goel Publishing House, Meerut.
10. Grosh, D.S. (1965) Biological Effects of Radiation, Blaisdell Publishing Co.,
11. Bascq, Z.M. and Alexander, P. (1961). Fundamentals of Radiobiology.
12. Sood, D.D. Reddy, A.V.R. and Ramamoorthy, N. (2000) Fundamentals of Radiochemistry, Indian Association of Nuclear Chemists and Allied Scientists, Radiochemistry Division, Mumbai



**Semester III**

**M. Sc., (Zoology)**

**Hrs. 6**

**Non major Elective**

**Credits 4**

**Code: 17PZYN31**

**Marks 100**

### **MEDICAL LAB TECHNIQUES**

#### **Course Outcomes:**

**CO1:** To study about the epidemiology and diagnosis of the different diseases.

**CO2:** To study about the remedial measures, treatments etc.

#### **UNIT: I FAMILY HEALTH CARE**

Measurement of blood pressure, Reading of arterial pulsation-Benefits of Physical exercise- Biochemical measurement of body fitness- Maternal child health care (MHC)- prenatal care, antenatal care, intra meeting care, post natal, neonatal care.

#### **UNIT: II HAEMATOLOGICAL ANALYSIS**

**BLOOD:** Collection of blood (Venous and Capillary) – Plasma and serum for analysis –Total RBC count – Total leucocytes count - differential count – Haemoglobin estimation(Sahli's methods) ESR (Wintrobe and Westgren methods) – Bleeding and clotting time –Estimation of packed cell volume – Blood grouping and cross matching (Slide and Tube methods) - Anti – D (Rho) test (slide, rapid tube and Du test).

#### **UNIT: III BIOCHEMICAL & SEROLOGICAL ANALYSIS**

Blood

glucose- Creatinine, urea, cholesterol- WIDAL, VDRL, Rheumatoid arthritis

#### **UNIT :IV**

**URINE :** Collection, preservation, routine examinations – protein – glucose – acetone –bile salts – bile pigments – urobilin – urobilinogen – microscopical examination of urine

**FAECES:** Microscopical examination – intestinal parasites – helminthes, nematodes, cestodes, trematodes, protozoa.

#### **UNIT V :**

**SPUTUM:**

Collection – microscopical and naked eye inspection – clinical examination.

**CEREBROSPINAL FLUID:** Composition – CSF cells total and differential count - estimation of protein – sugar chloride.

**SPERM:** collection of semen – microscopic examination – smear and count.

**PREGNANCY TESTS-** Gravindex test/ Preg kit

#### **REFERENCE BOOK:**

- 1.Samuel, K.M. (1992) Notes on Clinical Lab Techniques (IV Edition). Publishers: M.K.G.Iyyer & Sons, Madras.
- 2.Ochei- Text book of Medical lab technology, Bhalani Publishing House; 3rd edition (2005), Mumbai.
- 3.Ramnic Sood – Text book of Medical lab technology Volume I and II, Jaypee Brothers Medical Publishers; first edition (2006), Delhi.
4. Mukherjee- Text book of lab technology, Procedure manual for routine diagnostic tests. Volume I ,II, III, McGraw Hill Education, New York City

**Semester III**

**M. Sc., (Zoology)**

**Hrs. 6**

**Elective- V**

**Credits 4**

**Code: 17PZYE31**

**Mark 100**

## **BIOSTATISTICS & BIOINFORMATICS**

### **Course Outcomes:**

**CO1:** Define and distinguish between population and sample

**CO2:** Compute a sample mean, variance and standard deviation

**CO3:** To describe the contents and properties of the most important bioinformatics database

### **UNIT:I**

Definition of biostatistics – samples and population – variables, derived variables; Sources, classification, tabulation & presentation of data diagrammatic representative of data - Mean, Median, Mode, Standard Deviation, variance, coefficient of variation, Standard Error- Pie and bar diagram.

### **UNIT: II**

Methods of sampling and sampling distribution - Probability – Events – Addition and Multiplication laws- Binomial and Normal distribution - Correlation - (scatter diagram) dot diagram – Karl Pearson's – Correlation coefficient- Skewness and Kurtosis

### **UNIT: III**

Regression analysis – X on Y and Y on X. - Student t' test, (mean difference and paired sample) Significance of Chi-square test, **F – test : ANOVA – One way analysis of variance- Statistical package SPSS**

### **UNIT: IV**

Bioinformatics : Definition, Scope. Biomolecular Structure (Primary, secondary, tertiary and quaternary) - Proteins and Nucleic acids. Secondary or derived data base – Molecular modeling data base (MMDB)

### **UNIT:V**

DNA data base, Comparison of sequences – FASTA and BLAST – Methods to access and download genome sequences of several organisms from GENEBANK, EMBL and other sources - Sequence Alignments (CLUSTALW)- Structure prediction – Phylogenetic tree – RASMOL.

## **REFERENCE BOOKS:**

1. Sokal, R.J. and Rohlf, S.J. 1981, Introduction to Biostatistics, W.H. Freeman, London.
2. Arora, P.N. 1998, Biostatistics .Himalaya Publishing House.
3. Ramakrishnan, P. 1996, Biostatistics, Saras Publications, Nagercoil.
4. Irfan Ali Khan and AtiyaKhanum.(2003) Fundamentals of Bioinformatics.UkaazPublications Hyderabad, AP, India.
5. Murthy, C.S.V. (2003) Bioinformatics. Himalaya Publishing House. Mumbai, Delhi,Nagpur, Bangalore, Hyderabad, India
6. Subramanian, C. 2004. A Text book of Bioinformatics, Dominant Publishers andDistributors. New Delhi, India.
7. Mittal, C. 2003. Fundamentals of Information Technology, PraghatiPrakasam, Meerut.
8. ZAR, J. H. 2004. Biostatistical Analysis.Pearson Education Pvt. Ltd. Singapore.

**Semester III**

**M. Sc., (Zoology)**

**Hrs. 6**

**Elective – VI**

**Credits 4**

**Code: 17PZYE32**

**Marks 100**

### **CANCER BIOLOGY**

#### **Course Outcomes:**

**CO1:** To study about Structure of cancer cells

**CO2:** To study about the remedial measures, treatments of cancer etc.

#### **Unit 1**

Origin of life, types of cells, Genetic material and their stability. Isolation, culturing and maintenance of cells. Growth factors and signal transduction.

#### **Unit 2**

Genomic integrity: Importance of maintenance of genomic integrity. Carcinogenesis and mutagenesis. Proteins associated with genomic integrity. Cell cycle checkpoint: Density arrest, Intra- S, G2/M and Spindle check points.

#### **Unit 3**

Tumor suppressors: p53, Rb, ATM, P53 BP, p10 and apoptosis. Oncogenes: cMyc, and vMyc, Aurora A, AKT, PI3K, TRK. The cancer stem cell theory. Metastasis. Tumor viruses. Cell immortalization.

#### **Unit 4**

Phenotype of cancerous cell: Aneuploidy, abnormal centrosome, loss of cell cycle arrest upon loss of genomic integrity. Philadelphia chromosome. Hyperplasia, dysplasia, neoplasia, metaplasia.

#### **Unit 5**

Genes associated with cancers: Stomach, colon, breast, lung, cervical, and oral cancers. Techniques of cancer biology: Biochemical and imaging technique., early detection of cancer: Therapeutic aspects of cancer.

#### **Reference**

1. Reya, T; Morrison, SJ; Clarke, MF; Weissman, IL (2001 Nov 1). "Stem cells, cancer, and cancer stem cells". *Nature* 414 (6859): 105–11.
2. Heppner, GH; Miller, BE (1983). "Tumor heterogeneity: biological implications and therapeutic consequences.". *Cancer metastasis reviews* 2 (1): 5–23.
3. Dunmock N.J and Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 1988.

## **M. Sc., (Zoology) Practical - III**

**Semester III**

**Hrs. 6**

**Core course XI**

**Credits 5**

**Code: 17PZYP31**

**Marks 100**

### **DEVELOPMENTAL BIOLOGY, EVOLUTION AND BIOCHEMISTRY**

#### **Course Outcomes:**

**CO1:** To demonstrate the molecular & functional organization of a cell

**CO2:** To explain biochemical basis of inherited disorders

**CO3:** To use the methods of physics to study biological system

Preparation of sperm suspension in frog/bull and observation of the spermatozoa

Observation of motility of sperm in frog / bull semen

Effect of thyroxin or iodine on metamorphosis of frog. Induced ovulation in Fish,

Artificial fertilization using eggs & sperm of fish and frog.

Spotters : Different stages of oestrous cycle of rats.

Mounting of chick Blastoderm 48, 72, 98 hours.

#### **EVOLUTION**

Fossils – Nautiloid, Ammonoid, Belemnoids; Colouration and Mimicry

#### **BIOCHEMISTRY**

Quantitative estimation of aminoacid, protein, carbohydrate and lipids in tissue samples

Preparation of solutions – Molarity, Normality percentage

Buffer preparation – determination of pH using pH meter

#### **EDUCATIONAL TOUR**

Visit to R & D labs and different natural habitats related to the above subjects and submission of report is compulsory.

**Semester IV**

**M. Sc., (Zoology)**

**Hrs. 6**

**Core course XII**

**Credits 5**

**Code: 17PZYC41**

**Marks 100**

## **GENERAL AND APPLIED ENTOMOLOGY**

### **Course Outcomes:**

**CO1:** To study about the classes of Arthropoda, characteristics with examples

**CO2:** To study about the Insect's body exoskeleton

**CO3:** To study about the taxonomy of insects into different orders

### **UNIT: I**

Taxonomy: Basics of Insect classification. Key characters of Insect orders (any five) with common examples. Morphology: Head, segmentation and sutures. Wings: venation – Appendages in Apterygotes – Genitalia. Types of damages to plants by insects – reasons for insects attaining pest status.

### **UNIT: II**

Physiology: Integumentary system – structure and chemistry – physiology of moulting  
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.

### **UNIT: III**

Beneficial insects – Honeybee and Silkworm – Biology, Culture methods and Economic importance. Agriculture pests – Biology, damage caused and control methods of any 5 chief insect pests of agricultural importance – pests of paddy, sugarcane, coconut and brinjal – pests of stored products (any one).

### **UNIT: IV**

Medical and veterinary entomology: Biology of house fly, mosquito – control methods. Biology and control of Cattle and Poultry pests (any two).

### **UNIT: V**

Principles of Insect control – prophylactic measures – cultural, mechanical, physical Methods. Pesticides - classification – mode of entry, mode of action, chemical nature. Non-conventional methods: Pheromones and chemosterilants. Merits and Demerits of chemical methods of pest control – Biocontrol agents (List only) – Merits and Demerits – Integrated Pest Management (IPM) – Definition, Principle, Merits and Demerits – precautions in handling pesticides.

**Reference Books:**

1. Mani,M.S., (1982) General Entomology, Oxford and IBH publishing Co., New Delhi.
2. Snodgrass, R.E., (1985) Principles of Insect Morphology, McGraw Hill and Co.,New York.
3. Wigglesworth,V.B., (1992) physiology of Insects, IX Ed., Chapman and Hall, London.
4. Borror,D.H., and De Long, (1964) An introduction to the study if insects, HoltReinhart& Winston Inc., New York.
5. Chapman, R.F. (1992) The Insects: Structure and Function, Hodder and Broughton Ltd., Kent, U.S.A.
6. Nayar, K.K., Ananthakrishnan,T.N., and David.,M. (1995). General and AppliedEntomology, Tata McGraw Hill Pub.Co., Ltd., New York.
7. Richards., O.W., and R.G. Davies (1983) IMMs' General Text Book of Entomology, X Ed., Vols.I and II, Chapman and Hall, New York.
8. VasantharajDavid,B (2001) Elements of Economic Entomology, Popular BookDepot., Chennai – 15
9. Nayar, K.K. et al., (1983) Economic Entomology and Applied Entomology, Oxford and IBH Publishing co., New Delhi.
10. Nayar,K.K., T.N.Ananthakrishnan and David B.V. (1986) General and AppliedEntomology, Tata McGraw Hill Publications, New Delhi.
11. Rathinaswamy,T.K.(1986) Medical Entomology, S. Viswanathan and Co., Madras.
12. NalinaSundari, M.S and Santhi, R (2006) Entomology, MJP Publishers, Chennai.

**Semester IV**

**M. Sc., (Zoology)**

**Hrs. 6**

**Core course XIII**

**Credits 4**

**Code: 17PZYC42**

**Marks 100**

### **Medical Parasitology**

#### **Course Outcomes**

**CO1:** Identify & classify human or animal protozoa of medical importance Describe their properties and life-cycle

**CO2:** Describe the mechanisms by which they cause diseases

**CO3:** Describe the mechanism by which they avoid the assault of the immune system

**CO4:** Have good knowledge of the laboratory detection of and the classical diagnosis methods

**CO5:** Have good knowledge of the prevention, control, treatment and eradication of these diseases

**Unit 1** - Classification of protozoa and definition of key concepts

Entamoeba Histolytica and other Amoebae inhabiting the alimentary canal.

**Unit 2** - Giardia Lamblia, Trichomonas vaginalis and other important flagellates – Plasmodium falciparum other Plasmodia species.

**Unit 3** – Presentation of the article summary Continuous assessment— Other Plasmodium species,– Toxoplasma gondii, and Trypanasoma species

**Unit 4** – Schistosomiasis- Leishmaniasis

**Unit 5** – Emerging protozoan diseases- Diagnostic Methods applied in parasitology

#### **REFERENCE BOOK**

1. Arora, D.R., Brij Bala Arora (1989) Medical Parasitology, Fifth Edition  
(2018)CBS Publishers & Distributors.



**Semester IV**

**M. Sc., (Zoology)**

**Hrs. 6**

**Elective – VII**

**Credits 4**

**Code: 17PZYE41**

**Marks 100**

## **CLINICAL LAB TECHNIQUES**

### **Course Outcomes:**

**CO1:** To study about the epidemiology and diagnosis of the different diseases.

**CO2:** To study about the remedial measures, treatments etc.

### **UNIT: I ESSENTIAL PRE-REQUISITES OF A CLINICAL LABORATORY**

Introduction – scope of the subject CLT – collection of specimens and preservation - records and report preparation and maintenance – cleaning, maintenance and care of glassware – sterilizations - physical and chemical methods – Disposal of specimen and infected materials – safety precautions in the laboratory – First aid treatments.

### **UNIT: II HAEMATOLOGICAL ANALYSIS**

#### **BLOOD:**

Collection of blood (Venous and Capillary) – Plasma and serum for analysis – Total RBC count – Total leucocytes count - differential count – Haemoglobin estimation (Sahli's methods) ESR (Wintrobe and Westergren methods) – Bleeding and clotting time – Estimation of packed cell volume – Blood grouping and cross matching (Slide and Tube methods) - Anti – D (Rho) test (slide, rapid tube and Du test).

### **UNIT: III BIOCHEMICAL & SEROLOGICAL ANALYSIS**

Blood glucose- Creatinine, urea, cholesterol- WIDAL, VDRL, Rheumatoid arthritis

### **UNIT: IV FAMILY HEALTH CARE**

Measurement of blood pressure, Reading of arterial pulsation- Benefits of Physical exercise- Biochemical measurement of body fitness- Maternal child health care (MCHC)- prenatal care, antenatal care, intra meeting care, post natal, neonatal care.

### **UNIT: V PHYSICAL AND BIOCHEMICAL ANALYSIS**

**URINE :** Collection, preservation, routine examinations – protein – glucose – albumin-acetone – bile salts – bile pigments – urobilin – urobilinogen – microscopical examination of urine. Odour,  $P^H$ , Volume, specific gravity.

**FAECES:** Microscopic examination – intestinal parasites – helminthes, nematodes, cestodes, trematodes, protozoa

## **UNIT VI**

**SPUTUM:** Collection – macroscopic,color, odour examination for AFB

**CEREBROSPINAL FLUID:** Composition – CSF cells total and differential count - estimation of protein – sugar chloride.

**SPERM:** collection of semen – microscopic examination – smear and count.

**PREGNANCY TESTS-** Gravindex test/ Preg kit

Widal test, VDRL test, test for Rheumatoid

## **REFERENCE BOOK:**

1. Samuel, K.M. (1992) Notes on Clinical Lab Techniques (IV Edition).  
Publishers: M.K.G.Iyyer & Sons, Madras.
2. Ochii- Text book of Medical lab technology
3. Ramic suood –Text book of Medical lab technology. Volume I and II
4. Mukherjee- Text book of Medical lab technology, Procedure manual for  
Routine diagnostic tests .Volume I ,II, III

**Semester IV**

**M. Sc., (Zoology)**

**Hrs. 6**

**Elective - VIII**

**Credits 4**

**Code: 17PZYE42**

**Marks 100**

## **AQUACULTURE AND FARM MANAGEMENT**

### **Course Outcomes:**

**CO1:** To study about the production of protein rich, nutritive, palatable human food at low cost

**CO2:** To promote effective fisheries management and improving standards of fisheries management

**CO3:** To promote provision of quality aquaculture input including high quality fish seeds and fish feeds

### **UNIT-I: Introduction to Aquaculture**

Importance of aquaculture, Global scenario, Present status in India - Prospects and scope. Aquaculture Farms Site selection, topography, water availability and supply, soil conditions and quality. Design and layout, structure and construction.

### **UNIT II: Biology of important cultivable species and their economics**

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

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

Distribution and abundance of natural seed resources, collection methods and segregation. Artificial seed production - breeding under controlled condition, induced breeding technique, larval rearing, packing and transportation.

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

### **UNIT-IV: Culture systems**

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

### **UNIT-V: Farm Management**

Water quality management - temperature, salinity, pH, O<sub>2</sub>, CO<sub>2</sub> levels, nutrients and trace elements. Control of parasites, predators, weeds and diseases in culture ponds. Disease diagnosis - ELISA, Western blotting - DNA based diagnosis of diseases and fish vaccines.

## **REFERENCE BOOKS**

1. Balugut, E.A.1989. Aquaculture system and practices.A selected review publishing House, New Delhi.
2. Dash, M.C. and Patnik, P.N.1994. Brackish water culture.Palani Paramount publications, Palani.
3. Michael, B.N. and Singholka, B. 1985. Freshwater Prawn Farming.A manual of culture of *Macrobrachium rosenbergii*.Daya Publishing House, New Delhi.
4. Paul Raj, S. 1995. Shrimp Farming techniques, Problems and solutions.Palani Paramount Publications, Palani.
5. Paul Raj, S. 1996. Aquaculture for 2000 A.D. Palani Paramount Publications, Palani.
6. Pillay, T.V.R. 1990 Aquaculture Principles and Practices. Blackwell Scientific Publications Ltd.
7. Ponnuchammy, R.1997. Practical Guide to shrimp farming. Palani Paramount Publications,palani.
8. Post, G.M. 1983. Text Book of Fish Health.TFH Publication.
9. Sinha, V.R.P. and Srinivastava, H.C. 1991. Aquaculture Productivity. Oxford and IBH Publications Co., Ltd., New Delhi.

**M. Sc., (Zoology) Practical - IV**

**Semester IV**

**Hrs. 6**

**Core Course XIII**

**Credits 5**

**Code: 17PZYP41**

**Marks 100**

## **GENERAL AND APPLIED ENTOMOLOGY**

### **Course Outcomes:**

**CO1:** To study about the classes of Arthropoda, characteristics with examples

**CO2:** To study about the Insect's body exoskeleton

**CO3:** To study about the taxonomy of insects into different orders

### **I. Collection and Identification of Insects, their parts and stages**

1. Collection and preservation of insects.
2. Identification of insects belonging to important orders and super families using dichotomous key.
3. Identification of beneficial insects, predators and parasites (relevant to biological control).
4. Identification of harmful insects (two examples for each of the plants mentioned in theory).
5. Identification of household pests, mosquitoes and fleas
6. Study of types of larvae and pupae.
7. Study of types of antennae, legs, wing, mouth parts and external genitalia.

### **II. Mounting and Dissections**

1. Mounting of mouth parts of bedbug, mosquito, honey bee and house fly
2. Dissections of digestive system, nervous system and reproductive systems of Grasshopper, Chrysocoris, Mylabris, House fly, Silk worm moth and Honey bee.
3. Dissection of Neuroendocrine system of cockroach.
4. Dissection of silk gland of silk worm.

### **III. Experiments**

1. Estimation of Insects respiratory rate using respirometer.
2. Experiment on the role of cuticular lipids in preventing transpiration.
3. Experiment on the functioning of Malpighian tubules (in vitro study)
4. Insect haemolymph – total and differential counts of haemocytes.

### **IV. Field visits**

Visits to Sericulture units, Crop research stations, Farms and IPM Centers to have a first hand knowledge on culture techniques and problems. A record of laboratory work and collection of insects (including insects of economic importance) shall be submitted for the practical examination.

**Semester IV**

**M. Sc., (Zoology)**

**Hrs. 6**

**Core Course – XIV**

**Credits 5**

**Code: 17PZYC43**

**Marks 100**

**Project Work**