

MADURAI KAMARAJ UNIVERSITY
MADURAI 625 021
DIRECTORATE OF DISTANCE EDUCATION
M.Sc., ZOOLOGY (Non Semester)
(With effect from the academic year 2013 - 14)

Eligibility for the course

Candidates for admission to M.Sc. (Zoology) could possess a Bachelor's degree in Zoology ancillary Botany and Chemistry of any recognized university with minimum aggregate of 45% marks

Duration of the course

2 years M.Sc. (Zoology) degree course non-semester for two year duration

Examination

All the theory papers are of 3 hours duration each for maximum of 100 marks with passing minimum of 50 marks. Practical examinations are also for 3 hours duration for a maximum of 100 marks and a passing minimum of 50 marks

Question paper pattern

Maximum marks: 100

Time: 3 hours

Part A (10×2=20)

10 Questions (Answers are to be given for all questions; Two questions from each unit)

Part B (Total questions 10, out of which answers are to be given for any seven questions; 7×5=35)

Part C (Total questions 5, out of which answers are to be given for any three questions; 3×15=45)

Madurai Kamaraj University

Distance Education M.Sc. (Zoology)

Sl. No.	Code No.	Theory & Practicals	Marks
First Year			
1		Cell and Molecular Biology	100
2		Biochemistry and Biophysics	100
3		Animal Physiology	100
4		Developmental Biology	100
5		Biostatistics and Computer Applications	100
6		Genetics	100
P1		Practical I Theory Papers 1,2 & 3	100
P2		Practical II Theory Papers 4,5 & 6	100
Second Year			
7		Biotechnology	100
8		Microbiology	100
9		Immunology	100
10		Environmental Biology & Evolution	100
11		Fisheries & Aquaculture	100
12		Entomology	100
P3		Practical III Theory Papers 7,8 and 9	100
P4		Practical IV Theory Papers 10,11 and 12	100
Total			1600

Cell and Molecular Biology

Unit I

Cell Structure: Cellular and structural organization – Prokaryotes and Eukaryotes – Cytoskeleton – Microfilaments – Microtubules – Cilia and flagella – Plasma membrane – Ultra structure and functions – Membrane associated receptors – Extra cellular space – Cell adhesion – Inter cellular junctions

Unit II Cell Organelles: Structure and function of cell organelles – Mitochondria – Endoplasmic reticulum – The Golgi apparatus – Lysosome – Ribosome – Centrosome, Mitochondria

Unit III

Mitochondria Structure and function – Glycolysis, Krebs cycle, Respiratory chain, Oxidative phosphorylation – Mitochondria as semiautonomous organoids – Mitochondrial dysfunction and diseases – Nucleus – Nuclear envelope – Structure and function of chromatin – Organization of nucleosome – Euchromatin and Heterochromatin – Unusual chromosomes – Polytene and Lampbrush chromosomes – Mechanism of chromosome formation – Nucleolus

Unit IV

Cell Cycle: Cell cycle and its components – Spindle organization – Chromosome movements – Synchronisation of cell division – Mitosis and Meiosis – Differences between Normal and Cancer cells – Membrane, biochemical, nuclear and chromosomal changes in cancer cells

Unit V

DNA structure and Function – Watson & Crick Model – Types of DNA & RNA – DNA Replication – DNA Transcription – Genetic Code – Protein synthesis

Text book

- 1) Essentials of Cell and Molecular Biology. DeRobertis E.D.P., & DeRobertis E.M.F., 1981. Saunders International Edition

Reference Books

- 1) Cell Biology, 2nd edition, Karp. G., 1985, McGraw Hill
- 2) Molecular Biology of the Cell, 3rd Edition, Alberts, B., et al., 1994, Garland Publishing Inc.
- 3) DNA Replication, Kornberg, A., 1974, W.H. Freeman and Company
- 4) Cell Physiology, Howland, J.L., 1973. Macmillan Publishing Co.

Biochemistry and Biophysics

Unit I

Basic concept of biochemistry– atoms, bonds,–ionic, hydrogen, covalent Vanderwalls force, pH value, acid and base concept, chemical equilibrium and buffers

Unit II

Amino acids – classification, structure and properties – Proteins – classification – primary, secondary, tertiary and quaternary structures – Biological significance of proteins

Unit III

Carbohydrates – classification, monosaccharides, disaccharides and polysaccharides. Lipids– classification, simple lipids, waxes– derived lipids– cholesterol and properties – Biological significance of carbohydrates and lipids

Unit IV

Photon concept – light and wavelength emittance – photoelectric effects – displacement of electrons by light – quantum theory of light. Microscopy – Principles of optics with reference to compound, polarizing, phase contrast and electron microscope

Unit V

The movement of molecules – plasmolysis – incipient plasmolysis – haemolysis – cyclosis diffusion rate in relation to temperature – Pfeffer's membrane – movement of water – rate of diffusion in air/water – effect of electrolytes and non electrolytes on osmosis – methods of determination – Definition – drop weight method – determination and uses

Text Book

- 1) Jain, "Principles of Biochemistry", Chand and Co.
- 2) Biophysics by Salil Bose

Reference Books

- 1) Roland Glaser (2004) "Biophysics: An Introduction", Springer
- 2) Basic Biophysics for Biologists (1989) M. Daniel, S.S. Purohit Agro Botanical Publishers, 1989
- 3) Voet. D., Voet J.G., 1995, Biochemistry, John Wiley & Sons Inc.
- 4) Murray R. K., Granner D.K., Mayes P.A. Rodwell V.W., 2000, Harpers Biochemistry, Mc Graw Hill
- 5) Nelson D.L., Cox M.M., 2001, Lehninger Principles of Biochemistry, 3rd Edition Macmillan Worth Publishers
- 6) Glasstone. S, Thermodynamics for Chemists, East West press Pvt. Ltd.

Animal Physiology

Unit I

Nutrition and Digestion: Nutritive requirements – Feeding mechanism – General organization of alimentary canal – Digestive glands and enzymes – Digestion – Absorption, Assimilation, Ejection or defecation

Unit II

Respiration: Definition of Respiration – Respiratory mechanism – Respiratory pigments – Transport of gases – Factors influencing transportation of gases – Oxygen dissociation curve – Respiratory quotient – Respiratory disturbance and diseases

Unit III

Circulation: Circulatory fluids – Blood constituents – Types of circulatory system – Types of hearts – Blood Clotting – Theories – Haemolysis – Anticoagulation – Role in Acid base regulation – Origin and evolution of heart beat – Blood pressure and its consequences – Osmoregulation – Osmoregulation in fresh water, marine, estuaries and terrestrial animals

Unit IV

Excretion: Types of excretory products – Excretory organs in animals [Invertebrates and Chordates] – Human kidney and its physiology – Structure of Nephrons – Mechanism of urine separation in Nephron – Diseases of kidney

Unit V

Nervous system and Hormones: Neurons – Transmission of nerve impulse through neurons – Synapse and synaptic transmission – Classification of Sensory Receptors – Chemoreception (Tongue & Nose) – Mechanoreceptors and Photoreceptors – Endocrine organs of human – Pituitary and its hormones – Mode of action of hormones – Reproduction in male and female – Reproductive organs – Hormonal regulation of reproduction – Mechanism of muscle contraction – Ultra structure of Skeleton muscles – Structure and types

Text and Reference Books

- 1) Comparative Animal Physiology, 3rd Edition, Prosev, C.L., 1984, WB Sainders
- 2) General and Comparative Physiology, Hoar, W.S., 1976, Prentice Hall of India

- 3) Text Books of Animal Physiology, 2nd Edition, Nagabushanam, R., Kadarkar, M.S, Sarojini, R., 1999, Oxford & IBH

Developmental Biology

Unit I

Gametogenesis – Origin of germ cells – Significance of gametogenesis Oogenesis – Types of eggs–growth, development and maturation of oocyte, Egg envelopes, Polarity and symmetry, Spermatogenesis–Sperm Structure, Types of sperm, Fertilization – Approach of spermatozoon–Reaction of egg, essence of activation – Changes in egg cytoplasm caused by fertilization

Unit II

Cell division in cleavage – Chemical changes–Patterns of embryonic cleavage – Morula and Blastula – Role of egg cortex – Morphogenetic gradients – Fate map – Gastrulation – Primary organ, Rudimental organs, Organizer – Morphogenetic movements

Unit III

Organogenesis: Induction and differentiation of Brain, eye, ear, limb, Heart, kidney, Development of Immune system, Chemical basis of differentiation – selective action of genes–gene action in development – Nuclear transplantation–cell death in development–aging–Teratogenesis

Unit IV

Metamorphosis and Regeneration: Metamorphosis – causation of metamorphosis – Hormonal control of amphibian and insect metamorphosis – Regeneration – Regenerative ability in animals – Histological processes involved in Salamander limb regeneration – Polarity and gradients in regeneration – Factors stimulating regeneration of limbs

Unit V

Experimental Embryology: Mammalian reproductive cycle-Hormonal regulation of reproductive cycle-Endocrine changes associated with normal pregnancy-Induced ovulation in humans- *In vitro* Fertilization

Text Book

- 1) An Introduction to Embryology, 5th Edition, Balinsky B.I., 1981, Holt Saunders International Edition

References

- 1) Developmental Biology, Berrill N.J., 1974, TMH Edition
- 2) Animal Regeneration, Diwan A.P., Dhakad N.K., 1996, Anmol Publications Ltd
- 3) Developmental Biology, Browder L.W., Erickson C.A., And Jeffery W.R, 1991
Saunders College Publishing House, Philadelphia

Biostatistics and Computer Application

Unit I

Data collection – Sources and Methods – Methods of Sampling – Presentation of Data – Diagrammatic and Graphic representation of data

Unit II

Measures of Central Tendency – Mean, Median, Mode – Measures of Dispersion – Variance and Standard Deviation – Skewness and Kurtosis – Correlation and Regression – Rank Correlation

Unit III

Test of Significance – tTest – chi-square test – Analysis of Variance – One way classification and two way classification Model

Unit IV

Computer – Types of Computer – Architecture – Computer Hardware – CPU, Input and Output devices – Auxiliary Storage devices

Unit V

Microsoft Office – Statistical Packages – SPSS – Mat Lab – Database in Biology – Internet – devices – Email – PubMed – Sequence analysis – Genome and Protein Database – Computer and Genome research

Text Book

- 1) Snedecor G.W., Cochran W.G., Statistical methods, 6th Edition, Oxford & IBH Publishing Co.

Reference Books

- 1) Zar J.H., 1984. Biostatistical analysis, 2nd Edition, Prentice Hall Inc.
- 2) Daniel W.W., Biostatistics–A foundation for analysis in the Health Science, 5th Edition, John Wiley & Sons

Genetics

Unit I

DNA as genetic material – Experimental evidences – Semi conservative application of DNA – DNA damage and repair mechanism – Molecular basis of spontaneous and induced mutations

Unit II

Mendel's law – Principles of segregation and independent assortment – deviation from Mendel's findings – Linkage and crossing over – Genetic mapping – Polygenic inheritance – Polygene concept – Multiple alleles – ABO blood groups in man – Mn blood group – Rh blood group – erythroblastosis foetalis

Unit III

Chromosomal aberration – Ploidy – Euploidy & Polyploidy – Aneuploidy – Syndromes – Turner's, Klinefelter's, Down's syndromes – inherited disorders – Sickle cell anemia, Thalassaemia – genetic counseling

Unit IV

Bacterial genetics – Conjugation, Transformation – Transduction, Sexduction – Mapping of Bacterial chromosome

Unit V

Genetics of Human metabolic disorders & diseases; Defects in amino acid, lipid and sugar metabolism – one gene – one enzyme theory; one gene – one polypeptide theory – Oncogenes & cancer, karyotype study and identification of diseases – Transposons, IS elements

Text book

- 1) Principles of Genetics, 8th edition, Gardner EJ, Simmons MJ, Snustad DP, 1991, John Wiley & Sons

References

- 1) Genetics, 3rd edition, 2002, Strickberger, Prentice Hall of India
- 2) Genes VII, Benjamin Lewin, 2000, Oxford University Press
- 3) Genetics, Sarin C, 1990, Tata McGraw–Hill Publishing Co., Ltd., New Delhi
- 4) Genetics, Gupta PK., 1996, Rastogi Publications, Meerut, India

Second Year

Biotechnology

Unit I

Definition – Scope of Biotechnology – Achievements of biotechnology – Enzymes in genetic engineering – Cloning vectors – Plasmids – Phages, cosmos and Phagemids, Shuttle vectors – PBR 322 – CDNA bank – Gene bank

Unit II

Gene cloning in *E. coli* – selection of clones – Recovery of cells – Colony hybridization, Southern Blotting – Electroporation – Microinjection – Shot gun cloning – Liposome mediated gene transfer

Unit III

Human peptide hormones – insulin growth hormones – Vaccines – Interferons – Gene therapy – Monoclonal antibodies – IVF, embryo transfer in farm animals – transgenic animals

Unit IV:

Culture of plant materials – Micropropagation – Protoplast culture – Encapsulated seed – Biological nitrogen fixation – Algal, fungal, bacterial biofertilizers – Biocontrol of pests – Genetically modified plants – Vermicompost – Methods and application

Unit V:

Bioreactor – Growth curve of bacteria – Primary metabolites – Secondary metabolites – Microbial enzyme production – Immobilization of enzymes, biosensor, single cell protein – Mushroom culture – Bioremediation – Microbial leaching and biosafety – Biogas production – Sewage transport

Text Books

- 1) A text book of Biotechnology, Dubey R.C., 2001, S. Chand and company Ltd.
- 2) Elements of Biotechnology, Gupta P. K., 2003, Rastogi Publications

Reference Books

- 1) Principles of Gene Manipulation, 5th edition, Old R.W., Primrose S.B., 1996, Blackwell Science
- 2) Molecular Biotechnology – Principles and Applications of Recombinant DNA, 2nd Edition, Glick B.R., Pasternak J.J., 1988, ASM Press
- 3) Biotechnology – Principles and Applications, Higgins E.J., Best D.J., Jones J. 1988 Blackwell Science

Microbiology

Unit I

Structure of prokaryotic cell – Structure of bacterium – Classification of prokaryotes – Identification – Staining – Gram and Acid fast staining – Structure of virus – Bacteriophage – Sterilization and Disinfection – Growth of microorganisms – Nutrition – Nutrient media – Culture methods – Growth Curve

Unit II: Environmental Microbiology

Overview of Soil microorganisms – soil habitat and Distribution of microbes – Factors affecting microbial communities Carbon cycle, Nitrogen cycle, Sulfur cycle, Phosphorus Cycle, Microbes and metal toxicity – Biofilms – Biological nitrogen fixation; *Nif* genes

Unit III: Food and Dairy Microbiology

Introduction to food microbiology – Methods of food preservation: Dehydration, Osmotic preservation, Heat and cold preservation, Spoilage and preservation of Milk Products and meat, Pasteurization and other processing techniques

Unit IV: Industrial Microbiology

Fermentation technology – Fermentor – Types of fermentor – Production of microbial products through fermentor – Production of alcohol, vinegar and penicillin

Unit V: Medical Microbiology

Normal microbial flora of Human – Host – Microbe Interaction Biology, infective processes and control of Mycobacterium tuberculosis, *Vibrio cholerae*, Human Immunodeficiency Virus, Oral Candidiasis and Nosocomial infection – Laboratory Control of Antimicrobial Therapy

Reference Books

- 1) Modern Industrial Microbiology and Biotechnology, Nduka Okafor 2007, Taylor and Francis
- 2) Text book of Microbiology, 8th edition, Ananthanarayanan, 2009, University Press.
- 3) Microbiology, 6th edition, Prescott, Harley, Klein, 2002, WCB McGraw Hill Co.
- 4) Food Microbiology, 4th edition, Frazier W.C., Westhoff D.C., 1995, Tata McGraw Hill Pvt Ltd.
- 5) Microbiology, 5th edition, Pelesar M.J., Chan E.C.S., Kreig N.R., 1998, TataMcGraw Hill Pub Co.Ltd.

Immunology

Unit I

Overview of the Immune system – Historical perspective – Types of Immunity – Innate and Adaptive Immunity – Cell and Humoral – Haematopoiesis – Cells of Immune System (B cell, T cell, APC, NK Cells)

Unit II

Lymphoid organs – Primary (Thymus, Bone marrow, Bursa of Fabricus), Secondary Lymphoid Organs – Lymph node, Spleen, Payer's patches (GALT), Tonsils (MALT) – Development and maturation of Lymphocytes

Unit III

Antigens and Antigen recognition Molecules – Antigen Characteristics and Antibody Diversity (G, M, A, D and E) – Structure, properties – Antigen processing and presentation Detection of antigen – antibody reaction – precipitation, agglutination, cytolysis, complement fixation, flocculation, opsonisation, immunofluorescence, ELISA – Monoclonal antibody

Unit IV

Immune system in Health and Disease: Immunization and Immunization schedule – vaccines (attenuated, heat killed vaccines) – Types of Vaccine – Vaccination Schedule in India – Transplantation – Types of grafts – Graft rejection – Graft versus Host Disease – Clinical Transplantation

UNIT V

Hypersensitivity reaction – Type I to V – Tumour immune response – immune diagnosis of tumour, immunotherapy of tumour – Immunodeficiency disorders – primary, secondary – Autoimmunity – localized and systemic autoimmunity

Text Book

- 1) Kuby, J. 2006. Immunology 4th Edition, Goldsby R.A., Kindt T.J., Osborne B.A., W.H. Freeman and Company

Reference Books

- 1) Roitt, I.M, 2006. Essential of Immunology 12th edition, ELBS, Blackwell Scientific Publication
- 2) Abul K. Abbas, Andrew H.L, Shiv Pillai, “Cellular and Molecular Immunology” 7/e Saunders Publications
- 3) The Immune system– peter Parham Garland science, 2/e, 2001

Environmental Biology & Evolution

Unit I

Ecosystem: Structure – Classification & Examples–Energy – Concepts of Productivity – Food chain & Food web – Trophic levels–Energy based classification of ecosystem – Biogeochemical cycles

Unit II

Renewable & Non-renewable resources: Non Renewable resources–Fossil fuel (Coal, Petrol & Natural Gas), Nuclear Fuels, Renewable resources–Biomass, Biogas, Solar energy, Wind Energy, Tidal Energy, Geothermal Energy

Unit III

Pollution: Pollution of Air, soil & water, Carbon monoxide& Carbon dioxide air pollution–Pesticides, Heavy metals, Industrial effluents, urban wastes, Organic pollutants, Radio–active pollutants, Oil & Water Pollution

Unit IV

Origin of Life – Theories of Evolution – Darwinism, Lamarckism, Neo-Darwinism – Forces of evolution - Variation, Mutation, Genetic drift & Natural selection – Adaptation – Modes of selection - Evidences for evolution from Comparative Anatomy, Embryology, Biochemistry, Paleontology- Isolating mechanisms & species formation

Unit V

Origin of human – Uniqueness of Man – Similarities & Differences between human & apes – Human fossils - Human Evolution – Future of human evolution – Cultural Evolution – Molecular Evolution – Molecular Phylogeny – DNA bar coding

References:

- 1) Basic Ecology, Odum. E.P. 1983, Saunders College Publication
- 2) Concepts of Ecology, Third Edition, Kormandy E.J. 1986, Prentice Hall of India Pvt.
- 3) Air pollution, Rao. M.V.N. 1998, Tata McGraw Hill Publication Co. Ltd
- 4) Introduction to Evolution, Moody. P. A. 1978, Harper International
- 5) Process of Organic Evolution, Stebbins. G. L. 1979, Prentice Hall India
- 6) Human Biology and Behaviour– An Anthropological Perspective, Fourth Edition, 1985, Weiss M.L. & Mann A.E, Little Brown & Co.
- 7) Evolution: Process and product. Edward O. Dason, 1960, Second Edition, Reinhold, New York. Evolving: The Theory and processes of organic evolution, Francisco J. Ayala & James W. Valentine, 1979, The Benjamin/Cummings Publishing Company

Fisheries & Aquaculture

Unit I

Present status and Scope of Fisheries in India – Commercially important Fishes – Food and feeding habits of important edible fishes – Age and Growth: Method of determination

Unit II

Aquaculture types – Farm types – Site Selection and Construction of Farm maintenance and management – Eradication of algal Blooming and predators – Water Quality Management in culture ponds – Natural and supplement feed – Formulated feed for Fishes and Prawn

Unit III

Induced breeding – Hypophysation – Factors of Induced spawning – transport of fish feed – Fish Diseases and Control methods

Unit IV

Culture of Fresh water Prawn *Macrobrachium* – Marine Prawn *Penaeus* – Pearl Oyster – Green Mussel culture – Mono sex and poly sex culture – Integrated fish farming

Unit V

Fishing – Grafts and gears – Fish harvesting – Traditional and Modern Method – Eco sounding method – Electric Fishing – Fish preservation – Drying, salting, smoking, canning and refrigeration – Economics and Marketing of fishes

Text Book

- 1) Aquaculture: Principles and Practices, Pillay T.V.R and Kutty M.N., 2005. John Wiley & Sons

References Books

- 1) Fish and fisheries of India. V. G. Jhingran. 1997. 12/e Hindustan Publishing Corporation
- 2) Fisheries Science, Santhanam R. 1990. Day a Publishing House, New Delhi
- 3) Fresh water Aquaculture Rath R.K., 2000. Laurier Books Ltd.

Entomology

Unit I

Insect taxonomy up to orders, Insect morphology – insect head, thorax and abdomen–types of antennae – mouth parts and their modification. Integument

Unit II: Insect physiology

Physiology of digestive system – Respiration of terrestrial, aquatic and endoparasitic insects. Circulation–components–fat body and mechanism of circulation

Unit III

Excretion types, organs of excretion and physiology of excretion– reproductive system of male and female system. Neuroendocrine system of insects – neurosecretory cells, corpus cardiacum, corpus allatum – Metamorphosis and hormonal control of Metamorphosis

Unit IV

Important pests of paddy, Sugarcane, Vegetables and Cotton – Integrated Pest Management (IPM)

Unit V

Bee keeping–bee colony– bee hives maintenance and management. Sericulture: collection and incubation of eggs–rearing of larval reeling of cocoons – Lac insect – Commercial value of Lac

Text Books

- 1) Elements of Economic Entomology, Vasanthraj David B., 1988. Popular Book Depot, Saidapet, Chennai.
- 2) Hand Book of Economic Entomology, Ramakrishnan Iyer T.N. 1940. Government Press, Chennai

Reference Books

- 1) The Insect Structures and Functions, Chapman R.F., 1982. English language Book Society, Hooder Strongton
- 2) Insect Physiology, Wigglesworth V.B., 1994. Chapman and Hall – London
- 3) General and applied Entomology, Nayer K.K., Ananthakrishnan T.N and David E.V., 1986. McGraw Hill, New Delhi
- 4) Economic Entomology, Krishnan N.I. 1993., J.J. Publication, Madurai

PRACTICAL I

Cell & Molecular Biology Practical

1. Principles of light & electron microscopy
2. Measurement of cells using
 - a). camera lucida, b) stage micrometer & ocular meter
3. Identification of mitotic cell division stages in onion root tip (By Squash method)
Identification of Barr body in buccal epithelial cells

Biochemistry & Biophysics Practical

1. Quantitative estimation of proteins & carbohydrates
2. Isolation and identification of amino acids by using chromatographic method (Demonstration only)

3. Surface tension by drop weight method
4. Comparison of Viscosity of two liquids

Animal Physiology Practical

1. Quantitative estimation of salivary amylase
2. Estimation of oxygen consumption in tissues
3. Quantitative estimation of hemoglobin (Sahli's Method)
4. Quantitative analysis of haemin crystals

PRACTICAL II

Developmental Biology Practical

1. Structure of spermatozoa and egg
2. Vital staining and mounting of chick blastoderm
3. Observation of developmental stages of frog
4. Observation of malformed embryos

Statistics Practical

1. Data Collection and frequency distribution (Polyalthia leaves)
2. Measurement of Central Tendency (Mean, Median, Mode & Standard Deviation)
3. Test of Significance (Chi-square Test): Law of Segregation and Law of Independent assortment
4. Identification of Computer devices (Input, CPU, Output and Accessory memory units)

Genetics Practical

1. Statistical analysis of genetic data using Chi-square test
2. Human traits survey and gene frequency calculations
3. Human pedigree construction for a family data
4. Study of hereditary disorders with the aid of chromosome karyotyping (Klienfelter's syndrome, Turner's syndrome, Down's syndrome)

PRACTICAL III

Biotechnology Practical

1. Estimation of Micro flora of milk by MBR and Risazurin Test
2. Demonstration of antibiotic assay – Streptomycin
3. Demonstration of Agarose Gel Electrophoresis
4. Identification of Transgenic animals (Mouse)

Microbiology Practical

1. Cleaning of glasswares and modes of sterilization
2. Measurement of microbes using ocular and stage micrometer

3. Preparation of culture media and slants for micro organisms
4. Counting of viable cells by serial dilution and spread plate or pour plate
5. Estimation of microflora of milk by Methylene Blue Reduction test
6. Test for antibiotic sensitivity
7. Gram staining
8. Acid fast staining
9. Isolation of nitrogen fixing symbiotic bacteria from root nodule

Immunology Practical

1. Laboratory safety precautions and good laboratory practices
2. Histology of lymphoid organs
3. Cell imprinting of thymus and spleen
4. Identification of blood grouping
5. Components of human blood
6. Isolation of lymphocytes and enumeration
7. Haemagglutination titration
8. Gel diffusion techniques – radial and double immunodiffusion
9. Immunoelectrophoresis
10. Latex agglutination – RF
11. Widal test

Practical IV

Environmental Biology and Evolution Practical

1. Estimation of oxygen by Winklers Method
2. Estimation of salinity
3. Biodiversity and bioresources spotters
4. Estimation of Dissolved CO₂
5. Identification of Embryological and paleontological fossils

Fisheries and Aquaculture Practical

1. Identification of commercially important fishes
2. Identification of predators of fish ponds
3. Study of morphology and morphometry of fishes
4. Identification of gears and grafts
5. Identification of fish diseases

Entomology Practical

1. Identification of Insects up to order level by using entomological key
2. Dissecting and mounting mouth parts of honey bee and Mosquito
3. Identification and histo-analysis of neuroendocrine
4. Identification of insects bee colony, *Bombyx mori* and Lac insect

