

# **SYLLABUS**

## **M.Sc., ZOOLOGY**

**(For candidates admitted from the Academic year 2017 Onwards)**



**P.G. DEPARTMENT OF ZOOLOGY**  
**JAMAL MOHAMED COLLEGE (AUTONOMOUS)**

**(Nationally Accredited with 'A' Grade by NAAC)**

**TIRUCHIRAPPALLI- 620 020.**

**JAMAL MOHAMED COLLEGE (Autonomous), Tiruchirappalli-620 020**  
**M.Sc., ZOOLOGY – Course Structure under CBCS**

(For candidates admitted from the academic year 2017-2018 onwards)

SEM	Course Code	Course	Course Title	Ins.Hrs / Week	Credit	Marks		Total
						CIA	ESE	
<b>I</b>	17PZO1C1	Core- I	Biology of Invertebrates & Chordates	6	5	25	75	100
	17PZO1C2	Core - II	Developmental Biology	6	5	25	75	100
	17PZO1C3	Core- III	Env. Biology, Evolution & Paleontology	6	4	25	75	100
	17PZO1C4 P	Core-IV	Practical-I: BIC, DB & EB, E & P	6	4	20	80	100
	17PZO1CE1	Elective- I	#Biophysics & Radiation Biology /Occupational Health and Safety	6	4	25	75	100
			<b>TOTAL</b>		<b>30</b>	<b>22</b>		
<b>II</b>	17PZO2C5	Core- V	Genetics	6	5	25	75	100
	17PZO2C6	Core- VI	Cell & Molecular Biology	6	5	25	75	100
	17PZO2C7	Core- VII	Animal Physiology	6	4	25	75	100
	17PZO2C8 P	Core- VIII	Practical-II: Genetics, CMB & A. Physiology	6	4	20	80	100
	17PZO2CE2	Elective- II	#Biotechnology / Endocrinology	6	4	25	75	100
			<b>TOTAL</b>		<b>30</b>	<b>22</b>		
<b>III</b>	17PZO3C9	Core- IX	Biochemistry	6	5	25	75	100
	17PZO3C10	Core- X	Immunology	6	5	25	75	100
	17PZO3C11	Core- XI	Biostatistics & Bioinformatics	6	4	25	75	100
	17PZO3C12 P	Core- XII	Practical-III: B.C., IM. & B.S.& BI	6	4	20	80	100
	17PZO3CE3	Elective- III	#Animal Behavior and Biodiversity Conservation /Biodiversity and Taxonomy	6	4	25	75	100
	17PZO3EC1	Extra Credit Course - I	Comprehensive Examination in Zoology	-	5*	-	100	100*
		<b>TOTAL</b>		<b>30</b>	<b>22</b>			<b>500</b>
<b>IV</b>	17PZO4C13	Core- XIII	General and Applied Entomology	6	5	25	75	100
	17PZO4C14	Core- XIV	Microbiology	6	5	25	75	100
	17PZO4C15 P	Core- XV	Practical-IV: Entomology & Microbiology	6	5	20	80	100
	17PZO4CE4	Elective - IV	#Aquaculture Practices and Farm Management / Industrial Fish and Fisheries	6	4	25	75	100
	17PZO4PW	Project		6	5	-	100	100
	17PZO4EC2	Extra Credit Course - II	Advanced studies in Zoology	-	5*	-	100	100*
		<b>TOTAL</b>		<b>30</b>	<b>24</b>			<b>500</b>
		<b>GRAND TOTAL</b>			<b>90</b>			<b>2000</b>

\*Not considered for Grand total and CGPA

Any Core paper can be converted to a Practical paper (if need be) and the Subject Code has to be changed as 17P\*\*1CP or 17U\*\*1AP (Example).

SEMESTER		Subject Code	Core Based Elective (Any one to be selected for each semester)
I	Elective- I #	17PZO1CE1	Biophysics & Radiation Biology
			Occupational Health and Safety
II	Elective- II #	17PZO2CE2	Biotechnology
			Endocrinology
III	Elective- III #	17PZO3CE3	Animal Behavior and Biodiversity Conservation
			Biodiversity & Taxonomy
IV	Elective - IV #	17PZO4CE4	Aquaculture Practices and Farm Management
			Industrial Fish and Fisheries

**SEMESTER I: CORE -I**

**BIOLOGY OF INVERTEBRATES & CHORDATES**

**Course Code: 17PZO1C1**

**Hours/Week: 6**

**Credit: 5**

**Max Marks : 100**

**Internal Marks: 25**

**External Marks: 75**

**Objective:**

To impart the significance of Invertebrate and Chordate organization and their evolving adaptations in organ systems. Also to highlight the importance of minor phyla.

**BIOLOGY OF INVERTEBRATES**

**UNIT I**

**18 hours**

Symmetry in Animal organization - Significance of Coelom and Metamerism – Evolution of Metamerism - Body wall in Invertebrates - Locomotion in Arthropods and Molluscs - Nutrition in Polychaetes, Molluscs and Echinoderms.

**UNIT II**

**18 hours**

Respiration in Arthropods and Molluscs – Excretory organs in Invertebrates – Nervous system in Arthropods and Echinoderms – Reproduction in Invertebrates.

**UNIT III**

**18 hours**

Larval life of Invertebrates: Larval forms, their existence, adaptation and transformation – Minor Phyla Classification - Mesozoa, Rotifera, Phoronida and Chaetognatha.

**BIOLOGY OF CHORDATES**

**UNIT IV**

**18 hours**

Integument system in Vertebrates – Dermal and Epidermal derivatives of Vertebrates - Digestive system in Vertebrates – Stomach in Mammals – Circulatory system of Fishes and Mammals – Heart in Vertebrates.

**UNIT V**

**18 hours**

Respiration in Fishes – Pulmonary Respiration in Tetrapods – Types of Kidneys - Reproductive system in Vertebrates – Appendicular Skeleton in Vertebrates: Pectoral and Pelvic girdles of Vertebrates – Limbs of Vertebrates .

### **Text Books**

1. Barnes, R.D. Invertebrate Zoology, IV Ed., Holt Saunders – International Edition.1982.
2. Barrington, E.J.W. Invertebrate Structure and Function, II Ed., ELBS and Nelson.1979.
3. Hyman, G.H., The Invertebrates, Vols. I to VII, McGraw Hill Book Co. Inc. New York.
4. Kent. G.C. Comparative Anatomy of the Vertebrates, McGraw Hill Book Co., Inc., New York.1976.
5. Malcolm Jollie, Chordate Morphology, Reinhold Publishing Corporation, New York.1962.

### **Books for Reference:**

1. Kotpal, R.L., Minor Phyla.,Rastogi Publication, Meerut. 2<sup>nd</sup> Edition, 2002.
2. Vasantika Kashyap., Life of Invertebrates, Vikas Publishing House Pvt. Ltd., New Delhi.1997.
3. Waterman, A.J., Chordate Structure and Function, The MacmillanCompany.1971.

## SEMESTER I: CORE II

### DEVELOPMENTAL BIOLOGY

**Course Code: 17PZO1C2**

**Hours/Week : 6**

**Credit : 5**

**Max Marks : 100**

**Internal Marks : 25**

**External Marks : 75**

#### **Objective:**

To elucidate the segmental changes in pattern, development and organization of the developing embryo and to highlight the interaction of cells and their role in fetal formation.

#### **UNIT I : PHASES OF DEVELOPMENT**

**12 hours**

Developmental patterns among Metazoans – Gametogenesis: Structure of Mammalian gametes. Fertilization : Biochemical events. Cleavage (patterns & types) – Gastrulation: Germ layer formation. Organogenesis. Growth and differentiation. Genetic regulations of early embryonic development – Gradient theory.

#### **UNIT II : EMBRYONIC INDUCTION AND ORGANISER**

**12 hours**

Embryonic induction. Organizers - Spemann and Mangold experiments. Functions of organizer – Induction Regional specification types – Nuclear transplantation - Growth and Post embryonic development.

#### **UNIT III : METAMORPHOSIS AND REGENERATION**

**12 hours**

Influence of hormones on growth and metamorphosis of Insects and Amphibians – Formation of limb bud in Amphibia – Specification of limb fields – Induction of early limb bud – Cell death and the formation of digits and joints. Regenerative ability of various Invertebrates and Vertebrates – Mechanism of regeneration – Blastema formation – Factors affecting regeneration.

#### **UNIT IV : DIFFERENTIATION AND AGING**

**12 hours**

Teratogenesis : Teratogenic agents. Embryonic induction and differentiation. Embryonic induction in vertebrates: Types – exogenous and endogenous. Theories of organizer or inductor. Morphology - Chemical basis of neural induction. Differentiation - Aging and Senescence - Evolution of Development – Characteristics and types of Differentiation. Selective action of genes in differentiation.

#### **UNIT V : ADVANCED TECHNIQUES IN DEVELOPMENTAL BIOLOGY**

**12 hours**

Cell differentiation and Stem cells - Applications of Stem cells – Control of transcription involving tissue specific transcription regulators – Assisted Reproductive Technology (ART) - Super ovulation, ICSI, GIFT- Artificial insemination – *In vitro* fertilization – Human development – Placentation –Birth control and its need.

**Text books:**

1. Gilbert, S.F. Developmental Biology, II Edn. Sinamer Associates Inc. Publishers Sanderland, Massachusetts, USA. 1995.
2. Strickberger, M.W., Evolution. Jones and Barlett Pub. Inc., London. 1996.

**Books for Reference:**

1. Balinsky, B.L., An Introduction to Embryology, V Ed., Saunders Co., Philadelphia. 1981.
2. Berrill, N.J., Developmental Biology, Tata McGraw Hill, New Delhi. 1986.
3. Browder, L.N., Developmental Biology, Saunders Co., Philadelphia. 1980.
4. N. Arumugam. Organic Evolution, 10<sup>th</sup> Revised edition, Saras Publication. 114/35. ARP Camp road. Periyavilai kottai. Nagercoil, 2013.
5. Saunders, A.W., Developmental Biology, Patterns, Principles and Problems. Macmillan Publishing Co., New York. 1982.
6. Stevan, B. and Oppenheimer., Introduction to Embryonic Development, Alley and Bern. 1980.
7. Sharma, B.K. and Kaur, H. Environmental Chemistry, Goel Pub. House, Meerut. 1997.
8. Tacconi, L., Biodiversity and Ecological Economics - Participation, Values and Resource Management. Earthscan Pub. Ltd., London. 2000.
9. Castri, F.D. and Younes, T., Biodiversity: Science and Development, CAB Int, Wallingford, U.K. 1996.
10. Dobzhansky, T., Ayala, F.J., Stebbins, G.L. and Valentine, J.W. Evolution. Surjeet Pub. and Co., New York. 1975.

**SEMESTER I: CORE II**  
**ENVIRONMENTAL BIOLOGY, EVOLUTION AND PALAEOLOGY**

**Course Code: 17PZO1C3**  
**Hours/Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 25**  
**External Marks : 75**

**Objective:**

To make students to realize the structure and function of ecosystem, wealth of our natural resources and conservation measures to be taken and create awareness of the laws governing environment.

**UNIT I CONCEPTS IN ECOLOGY**

Branches of ecology and scope of ecology, Ecosystem, Structure of ecosystem, Types of ecosystem, Dynamics of ecosystem, Food chain, Food web, Tropic level and ecological pyramids - Types of Biogeochemical - Community Ecology and Population Ecology.

**UNIT II NATURAL RESOURCES**

Forest and Water resource – Exploitation, decrease of forest cover, its impact on Urbanization, Impact of dams on forest exploitation of ground water – surface water and sustainable use.

Energy resources and Disaster Management – Renewable and Non renewable resources, Exploitation of Non-renewable resources, Flood warning system – earthquakes , Droughts, Famines and Heat waves – Cyclones - Wild fires – Landslides – Disaster Management Information System (DMIS)- A guideline for disaster management.

**UNIT III 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 IV EVOLUTION**

Direct and indirect evidences of evolution - Lamarckism - Darwinism – Germ plasm theory – Germ Plasm theory – Mutation theory. Population genetics and evolution - Isolation and isolation mechanism – Speciation – Origin of life– Evolution of man, Future evolution of man.

## UNIT V PALAEOLOGY

Scope and development – Geological time scale - Fossils and fossilization; Collection of fossils – Dating of Rocks – Micropalaentology; Collection, sampling and storing – Vertebrate Palaentology - Mammalian Palaeontology.

### Text books

1. Odum, E.P. Fundamentals of Ecology, W.B. Saunder's Co. Philadelphia. 1971.
2. Sharma, P.D. Ecology and Environment VII edition, Rastogi Publication.2005.
3. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P.R,Verma and V.k.Agarwal. S.Chand publication.
4. An Introduction to Palaentology by M.P.Arora. Himalayan publishing house.

### Books for Reference:

1. Clarke, G.L. Elements of Ecology. John Wiley & Sons, New York. 1954.
2. Kendeigh, S.C. Animal Ecology. Prentice Hall. 1961.
3. N.Arumugam. Concepts of ecology. Saras publication. 114/35G. A.R.P.Comp road .Periyevilar, Kottar(post). Nagargovil. 1983.
4. Odum, E.P. and Barrett, G.W. Fundamentals of Ecology. Thomson Brooks/ Cole (EWP)5<sup>th</sup> Ed. 2005.
5. Rastogi, V.B. and M.S. Jayaraj Animal Ecology and distribution of animals, Kedarnath Ramnath. 1989,
6. Southwick, C.H. Ecology and the quality of Environment. D.Vas Nostrand Co. 1976.
7. Verma, P.S. and V.K. Agarwal, Principles of Ecology. S. Chand & Co. New Delhi. 1996.
8. Saunders, A.W. Developmental Biology, Patterns, principles, problems. Macmillan publishing Co., New York. 1982.
9. Stevan, B and Oppenheimer. Introduction to Embryonic development, Alley and Bern. 1980.
10. Sharma, B.K. and Kaur, H. Environmental chemistry Goel Pub. House, Meerut. 1997.
11. Tacconi, L Biodiversity and Ecological Economics Participation, values and resource management. Earthscan Pub. Ltd. London. 2000.
12. Castri, F.D. and Younes, T. Biodiversity: Science and development. CAB Int, Wallingford, U.K. 1996.
13. Dobzhansky, T., Ayala, F.J., Stebbins, G.L. and Valentine, J.W. Evolution. Surjeet Pub. and Co., New York. 1975.



**SEMESTER I: CORE – IV**

**BIOLOGY OF INVERTEBRATES & CHORDATES, DEVELOPMENTAL BIOLOGY,  
ENVIRONMENTAL BIOLOGY, EVOLUTION & PALEONTOLOGY – PRACTICAL-I**

**Course Code: 17PZO1C4P**

**Hours/Week : 6**

**Credit : 5**

**Max Marks : 100**

**Internal Marks : 20**

**External Marks : 80**

**Objective:**

To impart knowledge on Taxonomy and Biology of chosen Invertebrate and Chordate representatives. To develop skill in cytological techniques, Molecular biology and estimation of Water Quality Parameters.

**BIOLOGY OF INVERTEBRATES & CHORDATES**

a. TAXONOMY

30 Invertebrates – Identifying features upto Class level

20 Vertebrates – Identifying features upto Order level

b. MOUNTING

Scales of Teleost Fish (Ctenoid and Cycloid types), Feathers (Ultra structure), Soil Nematodes

c. SPOTTERS

Invertebrate Larval forms, Rotifera, Phoronida, Chaetognatha.

**DEVELOPMENTAL BIOLOGY**

Preparation of sperm suspension of frog/bull and observation of spermatozoa.

Observation of live spermatozoa & study of motility rate of frog / bull spermatozoa.

Effects of Thyroxin or Iodine on metamorphosis of frog.

Vaginal smear preparation of rat/mouse to study the stages of estrous cycle.

Induced ovulation in fish.

**ENVIRONMENTAL BIOLOGY & RESOURCE MANAGEMENT**

Faunal adaptations of different Marine Habitat – Sandy, Muddy and Rocky shore characteristics.

A study on Pond ecosystem and Forest ecosystem – Report submission mandatory.

Analysis of water samples for Chlorides, Silicates, Calcium, Total hardness, Phosphates, Nitrates, and Water Quality Index.

Qualitative and Quantitative estimation of Plankton (Marine sample).

**EVOLUTION AND PALAENTOLOGY**

Fossil study - Nautiloid, Ammonoid and Belemnites.

Colouration and Mimicry

## SEMESTER I: CORE BASED ELECTIVE I

### BIOPHYSICS AND RADIATION BIOLOGY

**Course Code : 17PZO1CE1**

**Hours/Week : 6**

**Credits : 5**

**Max Marks : 100**

**Internal Marks : 25**

**External Marks : 75**

#### **Objective:**

To acquire knowledge on basic principles and applications of analytical tools in biological sciences and to study the sources, types, effects and applications of radio isotopes.

#### **UNIT I**

**12 hours**

Thermodynamic principles in biology – Concept of free energy – Energy rich bonds – Biological energy transducers – Oxidation, Reduction and Redox potential. Microscopy - Principles and applications of microscopy – Types of microscopes – Phase contrast, Fluorescence and Electron microscopes - Scanning and Transmission Electron Microscopy.

#### **UNIT II**

**12 hours**

Chromatography: Thin layer, Affinity, Gas, HPLC, GCMS. Principles & applications of Electrophoresis - UV- NMR and ESR Spectroscopy - X-ray diffraction.

#### **UNIT III**

**18 hours**

Scope of Radiation Biology – Sources of Natural Radiation: Terrestrial and cosmic sources - Man made radiations - Medical (occupational and diagnostic). Types of radiation – Ionizing and non-ionizing radiation - Properties of Radiation – Radiation Units (Becquerel, RAD, Gray & Curie, Sievert). Measurement of Radiation in the Environment - Alpha and Beta counters and Scintillometer.

#### **UNIT IV**

**18 hours**

Biological effects of Radiation - Cellular level – Organ and system level – Genetic effects (aberrations) – Radiation sickness – Syndromes – Cancer induction - Dosimetric study. Radiation protection – Principles and practices – Safety standards – safety measures.

#### **UNIT V**

**18 hours**

Applications of Radio Isotopes in Biology: Tracer Technology – Metabolic and Biochemical Pathways. Applications in Agriculture and Industry - Genetic improvement of crops – Insect, Pest and Disease Management - Food Preservation.

Applications in Health Care: Diagnostic Techniques – Radio Pharmaceuticals, Radiation Oncology, Radioactive wastes - Sources and Management - Nuclear Energy Programme in India.

**Text Books:**

1. N. Gurumani, Research Methodology for biological Sciences. MJP Publishers, 2007.
2. Sood, D.D., Reddy, A.V.R. and Ramamoorthy, N. Fundamentals of Radiochemistry, Indian Association of Nuclear Chemists and Allied Scientists, Radiochemistry Division, Mumbai. 2000.
3. Arun, B. Arun, S., Bhongirwar, D.R., Food Preservation by Irradiation. Indian Association for Radiation Protection, BARC, Trombay, Mumbai. 2001.
4. M. Eisenbud and T. Gesell, Environmental Radio activity from Natural, Industrial, and Military Sources. Academic Press. 1997.

**Books for Reference:**

1. Sha, V.C., Elements of Radiation Biology, Todays & Tomorrows Printers & Publishers, New Delhi. 1985.
2. Merril Eisenbud, Environmental Radioactivity, Academic Press, California, 1997.
3. Sharma, B.K., Environmental Chemistry, Goel Publishing House, Meerut. 1990
4. Grosh, D.S., Biological Effects of Radiation, Blaisdell Publishing Co. 1965.
5. Bascq, Z.M. and Alexander, P., Fundamentals of Radiobiology. 1961.
6. Wolf, G., Isotopes in Biology, Academic Press, New York. 1964.
7. Use of Radioisotopes in Biology, BRNS, BRIT-DAE, Mumbai. 1989
8. Rao, P.S., Guest Editor, Nuclear Agriculture and Biotechnology, IANCAS Bulletin, 15 (1). 1999.
9. Sharma, A.K., Guest Editor Preservation of Food by Ionising Radiation, IANCAS Bulletin, 14(1), 1998.
10. Sood, D.D., Reddy, A.V.R., Iyer, S.R.K., Gangadharan, S and Gursharan Singh, Applications of Radioisotopes and Radiation in Industrial Development, NAARRIM, Mumbai. 1998.
11. Lele, R.D., Principles and Practice of Nuclear Medicine, Arnold-Heinemann, New Delhi. 1984.
12. Pillai, M.R.A., and Bhandarkar, S.D., Radioimmunoassay - Principles and Practice, 3<sup>rd</sup> Edition, BARC, Mumbai. 1998.
13. Kowalsky, R.J. and Perry, J.R., Radiopharmaceuticals in Nuclear Medicine Practice, Appletons Lange, 1987.
14. Ramamoorthy. N, Shivarudrappa. V, and Bhelose, A.A., Radiopharmaceuticals and Hospital Radiopharmacy Practices, Eds., BRNS, BRIT-DAE, Mumbai. 2000.

**SEMESTER I: CORE BASED ELECTIVE I  
OCCUPATIONAL HEALTH AND SAFETY**

**Course Code: 17PZO1CE1: 2**  
**Hours/Week : 6**  
**Credits : 5**

**Max Marks : 100**  
**Internal Marks : 25**  
**External Marks : 75**

**UNIT I: INTRODUCTION TO SAFETY PHILOSOPHY**

Sequence of Accident Occurrence, Occupational Injuries-Effects of Industrial Accidents, Analysis of Accidents, Injury Data, Accident Investigations & Reporting, Accident Costing

**UNIT II: SAFETY & HEALTH MANAGEMENT**

Employer & Employee Responsibilities, Record-keeping & Reporting Requirements, Safety Organization, Responsibilities of Safety Officer, Supervisors, Safety committees.

**UNIT III: RISK MANAGEMENT**

Definitions of Hazards, Risks, Evolution of Methodical Analysis, System safety Analysis techniques, Performance measurement, Operational Reviews - Internal & External.

**UNIT IV: WORK PRACTICES IN INDUSTRIES**

Hazards in Chemical Operations, Material Handling Hazards, Lifting Machinery & Pressure Vessels, Material Safety Data Sheets, Classification of Chemicals, Hazardous Chemicals, Storage Practices, Radiation Safety, Petroleum Storage Requirements, Pesticide Safety.

**UNIT V: FIRE SAFETY**

Basic Elements, Causes, Industrial Fires, Explosions, Effect On Environment, Property & Human Loss, Prevention Techniques, Building Design, Fire Protection Systems, Contingency Plan, Emergency Preparedness, Evacuation.

**UNIT VII : INDUSTRIAL BEST PRACTICES**

In Electrical, Mechanical, Fire, Machine Guarding, Personal Protective Equipment, Occupational Health, Ergonomics Ambulance, Noise Abatement Methods, Management Of Contractors.

**Text Books:**

1. Industrial safety and health, David L. Goetsch, Macmillan Publishing Company, 1993.
2. Handbook of environmental health and safety.

**SEMESTER II: CORE V  
GENETICS**

**Course Code : 17PZO2C5**

**Hours/Week : 6**

**Credit : 5**

**Objective:**

**Max Marks : 100**

**Internal Marks : 25**

**External Marks : 75**

To understand the fundamental concepts of genetics, human related genetic problems, inborn errors and genetic counseling.

**UNIT I Structure and function of genetic material**

Chromatin structure and nucleosome concept, organization and function of genetic material, Structure of DNA and RNA, Stereochemistry of bases and secondary structures, gene paradox, repetitive DNA, satellite DNA, overlapping genes, split genes, pseudogenes - Structure of eukaryotic genomes.

**UNIT II Mendel's laws and Gene expression**

Principles of Segregation and Independent Assortment - Deviation from Mendel's findings - The chromosome theory of Inheritance - DNA as genetic material - Tobacco Mosaic Virus – Factors influencing Gene expression – Study on Twins. Gene regulation in eukaryotes - Short term and Long term regulation.

**UNIT III Gene and gene interactions**

Gene interactions and types, multiple alleles, recombination, Non chromologous recombinant and its molecular mechanism, Linkage, LOD Score linkage, QTL Mapping, crossing over, mapping, cytoplasmic genes and their expression.

**UNIT IV Mutation and Microbial genetics**

Mutation - types, causes and detection, mutant types - lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

**Microbial genetics** - Methods of genetic transfers - transformation, conjugation, transduction and sexduction, mapping genes by interrupted mating, fine structure analysis of genes.

**UNIT V Genetics of Human metabolic disorders**

Inborn errors of metabolism - Phenylketonuria, Alkaptonuria, Albinism, Lesch-Nyhan syndrome, ADA deficiency, Galactosemia, G6PD deficiency, Tay Sach's disease and Gaucher's disease. Human karyotype: Preparation and analysis - Chromosomal syndromes in man – Detecting genetic diseases – Genetic counselling, Prenatal diagnosis, Genetic diseases – Treatment - Altering genetic traits - Human Genome Project – Features, methods and future prospects.

**Text Books:**

1. P.S. Verma and V.K. Agarwal, Genetics, Ninth Revised edition, S. Chand & Company Ltd., 2009.
2. Monroe W. Strickberger, Genetics, Third Edition, Prentice-Hall of India Private Limited, 2004.

**Books for Reference:**

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

## SEMESTER II: CORE BASED ELECTIVE II

### BIOTECHNOLOGY

**Course Code: 17PZO2CE2**

**Hours/Week : 6**

**Credit : 5**

**Max Marks : 100**

**Internal Marks : 25**

**External Marks : 75**

#### **Objective:**

To study the potential benefits of biotechnology in human and animal health. Also to understand the application of biotechnology in industries and Environment Protection.

#### **UNIT-I RECOMBINANT DNA TECHNOLOGY**

Molecular Tools of Genetic Engineering - Restriction endonucleases - DNA ligases- Alkaline Phosphatase – Nucleases - Polymerases. Vectors: Plasmids - Bacteriophages, Cosmids, H A C, B A C, Shuttle vectors. Methods of Gene Transfer- Expression in Prokaryotes & Eukaryotes.

#### **UNIT - II MOLECULAR TECHNIQUES**

**Gene Synthesis** – Chemical Synthesis (Phosphoramidite method). **Gene Amplification** – PCR Technique, Types and Applications. **DNA Sequencing** – Sanger Coulson method, Chromosome walking. **Gene Libraries** – cDNA Library - Blotting techniques – Southern, Northern and Western blotting.

#### **UNIT- III ANIMAL AND MEDICAL BIOTECHNOLOGY**

**Animal cell culture technology:** Organ culture - whole embryo culture - Embryo Transfer in human. Transgenic animal. Methods involved and applications– Stem cell culture and preservation.

**DNA in Disease Diagnosis**– DNA Probes, chip & Microarray.

**Gene Therapy**– *Ex vivo* and *in vivo* therapy- Vectors used for gene therapy  
**DNA Fingerprinting and DNA Markers**- RFLP, VNTR, STR, SNP- **Pharmaceutical products** – Recombinant vaccines.

#### **UNIT- IV INDUSTRIAL BIOTECHNOLOGY**

Fermentation– Types– Fermenter designs – Scale up microbial process- Upstream and Downstream processing – Product recovery and Purification – Production of Alcohol, Enzymes, Vitamins, Single Cell Proteins– Improvement of Inoculum.

#### **UNIT- V ENVIRONMENTAL BIOTECHNOLOGY**

Bioremediation: Bioreduction, Bioabsorption, Bioleaching of Heavy Metals and Ores: Copper, Uranium, Gold. Waste water Treatment: Biological Treatment System - Activated Sludge Method - Effluent Treatment Plant.

### Text Books

1. Satyanarayana, U, Biotechnology, Books and Allied (P) Ltd., Kolkata. 2009.
2. Dubey, R.C., 1993, A Text book of Biotechnology, S. Chand and Co., Ltd., New Delhi.
3. Babiuk, L.A., John, P. Phillips and Murray, Animal Biotechnology, Pergamon Press, Oxford (1989).
4. Gordard and Lucassen, E. *In vitro* culture of Animal Cells, Butterworth – Heinemann Publications.1993.
5. Higgins, I.J., Best, D.J. and Jones, J. Biotechnology – Principles and Applications. Blackwell Scientific Publications, Oxford, London, Edinburgh. 1988.
6. Old, R. W and Primrose, S B., Principles of Gene Manipulation, An Introduction to Genetic Engineering, Oxford Blackwell Scientific Publications. 1989.
7. Mc Neil and Harvey L.M. Fermentation, Blackwell Scientific Publications. 1990.

### Books for Reference:

8. Brown, C.M., Campbell, I. and Priest, F.G. Introduction to Biotechnology. Blackwell Scientific Publications, U.K(1988).
9. Keshav Trehan. Biotechnology, New Age International Pvt. Ltd. Publishers, New Delhi. 1996.
10. Marx, J.L. A Revolution in Biotechnology, Cambridge University Press. 1989.
11. Primrose, S. B. Modern Biotechnology. Blackwell Scientific Publications, Oxford, London. 1989.
12. Prentis , S. Biotechnology New Industrial Revolution, Orbis, London. 1985.
13. Smith John, E. Biotechnology. Edward Arnold, London. 1988.
14. Watson, J.D. *et al.*, Recombinant DNA. Scientific American Books, W. H Freeman and Company, New York.



**SEMESTER II: CORE BASED ELECTIVE II  
ENDOCRINOLOGY**

**Course Code: 17PZO2CE2: 2**  
**Hours/Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 25**  
**External Marks : 75**

**Unit I** : Scope of Endocrinology – Hormones – Life history – Chemical structure – Synthesis – classification – Characteristic features of hormones –General and principles of hormone action, Cell signaling and hormonal action – Cyclic AMP.

**Unit II** : Functional organization of hormones of Endocrine glands – pituitary (hypophysis) : Adenohypophysial and Neurohypophysial hormones – Thyroid – Pancreas – Adrenal – Pineal gland (Epiphysis) – Tissue hormones.

**Unit III** : Hormones and reproduction : Ovary and Testis – Hormonal control of mammary glands, ovarian cycles, pregnancy and Lactation – Placenta and its endocrine function.

**Unit IV** : Gastrointestinal hormones and its function – regulation of hormone metabolism and mineral metabolism – carbohydrate– nitrogen – lipid. Metabolism . Influence of hormones on growth and development – Hormones and calcium – phosphate homeostasis

**Unit V** : Hormonal regulation of osmoregulation – Thermoregulation – Hormones and behavior – Hormones regulation on migration – Regeneration – Metamorphosis – Environmental endocrinology.

**Reference books :**

1. Bently, P. J., Comparative Vertebrate Endocrinology, Cambridge University Press.
2. Chandra, S. Negi, Introduction Endocrinology, PHI Learning Pvt. Ltd., New Delhi.
3. Wiliam, R. H., Textbook of Endocrinology, W. B. Saunders.
4. Gorbman et al., Comparative Endocrinology, John Wiley & Sons.
5. Yadav, B. N., Mammalian Endocrinology, Vishal Publishing Co., Jalandhar.
6. Martin, C. R., Endocrine Physiology, Oxford University Press.

## SEMESTER III: CORE IX

### BIOCHEMISTRY

Course Code: 17PZO3C9

Hours/Week : 6

Credits : 5

Max Marks : 100

Internal Marks : 25

External Marks : 75

#### Objective:

To provide a concise and unifying approach of knowledge-sharing of the structure, function and interaction of biomolecules & bioprocesses at molecular and metabolic levels.

#### UNIT I STUDY OF BIOMOLECULES

12 hours

Structure, Properties, Analytical tests and Functional Significance of: Carbohydrates (mono, di and poly saccharides) – Lipids (fatty acids, triglycerids and steroids) – Proteins (amino acid classification) #Protein configuration# .

#### UNIT II NUCLEIC ACID AND ENZYMES

12 hours

**Nucleic acid** : Molecular structure, Chemistry, Types and Properties of DNA and RNA- Biosynthesis of Purines and Pyrimidine.

**Enzymes** : Types, Kinetics and Mechanism of Action – Enzyme inhibition – #Coenzymes (NAD, FAD) # and Cofactors.

#### UNIT III VITAMINS AND HORMONES

12 hours

**Vitamins**: Types, Occurrence, Classification, Structure, Properties, Functions and Deficiency symptoms.

**Animal hormones**: Classification, Salient features, Biochemical Properties and Functions: Pituitary, Thyroid, Parathyroid, Adrenal, Reproductive, Placental, Thymus, Pineal and Gastrointestinal - #Prostaglandins#.

#### UNIT IV CELL RESPIRATION AND CARBOHYDRATE METABOLISM 12 hours

**Cell Respiration and Biological Oxidations** : Bioenergetics – High energy compounds – Biological oxidation – Electron Transport chain – Oxidative Phosphorelation – Enzymes involved in Biological oxidation – #Free radicals and Antioxidants#.

**Carbohydrate Metabolism**: Glycolysis - Krebs's cycle – Gluconeogenesis – Glycogenesis – Glycogenolysis - HMP Shunt – Electron Transport System.

**UNIT V PROTEIN AND LIPID METABOLISM**

**12 hours**

**Protein Metabolism:** Metabolism of Amino acid – Ammonia and Urea cycle – Disorders of Amino acid metabolism – #Phenylketoneuria# - Albinism.

**Lipid Metabolism:** Metabolism of Tryglycerols, Fatty acid oxidation – Ketone bodies – Metabolism of Phospholipids – Glycolipids – Cholesterol - HDL – Fatty liver – Obesity – Atherosclerosis.

**#.....# Self-Study portion**

**Text book:**

- 1,Lehninger,L. Biochemistry W.H. Freeman & Co. 1990.
2. Stryer,L. Biochemistry. Wiley International. 1992.

**Books for Reference:**

1. Frankton J.S. & S. Simmonds, G.General and R.H.Dol. Outlines of Biochemistry John Wiley & Sons. 1987.
2. Baldwin, E. An introduction to comparative Biochemistry, CUP, London. 1964.
3. Beck. Human Design, Harcourt Brace Joranorich Inc. 1971.
4. Giese, A.C. Cell Physiology and Biochemistry, Prentice Hall. 1979.
- 5.Narayanan,L.M., Nallasingam, K, Arumugam, N, Fathima, D., Pillai,R.P.M.,Kumar,S.P. Biochemistry- Saras publication. Nagercoil. 2003.

## SEMESTER III : CORE X

### IMMUNOLOGY

**Course Code: 17PZO3C10**

**Hours/Week : 6**

**Credits : 5**

**Max Marks : 100**

**Internal Marks : 25**

**External Marks : 75**

#### **Objective:**

To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease. To learn about Immune system and Defense mechanism with latest information pertaining to MHC and HLA. Also to familiarize the modern laboratory techniques applicable to the diagnosis and monitoring of diseases involving the immune system.

#### **UNIT I INTRODUCTION TO IMMUNE SYSTEM**

**18 hours**

An overview - Scope of Immunology – concept of external and internal defence system – First line (innate) and second line (acquired) of defense – Immune organs – Types, anatomical location, structure and function- Role of cells in immune response

#### **UNIT II ANTIGEN and ANTIBODY**

**18 hours**

**Antigen:** Definition, Types Characteristic features and classification – Adjuvants – Definition types and applications

**Antibodies:** primary structure – classification – variants – functional characteristics of various antibody classes – generation of diversity – antibody engineering and its applications – Vaccines- types preparations and efficacies

#### **UNIT III COMPLEMENT AND EFFECTOR MECHANISM**

**18 hours**

COMPLEMENT – definition – salient features – major activation pathways - Immune **response:** Hormonal immune response - Cell mediated immune response.

**Cytokines:** Properties – General structure and functions – Interleukins – types(Lymphokines and monokines) and functions - interferon – origin – types and functions -

#### **UNIT IV DISEASES AND IMMUNE RESPONSE**

**18 hours**

Hypersensitivity – Definition – Types I to IV and Immune Manifestations – Auto Immune Diseases – types – onset and spectrum of diseases - Immuno deficiency diseases – types – congenital and acquired - Tumor immunology – Immune response

to tumor – Transplantation immunology – Allograft rejection – types and mechanism - Major Histocompatibility Complex (MHC)

#### **UNIT V IMMUNOLOGICAL TEST**

**18 hours**

Precipitation tests - Immunodiffusion - Immuno electrophoresis – VDRL Agglutination test - Widal test - Immunofluorescence - ELISA – Hybridoma technology – Radio Immuno Assay (RIA) – Western Blotting technique

#### **Text Book:**

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

#### **Books for Reference:**

1. Roitt, ( 3<sup>rd</sup> Edition) Immunology, Crover Medical Publishing Company, London
2. Barret, J. T. (1983) Text Book of Immunology (5<sup>th</sup> Edition), The C.V. Mosly Company.
3. Richard, H.M. (1992), Immunology(2<sup>nd</sup> Edition), Williams and Wilkins, Baltimore Maryland.
4. Hidemann, W.H. (1980) Essentials of Immunology, Elsevier Science Publishing Co. Inc.
5. Weinn. D.M. and Steward, L. (1993), Immunology, Singapore Publishers Private Limited.

## SEMESTER III: CORE XI

### BIostatISTICS AND BIOinformatics

**Course Code : 17PZO3C11**  
**Hours/Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 25**  
**External Marks : 75**

#### Objective:

(To acquire the knowledge on statistics and its application in the evaluation of biological data and to impart knowledge of molecular databases and their application)

#### BIostatISTICS

##### UNIT I

**18 hours**

Population – Sample and sampling methods - Variables in biology - Primary and Secondary data – Classification and tabulation of data - Representation of data: Diagrams and Graphs – Mean, Median, Quartiles and Mode – Variance, Standard Deviation and Standard Error.

##### UNIT II

**18 hours**

Probability – Addition and Multiplication laws- Binomial, Poisson and Normal distribution – Moments, Skewness and Kurtosis. Correlation: simple Correlation and correlation for grouped data - Rank Correlation.

##### UNIT III

**18 hours**

Regression equation – Regression line – Ratio of variation - Hypothesis testing - Student 't' test – Confidence limits -Chi-square test, F – test - ANOVA: Principle - One way & Two way – Statistical packages in Biostatistics studies – SPSS – Cluster Analysis- Dendrogram.

#### BIOinformatics

##### UNIT IV

**18 hours**

Bioinformatics: Scope. Biomolecular Structure of Proteins and Nucleic acids. Biological Database: Primary Database:– Protein Sequence Database – Nucleotide Database – Secondary Database: Protein structure Database – Domain and Motif Database – Derived Database: Gene Expression Database – Metabolic pathway Database – Specialized Database. - Genome data bases.

## **UNIT V**

**18 hours**

Sequence Alignments: Pairs wise Sequence Alignments – Local Sequence Alignments – Global Sequence Alignments – Multiple Sequence Alignments - Bioinformatics tools – FASTA, BLAST, Clustal W, RasMol, MMDB - Molecular phylogenetic analysis and construction of phylogenetic tree.

### **Text Books**

1. Arora, P.N. Biostatistics . Himalaya Publishing House. 1998.
2. Subramanian, C. A Text book of Bioinformatics, Dominant Publishers and Distributors. New Delhi, India. 2004.

### **Books for Reference:**

1. Sokal, R.J. and Rohlf, S.J. Introduction to Biostatistics, W.H. Freeman, London. 1981.
2. Ramakrishnan, P. Biostatistics, Saras Publications, Nagercoil. 1996.
3. Irfan Ali Khan and Atiya Khanum. Fundamentals of Bioinformatics. Ukaaz Publications Hyderabad, AP, India. 2003.
4. Murthy, C.S.V. Bioinformatics. Himalaya Publishing House. Mumbai, Delhi, Nagpur, Bangalore, Hyderabad, India. 2003.
5. Mittal, C. 2003. Fundamentals of Information Technology, Praghati Prakasam, Meerut.
6. ZAR, J. H. Biostatistical Analysis. Pearson Education Pvt. Ltd. Singapore.2004.

**SEMESTER III: CORE XII**  
**BIOCHEMISTRY AND IMMUNOLOGY BIostatISTICS**  
**BIOINFORMATICS - PRACTICAL**

**Course Code : 17PZO3C12**  
**Hours/Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 20**  
**External Marks : 80**

**Objective:**

To develop skill in preparing slides for microscopic observation of gametes and embryonic stages. Also to understand analytical estimation procedures of chief nutrients and to acquire knowledge on Immunological techniques such as Electrophoresis, Blotting principles...

**Biochemistry**

Preparation of solutions: Percentage, Molarity, Normality.

Buffer preparation: phosphate buffer, Acetate buffer– Determination of pH using pH meter.

Quantitative estimation of: Proteins, Aminoacids, Carbohydrates and Lipids in tissue samples.

**Immunology**

Lymphoid organs- Primary and Secondary.

Immunodiffusion - Immunoelectrophoresis (Demo) – ELISA.

Blotting techniques. Blood group matching (Compatibility test for ABO Blood Grouping).

**Biostatistics:**

Statistics using EXCEL: Production of bar diagrams and pie charts for statistical data.

Correlation , ANOVA- One way and Two way analysis.

**Bioinformatics:**

Similarity search for Nucleotide Sequences and protein sequences using BLAST and FASTA. Protein structure determination (prediction) using SWISS-MODEL.

**Educational Tour:** Visit to R & D labs and different natural habitats related to the subjects maintained above and submission of Tour Report is compulsory.

**Observation Record.**

A record of lab work shall be maintained and submitted at the time of Practical Examination for valuation.





**SEMESTER III: CORE BASED ELECTIVE III**  
**ANIMAL BEHAVIOUR AND BIODIVERSITY CONSERVATION**

**Course Code : 17PZO3CE3**  
**Hours/Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 25**  
**External Marks : 75**

**Objectives:** To enlighten the behavioural pattern of animals and the importance in understanding the need for conservation of animal diversity.

**Unit –I Ethology**

Animal behavior : Classification, instinct, imprinting, learning, foraging and feeding behaviour. Adaptive value of behavior - Habituation and conditioning - Instinct versus learning - Circadian and circannual rhythms. Social behavior in insects. Kin selection concept, Altruism.

**Unit - II - Communication Behaviour**

Visual communication – Dance language of honey bee; mating dance of birds. Chemical communication – Pheromones of insects and mammals. Migration of fishes and birds. **Human behaviour** – Neuronal control; Mania; Excitement and Depression; Schizophrenia; Alzheimer's disease.

**Unit –III – Biodiversity and Species concepts:**

Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - Inventory Survey methods in Animal diversity - Biodiversity Hotspots (Western Ghats, Indo - Burma region).

**Unit - IV – Threats to animal diversity and conservation tools:**

Extinctions: Past rates of Extinction - Threats to animal diversity in India - Status of species: Rare, endemic, threatened and endangered species - Measuring status of species in the wild - IUCN Red list - Status of Indian animals. In situ and Ex situ conservation of Indian animals - Project Tiger and Elephant.

**Unit – V- Animal Laws and Policies in India:**

Wildlife (Protection) Act of India (1972) - Protected Area Network - Zoo policy - Laws and their applications in Zoological parks, Wildlife sanctuaries and Biosphere reserves. Global Conservation Organizations - Role of NGO's and Government organizations in Wildlife Conservation - Trade of Endangered species - Wildlife documentation.

**Reference:**

1. Animal Behavior – Smith and Hill
2. Animal Behavior – Arora
3. Animal Behaviour by Reena mathur, Rastogi Publication, Meerut. 4<sup>th</sup> edition.
4. Ecology and Environment. P.D.Sharma, Rastogi Publication, Meerut. 13<sup>th</sup> edition.
5. Ecology (Individuals, population and Communities) by Michael Begon, John L. Harper Colin R. Townsend, 2005, Wiley.
6. Environmental politics and policy by Walter A. Rocenbaun, 2010, CQ Press College
7. The Text Book of Animal behaviour by Hoshang S. Gunderia and Hare Govind Singh, 2005, S. Chand & Co.)
8. A Text Book of Animal Diversity by Kotpal, R.L., Rastogi Publication, Meerut. First edition.

**SEMESTER III: CORE BASED ELECTIVE III  
BIODIVERSITY AND TAXONOMY**

**Course Code :17PZO3CE3 : 2**  
**Hours/Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 25**  
**External Marks : 75**

**UNIT- I. Basic concept of Biodiversity** – What is Biodiversity, Why should we conserve it, Elements of Biodiversity - Ecosystem Diversity, Genetic Diversity, Species Abundance & Diversity, Patterns of Species Diversity. . Global patterns of Biodiversity – measuring biodiversity, Cataloging and Discovering Species, Geographical Patterns of Species Richness, Biogeography, Importance of Distribution Patterns (Local Endemics, Sparsely Distributed Species, Migratory Species), GAP Analysis.

**UNIT- II. Biodiversity & Conservation** – Overexploitation threatening living species, International Trade, Animals threatened by International trade, Controlling International Trade (Enforcement, Reservations, Illegal Trade), Free Trade & the Environment, Free Trade & Conservation, Common patterns of Overexploitation.

**UNIT- III. Exotic Species and Conservation**– Plants, Invertebrates, Fishes, Amphibians, Reptiles, Birds, Mammals, Detrimental Effects of Exotic Species. . Endangered Species Conservation – The US Endangered Species Act, State Endangered Species Acts Successes and Failures of the Endangered Species Act Role of ESA in Habitat Protection, Critical Habitat, Problems with the Endangered Species Act, Habitat Conservation Plans.

**UNIT - IV. Ethics of Conservation** – Values of Biodiversity, Biopiracy, Hybridized plants, GM crops (benefits & criticism), Economic Value of Biodiversity & Legal, Ethical and Conservation issues related to uses of biodiversity, Global Conservation Issues.

**UNIT - V. Basic concept of Taxonomy** – Classification, Construction of Phylogenetic tree, Systematics, Cladistics, Cladograms, Phenetics, Nomenclature. Taxonomy in relation to Chromosomal morphology & Evolution – Chromosomal evolution, why

location of genes matter, evolutionary oddities about chromosomes, evolutionary effect of rearrangements of chromosomes, karyotypic orthoselection, chromosomal evolution & speciation.

**Text Books:**

1. Ecology (Individuals, population and Communities) by Michael Begon, John L. Harper Colin R. Townsend, 2005, Wiley.
2. Environmental politics and policy by Walter A. Rocenbaun, 2010, CQ Press College
3. The text book of Animal behaviour by Hoshang S. Gunderia and Hare Govind Singh, 2005, S. Chand & Co.)

**SEMESTER III: EXTRA CREDIT - I**  
**COMPREHENSIVE EXAMINATION IN ZOOLOGY**

**Course Code : 17PZO3EC1**  
**Hours/Week : -**  
**Credit : 5\***

**Max Marks : 100\***  
**Internal Marks : --**  
**External Marks : 100\***

**Objective:**

To study the basic concepts of animal structure and function.  
To Provide an understanding of the cellular and molecular basis of life and appropriate foundation for a career in molecular biology and genetics.

**UNIT I**

Classification of Invertebrata upto phyla with diagnostic features and examples.  
Cockroach : External morphology, mouth parts, digestive system, respiratory system, circulatory system, nervous system and reproductive system  
General characters of Chordates - Classification of vertebrata upto classes with suitable examples.  
Frog: External features, digestive system, respiratory system, circulatory system, nervous system and urino-genital system.

**UNIT II**

Physiology of digestion and absorption, respiration, transport of oxygen and carbon-dioxide, structure of kidney and nephron, urine formation in man.  
Composition and functions of blood of man - Types of muscle - Structure of neuron - Nerve impulse conduction. Physiology of vision in man.  
Functions of Pituitary and Islets of Langerhans. Human Reproductive Systems – Menstrual cycle.

**UNIT III**

Stem cells: Sources, types and their use in human welfare. Modern concept of gene, split gene, genetic regulation, genetic code. Mendel's laws of inheritance, recombination, linkage, multiple alleles, genetics of blood groups, pedigree analysis, hereditary diseases in man. Mutations and mutagenesis. Theories of evolution; Natural selection, role of mutation in evolution, evolutionary patterns; molecular drive, mimicry, variation, isolation and speciation.

**UNIT IV**

Structure and function of cell and its organelles (Nucleus, Plasma membrane, Mitochondria, Golgi bodies, Endoplasmic reticulum, Ribosomes and Lysosomes). Cell division (mitosis and meiosis), mitotic spindle and mitotic apparatus, Chromosome

movement, Chromosome type: polytene and lampbrush, organization of chromatin, heterochromatin, cell cycle regulation.

Nucleic acid topology, DNA motif, DNA replication, transcription, RNA processing, translation, protein foldings and transport.

#### **UNIT V**

Apiculture, sericulture, lac culture, carp culture, pearl culture, prawn culture, vermiculture. Major infectious and communicable diseases (malaria, filaria, tuberculosis, cholera and AIDS) their vectors, pathogens and prevention. Pests of sugar cane (two each), oil seed and rice .Transgenesis.

#### **Books for Reference:**

1. Barrington, E.J.W. Invertebrate Structure and Function, II Ed., ELBS and Nelson. 1979.
2. Kent. G.C. Comparative Anatomy of the Vertebrates, McGraw Hill Book Co., Inc., New York. 1976.
3. R. Nagabhushanam, M.S. Kodarkar, R. Sarojini, Textbook of Animal Physiology. Second Edition, Oxford & IBH Publishing CO. PVT. LTD. 2002
4. M.W. Strickberger, Genetics, Third Edition, Third Edition, Prentice-Hall of India Private Limited, 2004.
5. De Robertis, E.D. P. and De Robertis, E.M.F. Cell and Molecular Biology, VIII Ed. Lea and Febiger, Philadelphia. 1987.
6. Tomer & Bhatnager, Text books of applied zoology. Emkay publication, Delhi. 2000.

**SEMESTER IV: CORE XIII  
GENERAL AND APPLIED ENTOMOLOGY**

**Course Code: 17PZO4C13**  
**Hours/ Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 25**  
**External Marks : 75**

**Objective:**

To impart a thorough knowledge on Insects, their taxonomy, biology and their interrelationship with environment. To provide students the opportunities to understand pests, vector insects and Insect Pest Management Techniques

**UNIT I INSECT TAXONOMY AND MORPHOLOGY 18 hours**

**Taxonomy:** Basics of insect classification. Salient features of the insect orders with common south Indian examples.

**Morphology:** Head: segmentation and sutures. Wings: venation – Types of antennae – Types of Legs and modifications

**UNIT II INSECT PHYSIOLOGY 18 hours**

Structure and physiology of Integumentary, digestive, circulatory, excretory, respiratory, nervous, reproductive and endocrine system

**UNIT III AGRICULTURAL AND MEDICAL ENTOMOLOGY 18 hours**

Biology, damage caused and control methods of any three chief pests of paddy, sugarcane, cotton, coconut, groundnut, brinjal and stored product pests

Arthropods as vector of Human diseases - Biology, disease caused and control measures of House fly, Mosquito, Flea and Louse

**UNIT IV INSECT OF ECONOMIC IMPORTANCE 18 hours**

Sericulture - Biology and culture methods of silkworm, types of silkworm – Apiculture – Types of honey bee, bee colony, rearing of honey bee, bee keeping accessories and by products- uses of honey. Biology and rearing methods of Lac insect – uses of lac

**UNIT V INSECT PEST MANAGEMENT 18 Hours**

Natural and artificial control of insect pests – Cultural, Mechanical, Physical and legal methods - Biological control - Parasites, Predators and Microbial agents. Chemical methods - Pesticides - Classification –Types of formulations – Mode of action - Non-conventional methods - Insect Growth Regulators (IGR), Repellents, Antifeedants, Pheromones and Chemosterilants - Integrated Pest Management (IPM) - Need for IPM and uses.



**Text book:**

1. Chapman, R.F. The insects: Structure and Function, Hodder and Broughton Ltd., Kent, U.S.A., 2015.
2. Nalina Sundari, M.S., and R. Santhi, Entomology, MJP Publishers, Chennai. 2006.

**Books for Reference:**

1. Mani, M.S., General Entomology, Oxford and IBH publishing Co., New Delhi. 1982.
2. Snodgrass, R.E., Principles of Insect Morphology, McGraw Hill and Co., New York. 1985.
3. Nayar, K.K., Ananthakrishnan, T.N., and David, M., General and Applied Entomology, Tata McGraw Hill Pub. Co., Ltd., New York. 1995.
4. Vasantharaj David, B., Elements of Economic Entomology, Popular Book Depot., Chennai – 15. 2001.
5. Nayar, K.K. et al., Economic Entomology and Applied Entomology, Oxford and IBH Publishing Co., New Delhi. 1983.
6. Rathinaswamy, T.K., Medical Entomology, S. Viswanathan and Co., Madras, 1986.

**SEMESTER IV: CORE XIV  
MICROBIOLOGY**

**Course Code: 17PZO4C14**  
**Hours/Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 25**  
**External Marks : 75**

**Objective:**

To understand the interaction of microorganisms with their environment and the practical consequences of these interactions. To impart knowledge on the basic principles of food, industrial and environmental microbiology.

**UNIT I INTRODUCTION TO MICROBES 18 hours**

Morphological shapes of bacteria and viruses, Bacterial growth: Growth curve, Factor affecting bacterial growth, Measurement of bacterial growth- Microbial culture – Types of Culture media – Method of Culturing Bacteria- Isolation and Purification Techniques, Staining Techniques: Simple Staining and Gram's staining: # Differentiation of Gram positive and Gram negative bacterial cell walls #

**UNIT II FOOD MICROBIOLOGY 18 hours**

Microbiology of food – Normal Microbial flora of common food - # Food spoilage # – food poisoning – food infection – food preservation – Microbiology of fermented food Milk and Egg– Detection of food borne pathogens.

**UNIT III INDUSTRIAL MICROBIOLOGY 18 hours**

Microorganism for Industrial Microbiology – Bioreactors. Types. Major products of Industrial Microbiology : Ethanol, Antibiotics and Vitamin-B12, Enzyme – #Organic acids# – Biopolymers – Biosurfactants –and Biofuels.

**UNIT IV MEDICAL MICROBIOLOGY 18 hours**

Microbial diseases: Protozoan diseases – Plasmodium, Entamoeba. Fungal diseases : Mycosis. Bacterial diseases: Tuberculosis (TB) and Tetanus. Water borne diseases : Typhoid. STD: gonorrhoea and syphilis - Contact diseases- Leprosy -. Viral diseases: polio – hepatitis B – AIDS – Causative agents, Mode of transmission, Symptoms, Prevention & Control.

**UNIT V AGRICULTURE AND ENVIRONMENTAL MICROBIOLOGY      18 hours**

Biofertilizers: symbiotic and asymbiotic nitrogen fixation – Inoculum Preparation & Formulation – Biopesticides - Bioleaching of metals-Biodegradation using microbial communities — Xenobiotics and hydrocarbon degradation in water and soil. Waste as a resource – #organic compost# – vermi composting. Sewage Treatment.

**#.....# Self-Study portion**

**Text Books:**

1. Dubey R.C and Maheswari D.K. Text book of Microbiology, S. Chand and Company Ltd, New Delhi. 2009.
2. Pelczar, Chan and Krieg. Microbiology, Tata Mc Graw Hill Pub. Co. Ltd. 1993.
3. Ananthanarayanan, R and Jayaram Panicker, C.K. Text Book of Microbiology, Orient Longman, Chennai and Hyderabad. 2000.

**Books for Reference:**

1. Sulia, S.B & Santhanam, S. General Microbiology , Oxford and IBH. 2001.
2. Thomas, C.G.A. Medical Microbiology, ELBS Publications. 1988.
3. Powar, C.B. and Diginawala. H. F. General Microbiology - Vol. I & II. Himalaya Publishing House, Bombay. 1987.
4. Sharma, P.D. Microbiology - Rastogi Publications, Meerut. 1993.

## SEMESTER IV: CORE XV

### GENERAL AND APPLIED ENTOMOLOGY & MICROBIOLOGY - PRACTICAL

**Course Code: 17PZO4C15: P**  
**Hours/Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 20**  
**External Marks : 80**

#### **Objective:**

To acquire thorough knowledge on Insect collection, preservation and identification procedures. Also to develop skill on analytical estimations on insect physiology, anatomy and haemolymph.

#### **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 and Vectors
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.

#### **MICROBIOLOGY**

Sterilization techniques  
Preparation of culture media  
Motility of bacteria  
Pure culture techniques  
Culture Techniques  
Simple staining  
Gram staining and differential staining

**Equipments in Microbiology**

- Inoculation loop
- Autoclave
- Laminar flow hood
- Spotters related to theory

**Field visits**

Visits to Sericulture units, Crop research stations, Farms and IPM Centers to have a firsthand knowledge on culture techniques and problems.

**Record work**

A record of laboratory work and collection of insects (including insects of economic importance) shall be submitted for the practical examination.

## SEMESTER IV: CORE BASED ELECTIVE – IV

### AQUACULTURE PRACTICE AND FARM MANAGEMENT

**Course Code : 17PZO4C16**  
**Hours/Week : 6**  
**Credit : 5**

**Max Marks : 100**  
**Internal Marks : 25**  
**External Marks : 75**

#### Objectives:

- To understand the improved techniques in Aquaculture Seed Production and Fish Health Management
- To acquaint with the techniques in Biotechnology as applied to Aquaculture Industry for enhancing self employment potentials

#### Unit – I Aquaculture Basics & Farm Management:

Aquaculture – Blue Revolution in India – Coastal & Freshwater Aquaculture – Site selection – Farm layout & Construction – Farm Engineering and equipments – Role of Aeration in culture system – Management of Culture ponds – Fertilization – Predator & weed management – Water and soil quality management.

#### Unit – II Aquaculture for Sustainability:

Sewage fed fish culture – Sewage treatment – Sewage cum Fish culture in India – Monoculture, Polyculture, Monosex culture. Recent developments in Integrated fish farming – Animal husbandry cum Fish culture – Paddy cum Pisciculture- Fish culture in cages & pens – Race-way fish culture – Culture of Air breathing fishes.

#### Unit – III Seed Production Techniques:

Brooder care management – Bund breeding- Hypophysation – In-vitro fertilization – Application of Synthetic Hormone- Transport of fish seed and brooders – Hatchery operations of Fin and Shell Fishes - Edible and Pearl Oysters – Ornamental fish culture.

#### Unit- IV Nutrition and Fish Health Management:

Culture of fish feed organisms: Diatoms - Cladocerans – Rotifers – Artemia – Copepod. Artificial feed formulation and management- Probiotics in formulated feed. Bacterial Gill Rot & Furunculosis ; EUS & Erythrocytic Necrosis (Viral) & Saprolegniasis & Erythroderma (Fungal diseases) - Nutritional deficiency diseases - Ectoparasites and Endoparasites - Principles of Fish Health Management- Fish vaccines and Antibiotics.

#### Unit- V Aquaculture Biotechnology and Economics

Genetic improvement of stock – Selective and diversified breeding – Hybridization – Transgenic fishes (Antifreeze & Green fluorescent proteins).

Chromosomal manipulation- Ploidy in Fishes- Gynogenesis and Androgenesis in Fishes- Production of Monosex and Sterile fishes- Cryopreservation of gametes.

Aquaculture Economics – Fish Marketing and Preservation – Cold storage - Governmental involvement in enhancing fish production and marketing – Role of MPEDA,NIOT, CMFRI, CIBA, and NABARD.

**Text books:**

1. Agarwal, S.C. A Hand Book of Fish Farming . Narendra Publishing House, New Delhi. 3<sup>rd</sup> Edition, 1994.
2. Chakrabarthy, M.N., Biology, Culture and Production of Indian major carps, Narendra Publishing House, New Delhi. 2<sup>nd</sup> Edition, 1998.

**Books for Reference**

1. Hall, C.B. Ponds and fish culture . Agrobotanical Publishers India. 1999.
2. Jhingran,V.G. Fish and fisheries of India, Hindustan Publishing Co., New Delhi. 1997.
3. Santhanam,R., Fisheries Science, Daya Publication House. New Delhi. 1990.
4. S.K. Gupta., P.K. Gupta., General and Applied Ichthyology (Fish and Fisheries). S. Chand & company LTD, Ram Nagar, New Delhi Edition – 2006.
5. Aquaculture, N. Arumugam., Saras Publication, 114/35 G, A.R.P Camp road, Periyakavilai, Kottar P.O. Nagercoil, Kanyakumari Dist. Second edition- 2010.
6. Fish and Fisheries. Santosh Kumar and Manju Tembhare., New Central book Agency (P) LTD, London, January- 2010.

## SEMESTER IV: CORE BASED ELECTIVE – IV

### INDUSTRIAL FISH AND FISHERIES

**Course Code : 17PZO4C16 : 2**

**Hours/Week : 6**

**Credit : 5**

**Max Marks : 100**

**Internal Marks : 25**

**External Marks : 75**

#### **OBJECTIVE:**

To help the students taking Industrial Fish and Fisheries as a subject to have a through knowledge of the various aspects of the Biology of Fish

#### **UNIT I**

Introduction: Fish Biology – Definition and basic concepts of biosystematics, Importance of classification – Theories of biological classification, Variations in structure, Form, Skin, Coloration, Scales, Mouth, Jaws, Teeth, Fins, Spines and other structures used in taxonomic studies. Induced breeding techniques – Hatching methods – Seed and Brood transport.

#### **UNIT II**

Study of external morphology and internal organization of a typical elasmobranch and teleost. Alimentary Canal and Associated Structures – Gills – Swim Bladder – Accessory Respiratory organs – Lateral line system – Sound and Light producing organs. Morphological and anatomical characters of Prawn, Crab, Lobster, Bivalve, Gastropod and Cephalopod ( one example each )

#### **UNIT III**

Natural food of fishes – Feeding habits in various groups of fresh water and marine fishes, Prawns, Crabs, Lobsters and Cephalopods. Qualitative and Quantitative estimation of food consumption based on experimental studies and stomach content analysis – Seasonal changes in food availability and food preference – Food and Feeding in relation to age – Food selectively – Feeding intensity. Nutrition of fishes and utilization of food, Feeding strategies and energies. Artificial feeding – Nutritional requirement.

#### **UNIT IV**

Growth of fish – Absolute, Relative, Isometric and Allometric growth. The Cube Law – Methods for determination of growth – Length frequency analysis – Analysis of growth checks on hard parts like Scales, Otolith and Vertebrae – Estimation of growth by direct methods – Marking and tagging of fish for growth studies – Aging of fish and shell-fish based on length data and growth checks – Length weight relationships, Ponderal index, Relative condition factor and Gonado – Stomach index.



## UNIT V

Types of reproduction, Sex differences – Sexual maturity, Classification of maturity stages, Size at first maturity. Estimation of fecundity – Ova diameter frequency – Fecundity in relation to length, Weight, Age and food supply. Spawning habits – Factors affecting Spawning, Spawning seasons and frequency. Embryonic and early development – Types of egg and Larvae – Metamorphosis of larva – Larval life and feeding habits. Reproductive behaviour and parental care – Social behaviour – Aggregation and Shoaling. Migrations – Anadromous and Catadromous.

## REFERENCES

1. The Biology of Fishes, Kyle, H.M., T.F.H. Publication, Hong Kong 366 P.
2. The Life of Fishes, Marshall, N.B. 1965, Weidenfeld & Nicolson, London 402 P.
3. The Marine and Freshwater Fishes of Ceylon, Munro I.S.R., 1982. Soni Reprints Agency, New Delhi 351 P.
4. Inland Fishes of India and Adjacent Countries., Vol I & Vol II, Talwar, P.K. and A.G. Jhingran, 1991, Oxford & IBH Publishing Co Pvt Ltd., New Delhi 1958 P.
5. Fisheries Ecology, Pitcher, T.J. & P.J.E. Hart, 1992, Room Helm, London 414P.
6. Introduction to the Practice of Fisheries Science. Royce, W.F. 1984, Academic Press 438 P.
7. Fisheries Science its methods and application, 1993, Rounsfell, G.A. and W.H. Everheart, John William & Sons New York, 444 P.

**SEMESTER IV: EXTRA CREDIT – II**  
**ADVANCED STUDIES IN ZOOLOGY**

**Course Code : 17PZO4EC2**  
**Hours/Week : -**  
**Credit : 5\***

**Max Marks : 100\***  
**Internal Marks : --**  
**External Marks : 100\***

**Objective:**

To study the basic concepts of animal structure and function.  
To Provide an understanding of the cellular and molecular basis of life and appropriate foundation for a career in molecular biology and genetics.

**UNIT I**

Classification of Invertebrata upto phyla with diagnostic features and examples.  
Cockroach : External morphology, mouth parts, digestive system, respiratory system, circulatory system, nervous system and reproductive system  
General characters of Chordates - Classification of vertebrata upto classes with suitable examples.  
Frog: External features, digestive system, respiratory system, circulatory system, nervous system and urino-genital system.

**UNIT II**

Physiology of digestion and absorption, respiration, transport of oxygen and carbon-dioxide, structure of kidney and nephron, urine formation in man.  
Composition and functions of blood of man - Types of muscle - Structure of neuron - Nerve impulse conduction. Physiology of vision in man.  
Functions of Pituitary and Islets of Langerhans. Human Reproductive Systems – Menstrual cycle.

**UNIT III**

Stem cells: Sources, types and their use in human welfare. Modern concept of gene, split gene, genetic regulation, genetic code. Mendel's laws of inheritance, recombination, linkage, multiple alleles, genetics of blood groups, pedigree analysis, hereditary diseases in man. Mutations and mutagenesis.  
Theories of evolution; Natural selection, role of mutation in evolution, evolutionary patterns; molecular drive, mimicry, variation, isolation and speciation.

#### **UNIT IV**

Structure and function of cell and its organelles (Nucleus, Plasma membrane, Mitochondria, Golgi bodies, Endoplasmic reticulum, Ribosomes and Lysosomes). Cell Division (Mitosis and Meiosis), Mitotic Spindle and Mitotic Apparatus, Chromosome movement, Chromosome type: Polytene and Lampbrush, organization of chromatin, heterochromatin, cell cycle regulation.

Nucleic acid topology, DNA motif, DNA replication, Transcription, RNA processing, Translation, Protein foldings and transport.

#### **UNIT V**

Problems associated with foreign gene integration and expression, gene silencing; genes of interest; application of transgenic animals, plants and microbes; ethical issues. Application, ethical and legal issues, What are genetically modified microorganisms and their applications; risk groups; biosafety standards & measures; Expert committees (RDAC, GEAC, SBCC, DLC); environmental approval, National and international status of current research in 'Recombinant DNA Technology'; Artificial cell, synthetic life.

#### **Books for Reference:**

1. Barrington, E.J.W. Invertebrate Structure and Function, II Ed., ELBS and Nelson. 1979.
2. Kent. G.C. Comparative Anatomy of the Vertebrates, McGraw Hill Book Co., Inc., New York. 1976.
3. R. Nagabhushanam, M.S. Kodarkar, R. Sarojini, Textbook of Animal Physiology. Second Edition, Oxford & IBH Publishing CO. PVT. LTD. 2002
4. M.W. Strickberger, Genetics, Third Edition, Third Edition, Prentice-Hall of India Private Limited, 2004.
5. De Robertis, E.D. P. and De Robertis, E.M.F. Cell and Molecular Biology, VIII Ed. Lea and Febiger, Philadelphia. 1987.
6. DNA Cloning: A Practical Approach Volume 1: Core Techniques (The Practical Approach Series) (2nd edition) 1995. D. M. Glover, B. D. Hames Oxford University Press, USA.