Semester 1Subject Code: LIF011 Credits : 3

Title: Biology I

UNIT I

Introduction to concepts of biology: Biology and natural sciences, growth of biological thought, matter and life, origin of life, history of life and earth, kingdoms of life - prokaryotes, (Bacteria), eukaryotes (fungi and protists), archaea, primitive plants, seed bearing plants.

UNIT II

Invertebrates and vertebrates: Animals without backbones, vertebrate phylogeny and systematic, mechanism of evolution, chemical basis of life, cellular basis of life.

UNIT III

Plant and animal physiology: Plant physiology (fundamental process such as photosynthesis, respiration, plant nutrition, plant hormone functions, photoperiodism, photomorphogenesis, circadian rhythms). Animal physiology (cardiovascular systems, nervous system and immune system of vertebrates and invertebrates).

UNIT IV

Ecology: Introduction to ecology, plant ecology, (ecophysiology, ecosystem Ecology), animal ecology (food chains, food cycle, size of food, niches and pyramid of numbers).

UNIT V

Biodiversity: Definition and types of biodiversity, (plants, animals, soils, forests, aquatic organisms, microbes, invertebrates and pollinators), loss of biological diversity in recent times, conservation biology and future of biosphere.

Reference Books:

1. Campbell, NA, and Reece, JB, Biology, Pearson Benjamin Cummings, San Franscisco.
2. Raven, PH *et al.*,Biology, Tata McGraw Hill publications, New Delhi.
3. Barnes, RD, Invertebrates Zoology, Hold Saunders International Edition.
4. Barnes RSK.,Calow P., Olive PJW., Golding DW., and JI Spicer, The Invertebrates: A New Synthesis, III Edition, Blackwell Science.
5. Barrington EJW , Invertebrates Structure and Functions. II Edition, ELBS and Nelson.
6. Borodale LA and Potts EA , Invertebrates: A manual for the use of students. Asia publishing home.
7. BushbaumR , Animals without Backbones, University of Chicago press.
8. Guyton AC and Hall JE, Textbook of Medical Physiology, Hercourt Asia PTE ltd/WB Saunders Company.
9. OdumEP , Fundamentals of Ecology.
10. Ricklefs RE, Ecology, Chiron press.

Semester 1Subject Code: LIF012 Credits : 2

Title: Biology IPracticals

1. Use of micropipettes, preparation of normal, molar and standard solutions, preparation of buffers, serial dilutions, pH measurements.
2. To learn use of microscope, principles of fixation and staining.
3. To perform gram staining of bacteria.
4. To study prokaryotic cells (bacteria, viruses and eukaryotic cells) with the help of light and electron micrographs.
5. Measure the cell size (either length or breadth/diameter) by micrometry.
6. To study the cytochemical distribution of nucleic acids in cells/tissues from permanent slides.
7. To separate chlorophyll pigment from plant by TLC.
8. To study structure of different animal tissues through temporary mounts.
9. Catch the most diverse number of insects in your campus, do a field study and make a file of insect population
10. The great pond experiment: local biodiversity

Reference Books:

1. Campbell, NA, Reece JB, Biology , Pearson Beanjamin Cummings, San Francisco.
2. Raven, PH *et al*., Biology, Tata McGrawhill Publications, New Delhi.
3. Sheeler, P and Bianchi, DE , Cell and Molecular Biology, John Wiley and Sons NY.

Semester 2Subject Code: LIF021 Credits : 3

Title: BIOLOGY - II

UNIT I

Chromosomes: Mendel's laws-monohybrid and dihybrid inheritance; chromosome structure and organization in prokaryotes and eukaryotes; special types of chromosomes; polytene, lampbrush chromosomes; sex determination; disorders of sex linked and autosomal inheritance; bacterial genetics; conjugation and transduction.

UNIT II

Ultrastructure of the cell: Eukaryotic and prokaryotic cells; plasma membrane-composition, structure, and function; membrane proteins (internal and external); cytoskeletal proteins-extracellular matrix; structure and functions of the nucleus and its components; cell structure; ultrastructure of cell organelle; nucleus, mitochondria; endoplasmic reticulum; golgi apparatus, ribosomes, lysosomes and vacuoles.

UNIT-III: Cellular Organization, and differentiation: Cell types - organization of prokaryotic and eukaryotic cells, cell division - mitosis and meiosis, cell cycle - phases of cell cycle, and regulation of cell growth and cell cycle, cell motility, microtubules, structure and composition, microtubular associated proteins - role in intracellular motility, Differentiation of cell membrane - microvilli, epithelia, Bell and spot desmosomes, cell-cell interaction, cell adhesion proteins, cell junctions.

UNIT IV

Biomolecules: Carbohydrates, definition, classification, importance; monosaccharides-structure and properties; disaccharides-maltose, lactose, sucrose; polysaccharides-starch, cellulose, glycogen. Amino acids-definition, classification and properties; Proteins: classification of proteins based on the structure, solubility and function; Lipids-classification, properties, physical, chemical and biological role of lipids.

UNIT V

Nucleotides and nucleosides: Composition, structure and properties of nucleosides and nucleotides; DNA-primary and secondary structure of A,B, and Z forms-supercoils, denaturation and renaturation and other properties; RNA-classification, structure and functions of tRNA, rRNA and mRNA; Vitamins-definition, classification, general sources; functions, deficiency symptoms, properties and structural aspects of vitamin A,D,E,K,C, thiamine, riboflavin, niacin and biotin.

Reference Books

1. Gardner, Simmons and Sunstad, **Principles of Genetics**
2. Dornel JL, Baltimore D, **Molecular Cell Biology**, WH Freeman
3. Kimball IW, **Cell Biology**, Wesley Publishers
4. Lehninger AL., Nelson DL, Cox MM, **Principles of Biochemistry**, CBS publications
5. Stryer L., **Biochemistry, (Recent Edition)**, WH Freeman and Company, New York.
6. Gerald Carp and Nancy L Puritt, **Cell and Molecular Biology-Concepts and Experiment**, John Wiley and Sons, Inc,
7. Wolfe, Stephen L, **Molecular and Cellular Biochemistry**, Wadswords, Inc California,
8. Voet D, Voet G, **Biochemistry,** John Wiley and Sons
9. Zubay G, **Biochemistry,** Maxwell Macmillan International Editors
10. Conn E and PK Stump, **Outlines of Biochemistry,** Willey Eastern Ltd, New Delhi
11. Albert L Lehninger*et al.*,**Biochemistry,** Worth Publishing

Semester 2Subject Code: LIF022Credits : 2

Title: Biology IIPracticals

1. Demonstration of mammalian sex chromatin/Barr body
2. Identify male and female chromosome based on their karyotyping
3. Differentiation between various types of leucocytes based on their nucleus
4. Osmosis and Tonicity experiments
5. Cell counting-Haemocytometer
6. Qualitative tests for carbohydrates
7. Estimation of proteins by Lowry's method/Biuret method
8. Estimation of cholesterol by Zak's method
9. Separation of amino acids by ninhydrin method
10. Separation of lipids by TLC

Reference Book:

1. **Lab manual**

Semester 3Subject Code: LIF031Credits : 3

Title: Biology III

UNIT I: Molecular Biology: History and scope of molecular biology- Discovery of DNA-evidence for DNA as the genetic material. The genomes of bacteria, viruses, plasmids, mitochondria and chloroplast. Gene transfer in microorganisms- conjugation- transformation, transduction - protoplasmic fusion. Organization of eukaryotic genome- components of eukaryotic chromatin-chromatin and chromosome structure- DNA-supercoiling -linking number- satellite DNA-possible functions- Cot curve- C- value paradox.

UNIT II:Molecular Biology: DNA replication- Prokaryotic and eukaryotic DNA replication, mechanism of replication. Enzymes and necessary proteins in DNA replication.Telomeres, telomerase and end replication.Role of telomerase in aging and cancer. Transcription-Prokaryotic and eukaryotic Transcription- RNA polymerases- general and specific transcription factors- regulatory elements- mechanism of transcription regulation-Transcription termination

UNIT III: : Molecular Biology: Post transcriptional modification- 5 cap formation-3 end processing and polyadenylation- splicing- editing- nuclear export of mRNA- mRNA stability. Translation- Genetic code- Prokaryotic and eukaryotic translation-translational machinery-Mechanism of initiation- elongation and termination- Regulation of translation.

UNIT IV: Biophysics: Redox potential; Oxidation and reduction, redox potential and its calculation by Nernst equation, examples of redox potential in biological system. Energy requirements in cell metabolism, role and structure of mitochondria, high energy phosphate bond, electron transfer phenomenon and biological transfer. Surface tension, adsorption, diffusion, osmosis, dialysis and colloids

UNIT V: Molecular evolution: History of evolution of life on earth: elements, molecules to species. Evolution of DNA, RNA and proteins, origin of the genetic code: chemical basis of evolution. Evolutionary change by mutation, gene flow, genetic drift, natural selection and nonrandom mating.The concept of the Molecular Clock.Calibration.Limitation of molecular clock models. Human molecular clock: deducing evolutionary histories through mitochondrial DNA and Y chromosome.

References

1. **Biophysical Chemistry** by Bloomfield V A and Harrington R E, W A Freeman and Co.
2. **Introduction of Biophysics** by Pranab Kumar Banargy, S Chand and Co.
3. **Essentials of Biophysics** by P Narayanan, New Age International Publishers.
4. Freifelder D,**Molecular Biology**, 2nd edition. Narosa Publishing House, India
5. Brown TA,**Genetics: A Molecular Approach**, Van Nostrand Reinhold (International) Co. Ltd. London.
6. Freifelder D and Malacinski GM,**Essentials of Molecular Biology**, John and Bartlett Publishing, UK
7. **Fundamentals of molecular evolution,** by Dan Graur and Wen-Hsiung Li (Sinauer Associates, Inc., Publishers Sunderland, Massachusetts)
8. **Molecular Biology of the Cell,** Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. New York: Garland Science; 2002. ISBN-10: 0-8153-3218-1ISBN-10: 0-8153-4072-9

Semester 3Subject Code: LIF032Credits : 2

Title: Biology III Practicals

1. Isolation of genomic DNA from bacteria (E.coli) and human blood
2. Quantification of DNA using spectrophotometric method
3. Digestion of DNA using restriction endonucleases
4. Resolution and molecular weight estimation of fragmented DNA using agarose gel electrophoresis, Construction of restriction map by single and double digestion,
5. Protein Data Bank
6. SCOP Data Base
7. Nucleic Data Base
8. Homology modeling
9. Fold recognition method
10. *ab initio*structure prediction methods

Books Recommended

1. Ausbel FM, Brent R, Kingston RE, Moore DD, Sediman JG, Smith JA, Sruhi V (1989) **Current Protocols in Molecular Biology**, Greene Publishing and Wiley Interscience, NY
2. Sambrook Joseph and Russell DW (2000) **Molecular Cloning:** A Laboratory Manual,
3. **Bioinformatics- A beginner's guide** by Jean-Michel Claverie, John Wiley & Sons.
4. **Structural Bioinformatics** by Philip E. Bourne and HelgeWeissing, Wiley &Liss.

Semester 4Subject Code: LIF041Credits : 3

Title: Biology -IV

UNIT I: Immunology: Historical background, general concepts of the immune system. Innate and adaptive immunity; Inflammation - general properties. Structure, properties and functions of the immune cells & organs: Hematopoeisis, T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils. Mast cells and dendritic cells.Thymus and bone marrow; Lymph nodes, spleen, MALT, GALT and CALT. Antigens and haptens: Properties (foreignness, molecular size, heterogeneity). B and T cell epitopes. T-dependent and T- independent antigens.

UNIT II: Immunology: Antibodies: Structure, function and properties of the antibodies; Different classes and biological activities of antibodies; Antibody as B cell receptor, antigenic determinants on antibodies (isotype, allotype and idiotype). Genesis of antibody variability (definitions of combinatorial joining, junctional flexibility, somatic hypermutation, class switching, allelic exclusion, immunoglobulin superfamily).Hybridoma technology, monoclonal antibodies and abzymes.

UNIT III: Developmental Biology: Aims and scope of Developmental Biology. Spermatogenesis and oogenesis-comparative study of Invertebrate, vertebrate sperms and Eggs, polarity & symmetry of eggs-Fertilization- Mechanism, physiology & theories-Cleavage-Factors influencing cleavage-Fate map-Blastulation and Gastrulation; General principles-physiology and comparative study in Amphioxus, Frog and Chick. Experimental works of speerman and Mangold-Development of brain and eye in Frog. Placentation and types of Placenta.

UNIT IV: Neurobiology: An overview of the nervous system: Neurons: Introduction to neurons, The Neuron Doctrine, The Nissl and Golgi stains, Components of neurons, Classification and types of neurons, Cytology of neurons, Dendrites structure and function, Axons structure and functional aspects, ultrastructure, myelination and synapses. Glial cells: Structure and function of glial cells, Different types of glial cells: astrocytes, oligodendrocytes and Schwann cells, Function of other glial cells: oligodendrocyte and microglial cells, Microglial phenotypes, Overview of glial and neuronal relationship in the CNS, Glial –neuronal interplay in the CNS.

UNIT V: Recombinant DNA technology: An introduction to genetic engineering-Enzymes used in genetic engineering- Restriction endonucleases, DNA polymerases, Reverse transcriptase, Ligases, Polynucleotide kinase, Alkaline phosphatase, Nucleases, Klenow fragment, Terminal deoxynucleotidyltransferase, RNase. Vectors for cloning- Plasmids, Bacteriophage , Filamentous phage vectors, Cosmids, Phagemids, YACs. Ligation of DNA fragments with vectors - Homopolymer tailing, Ligation of cohesive termini, Blunt-end ligation, Linker molecules.

Reference books

1. Gilbert, Scott F. ***Developmental Biology***. 7th ed. Sunderland, MA: Sinauer Associates, 2003. ISBN: 9780878932580
2. Gorden shepherd , **Neurobiology III edition,**
3. **Neuroscience Exploring the brain**, 2nd edition
4. **Neuroscience,** 2nd edition, Edited by Dale Purves, George J Augustine, David Fitzpatrick, Lawrence C Katz, Anthony-Samuel LaMantia, James O McNamara, and S Mark Williams. Sunderland (MA): Sinauer Associates; 2001.ISBN-10: 0-87893-742-0
5. **From genes to clones , concepts and applications of DNA technology**, Second edition, Jeremy W Dale and Malcolm von Schantz
6. **Molecular biotechnology, principles and applications of recombinant DNA 4th edition,** Bernard R Glick, Jack J Pasternak, Cherryl L Patten.2010

Semester 4Subject Code: LIF042Credits : 2

Title: Biology IV Practicals

1. Analysis of cytokines using Elisa technique
2. Chick embryo whole-mount &microtechnique
3. Media preparation for tissue culture
4. Sterilization techniques, eg using autoclave
5. Neuronal cell culture maintenance using cell lines
6. Primer design tools and calculators
7. Polymerase chain reaction using gel electrophoresis of nucleic acids
8. Restriction endonuclease digestion of chromosomal and plasmid DNA
9. Comparison of plasmid and bacteriophage cloning vectors
10. The miniscreen: Rapid isolation of plasmid DNA
11. Purification of plasmid DNA by precipitation with polyethylene glycol

References

1. Tait, R.C. **An Introduction to Molecular Biology**. Horizon Scientific Press, Wymondham, UK.
2. Curr. Issues Mol. Biol. (2000) 2(3): 71-85: **Introductory Experiments in Recombinant DNA**
3. **Molecular Cloning**Eds. Sambrook& Russell / Maniatis et al
4. Bellairs& Osmond (2005) **Atlas of Chick Development**
5. **Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications** by R. Ian Freshney, John Wiley & Sons,

Semester 5Subject Code: LIF051Credits :4

Title: Cell Biology

UNIT I :Introductory cell biology : Evolution of the cell, From molecules to first cell, From Prokaryotes to eukaryotes, From single cells to multicellular organisms, Functional differentiation of cells/cell types, Cell Membrane structure, Lipid bilayer, Membrane proteins, Membrane transport of small molecules, Membrane transport of macromolecules and particles, exocytosis and endocytosis, Cell wall and cell structure of prokaryotes and eukaryotes.

UNIT II :Organelles of the eukaryotic cell: The lysosomes, The peroxisomes, The Golgi apparatus, The endoplasmic reticulum. Mitochondria and chloroplast, Structure of the mitochondria and chloroplast, Oxidation of glucose and fatty acids, Electron transport and oxidative phosphorylation, Chloroplast and photosynthesis. Ribosome, Organelle biogenesis and protein secretion and synthesis, protein targeting of mitochondria, chloroplast, nucleus and peroxisome; Translational modification in the ER.Intracellular traffic, vesicular traffic in the secretary pathway, protein sorting in Golgi, traffic in the endocytic and exocytic pathways.

UNIT III :The cytoskeleton: the nature of cytoskeleton, Intermediate filaments, Microtubules, Action filaments, Cilia and centrioles, Organization of the cytoskeleton.Cell growth and division, Overview of cell cycle and its control, The molecular mechanisms for regulating mitotic and meiotic events, Cell cycle control in mammalian cells, yeast and plant;Checkpoints in cell cycle regulation. Cell junctions and extracellular matrix, Cell-cell adhesion and communication, Cell matrix adhesion, Collagen, fibrous protein of the matrix, Non-collagen component of the extracellular matrix.

UNIT IV :Cell to cell signaling: Cell aging and death - necrosis and apoptosis - mitochondrial and death receptor pathway. Cell signaling - signaling molecules and their receptors, functions of cell surface receptors, pathways of intracellular signal transduction, G protein coupled receptors, receptors tyrosine kinases, Role of Ras and Raf in Oncogenesis, MAP kinase pathways, introduction to gene therapy.

UNIT V : Methods in Cell Biology: Methods for disrupting tissues and cells, organ and tissue slice techniques, isolation of clones, tissue culture techniques (animal and plant), cell fixation - fluid fixatives, freezing and section drying, fixation for electron microscopy - buffered osmium solutions, fixation of organic and inorganic substances, staining techniques acid and basic, fluorescent and radioactive dyes, staining of lipids, steroids, nucleic acids, proteins and enzymatic reaction products. Histopathological studies - organ specific morphohistological examination, identification of morphological changes related to pathology.

References

1. Molecular Biology of the Cell - by Alberts et al.

2. The Cell: A molecular approach - by Cooper and Hausman

3. Molecular Cell Biology - by Lodish et al.

Semester 5Subject Code: LIF052Credits :4

Title- Genetics

UNIT I: Introduction and scope of Genetics, Historical perspectives, Understanding the heredity, and variation. Chromosome structure, Centromeres, Telomeres.Chromosomal basis of inheritance. Alleles and Multiple Alleles, Linkage and crossing over. Extra chromosomal inheritance - mitochondrial and chloroplast inheritance, Bacterial genetics - Conjugation, transduction and transformation; Plasmids; Transposable elements - transposons and retrotransposons

UNIT II: Gene Interaction, Sex-determination and Sex-linked inheritance, Chromosomal basis of Sex- determination in animals and plants, Sex-linked genes and dosage compensation of X-linked genes. Human pedigree analysis. Linkage analysis and gene mapping in eukaryotes, Coupling and repulsion phases, Crossover and recombination. Chloroplast and Mitochondrial inheritance: Yeast, Chlamydomonas/ Neurospora and higher plants.

UNIT III: Changes in chromosome structure, Properties of chromosomes for detection of structural changes, Main type of changes– deletions, duplications, inversions and translocations, Somatic vs germinal mutation. Spontaneous and induced mutations, Chromosomal aberrations, Change in chromosome number. Somatic aneuploids.Selection and mutation. Pathogenic mutations, polymorphism versus mutations; Molecular pathology – evaluation and database of pathogenic mutations; mitochondrial mutations.

UNIT IV: **General organization of human genome,** mitochondrial genome organization, nuclear genome organization; size and banding of human chromosomes; distribution of tandems and interspersed repetitive DNA, gene distribution and density in human nuclear genome; organization of genes coding for rRNA, mRNA, small nuclear RNA.

UNIT V: Population genetics and Overlapping genes: genes within genes, gene families, pseudo genes, truncated genes and gene fragments application of Mendel's laws to whole population, Calculation of allele frequencies, Hardy Weinberg principal for calculating recessive gene frequency, calculating frequency of sex –linked alleles.

TEXT BOOKS

1. Introduction to Genetic Analysis - by Griffiths et al.

2. Concepts of Genetics - by Klug et al

3. Principles of Genetics - by Snustad et al.

REFERENCES:

1. Molecular Cell Biology, Sixth Edition, H. Lodish, A. Berk, and C.A. Kaiser, W. H. Freeman & Co Ltd.
2. Molecular Biology of the Gene, Sixth Edition, J.D. Watson, T.A. Baker, S.P. Bell, A.
3. Gann, M. Levine, R. Losick, Benjamin Cummings Publication
4. Molecular Cell Biology, Third edition,W.H.H. Lodish, A.Berk, and C.A. Kaiser, Freeman & Co Ltd.
5. Molecular Biology of the Gene, Fifth Edition, J.D. Watson, T.A. Baker, S. P. Bell, A. Gann, M. Levine, R. Losick, Pearson Education Inc.

Semester 5Subject Code: LIF053 Credits 4

Title-Microbiology

Unit I:Introduction to microbiology, Normal flora, pathogenicity of microorganisms, diagnostic microbiology, vaccines and antibiotics, The classical golden age of microbiology, the second and third golden age of microbiology, concepts and tools for studying microorganisms, classifying microorganisms, diversity of bacteria and archea, cell shape arrangements, external cell structures, the cell envelope, cell cytoplasm and internal structures, microbial reproduction, and growth, Enzymes and energy in microbial metabolism, catabolism of glucose, the anabolism of carbohydrates, physical and chemical methods of microbial control

UNIT II:Microorganisms: Staphylococci, streptococci, gram positive rods, Neisseria, gastrointestinal gram negative rods, other gram negative rods, clostridia and other anaerobic rods, spirochetes, mycoplasma, chlamydiae, mycobacteria and actinomycetes, rickettsia, characteristics and classification of fungi, classification and characteristics of protozoa , and helminthes. Viruses: Introduction to viruses, Non enveloped DNA viruses, Enveloped DNA viruses, Hepatitis B and Hepatitis D(delta viruses), Positive strand RNA viruses, Retroviruses an d AIDS, Negative strand RNA viruses, Double stranded RNA viruses:theretroviridae, Unconventional infectious agents.

UNIT III: Microbial genetics: DNA and chromosomes,DNA replication,protein synthesis, genetic recombination in bacteria, genetic engineering, microbial genomics, phenotypes in bacterial genetics, inheritance in bacteria, mutation rates, types of mutations, reversion versus suppression, identifying mutants, genetic analysis in bacteria, properties of plasmid, DNA repair, bacterial cell compartmentalization and sporulation.

UNIT IV: Diseases: Airborne bacterial diseases, food born and water born bacterial diseases, soil borne and arthropod born bacterial diseases, sexually transmitted and contact transmitted bacterial diseases, virus infections of the respiratory tract skin, viral infections of blood, lymphatic, gastrointestinal and nervous systems, fungal intoxications, fungal diseases of the skin, fungal diseases of the skin, lower respiratory tract, protozoan diseases of skin, digestive, urinary, blood and nervous system, the multicellular helminthes and helminthes infection

UNIT V: Resistance: The host microbe relationship, establishment of infection and diseases, infectious disease epidemiology, resistance and the immune system, the history and perspectives of antimicrobial agents, synthetic antibacterial agents, beta lactum family of antibiotics, bacterially produced antibiotics, antiviral, antifungal and antiparasitic drugs, Antibiotics assays and resistance.

Text books:

1. Microbiology (Lippincott's Illustrated Reviews Series) by Richard A. Harvey and CynthiaNauCornelissen Ph.D.
2. Alcamo's Fundamentals of Microbiology, Ninth Edition by Jeffrey C. Pommerville

Semester 5Subject Code: LIF055Credits : 3

Title:Microbiology Practicals

1. Introduction of Microbiology, Laboratory Safety, Use of Equipment; Sterilization Techniques;
2. Preparation of cotton plugs and preparation of media.
3. Sterilization techniques – dry and wet heat, chemical and sterilization
4. Culture Media-Types and Use; Preparation of Nutrient broth and agar
5. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
6. Microscopy methods in the study of microorganisms – Working and care of Microscope
7. Enrichment and isolation of oil degrading microorganisms near oil contaminated soil.
8. Measurement of bacterial population by turbidimetry and colony counting by serial dilution of samples
9. Effect of Disinfectants- Phenol Coefficient
10. Antibiotic Sensitivity tests-disc method
11. Growth Curve in Bacteria and Yeast
12. Preservation of pure cultures: slant preparation, water stock, glycerol stock
13. Biochemical tests for bacterial identification
14. Effect of pH, Temperature, UV radiation on Growth Bacteria

TEXT BOOKS

1. Cappuccino, J.G. and N. Sherman “Microbiology : A Laboratory Manual”,
2.Collee, J.G. etal., “Mackie & McCartney Practical Medical Microbiology”

Semester 5Subject Code: LIF054Credits : 4

Title:Biochemistry-I

UNIT I: An overview of Biochemistry, Cellular environment and applicability of basic laws of chemistry and thermodynamics. Concept of small and macromolecules, Molecular interactions and its importance in understanding cellular processes.

UNIT II: Macromolecules, proteins, glycoproteins, glycolipids, lipoproteins, polysaccharides, lipopolysaccharides, monosaccharides and derivatives of sugars, polysaccharides, glycosaminoglycans, proteoglycans, protein glycosylations and its significance. Lipids and fatty acids, triacylglycerols, glycerophospholipids, sphingolipids, cholesterol lipid bilayers.

UNIT III: Structure of amino acids and peptide bonds, Ramachandran Plot, alpha helical and beta pleated structures, structures of fibrous proteins like keratin, fibroin, elastin and collagen, Dynamics of protein structure, protein stability, globular proteins and maintenance of specific confirmation, structural motifs commonly found in various proteins and their functional relevance. Basic concepts of protein structure and folding, folding pathways,role of accessory proteins in protein folding.

UNIT IV: Hemoglobulin, Myoglobin, oxygen binding kinetics and its relation to the structure of Hb, mechanisms of cooperability, and oxygen and carbon dioxide transport. Biological membranes, integral membrane proteins, lipoproteins and trafficking through membrane. Classification of enzymes, factors affecting enzymes activities, feedback and allosteric inhibition. Enzyme catalysis, mechanisms and specificity of enzymatic action, coenzymes and vitamins. Chemical kinetics and order of reactions, Michaelisand Menten equation, V max and Michaelis constant, Competitive and non-competitive inhibition.

UNIT V: Characterization of proteins, isolation and chromatographic purification of proteins, ultracentrifugation, sequence determination, mass spectrometry, specific activity, biochemical calculations.

Suggested Readings

1. Biochemistry - by Jeremy Berg, John Tymoczko and LubertStryer

2. Biochemistry - by Donald J. Voet and Judith G. Voet

3. Lehninger Principles of Biochemistry - by David L. Nelson and Michael M.

Semester 5Subject Code: LIF056Credits :3

Title:Biochemistry Ipracticals

1. Qualitative analysis of carbohydrates (glucose, fructose, maltose, galactose, sucrose, lactose), Identification of both monosaccharides and disaccharides in mixtures.
2. Biochemical estimation of DNA/RNA using spectrophotometer
3. Color reactions of amino acids like tryptophan, tyrosine, arginine, proline and histidine.
4. Reactions of lipids: Solubility, acrolien test for unsaturation, Libermann- Burchard test for cholesterol.
5. Acid number, iodine number and saponification number of lipids.
6. Estimation of ascorbic acid by titrimetric method using 2,6-dichlorophenol indophenol.
7. Estimation of sodium and potassium by flame photometry.
8. Determination of saponification number
9. Isolation of DNA and RNA: Estimation of RNA by orcinol method and DNA by diphenyl amine method.
10. Qualitative tests of urine. Abnormal constituents- sugar, protein (albumin),ketone bodies, bile pigments and bile salts.
11. Quantitative estimations in Blood
    a. Glucose
    b. Cholesterol
    c. Calcium
    d. Urea
    e. Iron
12. Quantitative estimation in urine.
    a. Sugar
    b. Urea
    c. Creatinine
    d. Creatine
13. ESR, PCV, TC/DC count, haemoglobin content and blood grouping.
14. Separation of aminoacids using TLC
15. Separation of alkaloids by paper chromatography or TLC
16. Determination of α-amylase activity
17. Estimation of peroxidase activity
18. Effect of pH on Enzyme activity.

References

1. Manuals in Biochemistry – Dr. J. Jayaraman.
2. Practical Biochemistry – Varley.
3. Practical Biochemistry – Plummer.
4. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh.
5. Practical clinical Biochemistry – Harold Varley.
6. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh.
7. Text book of Clinical Chemistry – Tietz.

Semester 6Subject Code: LIF061 Credits :3

Title: BIOCHEMISTRY-II

Unit I: Metabolism: Basic concepts, Central role of ATP in metabolism, Carbon fuel and its oxidation, Concept of energy rich compounds and intermediates, Common types of reactions involved in metabolism.

Unit II: Glycolysis and gluconeogenesis, Urea cycle, Regulation of glycolysis, glycogen synthase, metabolic flux and its regulation by various metabolic intermediates, Glycogen synthesis, breakdown and its regulation.

Unit III: Energetics, ATP synthesis and chemo-osmotic hypothesis of ATP generation. TCA cycle, its regulation, its role in energy generation, its role in generating biosynthetic intermediates, glyoxylate cycle.

UNIT IV: Amino acid and nucleic acid metabolism, active carbon reaction, non-protein amino acids, amines and their role in cell function. Synthesis of purine and pyrimidine, Nucleotide biosynthesis and metabolism, salvage pathways, its regulation and diseases.

UNIT V: Redox reaction, mitochondrial structure and its role in energy metabolism, electron transport system. Pentose phosphate pathway and its importance in biosynthetic reactions.Fatty acid biosynthesis and degradation.Synthesis and degradation of steroids and glycolipids.Synthesis of secondary metabolites, such as alkaloids, non-protein amino acids, amines, cyanogenic glycosides, glucosinolates, lignin, suberin, terpenoids and phenolics.

Text Books

1. Biochemistry - by Jeremy Berg, John Tymoczko and LubertStryer
2. Biochemistry - by Donald J. Voet and Judith G. Voet
3. Lehninger Principles of Biochemistry - by David L. Nelson and Michael M. Cox

Semester 6Subject Code: LIF062Credits : 4

Title: Plant Biology-I

UNIT I: Algae: History of algal studies in India, Habit and Habitat, General characters, classification and economic importance. Important features and life histories of members of Cyanophyceae (Oscillatoria, Nostoc), Chlorophyceae (Chlamydomonas, Volvox ,Oedogonium, Coleochaete). Important features and life histories of members of Xanthophyceae (Vaucheria) Phaeophyceae (Ectocarpus, Sargassum), Rhodophyceae (Batrachospermum, Polysiphonia).

UNIT II: General characteristics, classification and economic importance. Important features and life histories of members of Mastigomycotina (Pythium, Phytophthora); Zygomycotina (Mucor); Ascomycotina (Saccharomyces, Eurotium, Chaetomium, Peziza); Basidiomycotina (Puccinia, Agaricus); Deuteromycotina (Cercospora, Colletotrichum).

UNIT III: General account of Lichens. Bryophytes: General characters, classification and economic importance. Bryophytes as amphibians of plant kingdom, adaptive characters for land habitat displaying heterologous alternation of generations.

UNIT IV: Classification and comparative study of classes as seen in the life histories of some members of Hepaticopsida (MarchantiaPellia, Porella), Anthocerotopsida (Anthoceros), Bryopsida (Funaria Sphagnum, andPolytrichum). A study of plants and products of economic importance.Pteridophytes: The first vascular plants, salient feature of structures and life cycle of representative members of the classes (Psilotum, Lycopodium, Equisetum, Nephrodium, Pteris and Marsilea). A comparative study of stelar system in pteridophytes. An elementary study of fossils, protocols of age determination of fossils.

UNIT V: Plant organization, external and internal, different groups of plants, organographic development, the basic body plan of flowering plants. Cells and tissues: The shoot, root and leaf meristems and their histological organization and function, types of cell, tissues and tissue systems, chemical and ultrastructure of cell and cell wall

Suggested readings

1. Salisbury, F. B. and Ross, C.W. Plant Biology.
2. Hopkins, W. G and Huner, N. P. A. Introduction to Plant Biology.
3. Mukherji, S and Gosh A. K. Plant Biology .

Semester 6Subject Code: LIF066Credits : 3

Title: Plant Biology Practicals

1. Separation of photosynthetic pigments by paper chromatography
2. Identification of C3 and C4 plants.
3. Determination of C4 photosynthetic subtypes using anatomical criteria
4. Comparative rate of respiration by titration method
5. Effect of plant growth regulators on seed germination
6. Isolation of chloroplasts and estimation of photochemical activity.
7. Determination of Chlorophyll a, Chlorophyll b in C3 and C4 plants.
8. Estimation of starch content by Anthrone reagent.
9. Spectrophotometric estimation of Indoleacetic acid in plant tissues.
10. Determination of nitrate reductase activity in crop plants under low water regimes.
11. Determination of Gibberllic acid by half seed method.
12. Determination of succinic dehyrogenase activity with and without inhibitors.
13. Determination of peroxidase activity.
14. Determination of protein under abiotic stress.

Semester 6Subject Code: LIF063Credits : 4

Title-Animal Physiology

UNIT I:Principles of physiology, relationship between structure and function, adaptation, acclimatization, acclimation, homeostasis and feedback controls, conformity and regulation. Tissue system and their functions, epithelial tissue, connective tissue, muscular tissue and nervous tissue.

UNIT II.Nervous systems in invertebrates and vertebrates. Movement and muscle, electrophysiology and biochemistry of contraction in skeletal, cardiac and visceral muscles.Circulatory systems, properties of myogenic and neurogenic hearts, electrocardiogram, hemodynamics, response to extreme conditions such as exercise and haemorrhage, neural control of cardiovascular system.

UNIT III.Respiratory system, respiratory pigments, transport of gases in blood, respiratory response to extreme conditions such as hypo-barrism and high altitude , physiology of respiration and Neural and chemical control of respiration.Mechanics of respiration.Gaseous transport and exchange.

UNIT IV:Excretory system, osmoregulation, conformers, obligatory exchanges of ions and water,osmoregulation in water and terrestrial environment, physiology of kidney. Digestive system, types of feeding, digestion, metabolism, and absorption, physiology of gastrointestinal system, neural and hormonal regulatory mechanisms.

UNIT V:Endocrinology: Hormone receptors. Mechanism of hormone action at cellular and sub – cellular levels.Feedback control of hormone secretion. Hypothalamic – hypophyseal axis. It should include (i) Hypothalamic – hypophysealaxiz controlling secretions from thyroid, parathyroid, adrenal and gonals, (ii) Endocrine control of general metalbolism. Releasing and inhibiting factors. Pineal gland and its hormones.Hormones of hypophysio and all other endocrine glands.Mechanisms of different hormone actions.Endocrine disorders.Gonadal hormones and their functions in male and female.Neuro-endocrine-gonadal axis and feedback regulation.

Text books

1. Animal physiology - by Randall Burggren& French
2. Animal Physiology - by Hill, Wyse & Anderson
3. Medical Physiology - by Guyton and Ganong

Semester 6Subject Code: LIF065Credits : 4

Title: Animal Physiology Practicals

1. Study of human salivary amylase in relation to either pH and Temperature.
2. Use of Kymograph unit, B.P. apparatus, Stethoscope.
3. Recording of simple muscle twitch with electrical stimulation.
4. Demonstration of the knee jerk reflex.
5. Preparation of temporary mounts: Squamous epithelium, Ciliated epithelium, Striated muscle fibres and nerve cells.
6. Examination of sections of Mammalian skin, Cartilage, Bone, Pancreas, Testis, Ovary, Pituitary, Adrenal, Thyroid, Parathyroid.
7. Preparation of permanent slide of any five mammalian tissues- Microtomy.

Semester 6Subject Code: LIF064Credits : 3

Title:Developmental Biology

Unit I : "Gametogenesis and Fertilization" : Spermatogenesis and oogenesis. Egg and sperm interaction, fertilization, vitellogenesis.Natural and artificial parthenogenesis.In vitro fertilization and embryo transplantation.

Unit II: Cleavage, Gastrulation & Differentiation: Cleavage and its patterns. Biochemical changes during cleavage, influence of male and female pronuclei during early development. Experimental works of Speeman and Mangold, Factors influencing cleavage - Fate map. Gastrulation and morphogenetic movements.Morphogenesis of germ layers.Morphogenetic field.Differentiation.Determination,transdetermination.

Unit III: Induction and Maturation: Induction, organization, competence and inductive response, Hierarchies of induction, principles of reciprocal action. Control of metamorphosis.Morphophysiology of metamorphosis in insects and frog.Histomorphological changes in regeneration of tail in Amphibians and Reptiles. Limb regeneration in amphibians.Vertebrate lens regeneration.Regeneration in Platyhelminthes and Coelenterates.Concept of growth at cellular, subcellular and organ level.

Unit IV:Genetic Control of Development: Nuclear determination of developmental events. Molecular basis of early embryonic development. How is genetic control exercised during development.Role of extrinsic factors in genetic control.Nucleus and cytoplasmic interactions during development.

Unit V: Human Reproduction: Puberty,Menstrual cycle ,Menopause, Pregnancy and related problems, Parturition, Lactation, Development and differentiation, Contraception - its merits and family welfare. Reproductive Technology: Monitoring of estrus cycle , Artificial insemination , Cryopreservation , IVF , Embryo transfer, Test tube babies.

Text books

1.Developmental Biology, Scott F Gilbert

Semester 7Subject Code: LIF071Credits :3

Title: Plant Biology-II

UNIT I: Water relations: Properties of water, Properties of solutions, Cell water potential, Soil plant atmosphere continuum. Photosynthesis: Light absorption, energy conversion, reaction centre complex, photosystem organization of thylakoids membrane, electron transport pathway in chloroplast membrane, ATP synthase, carbon fixation in C3, C4, CAM plants.

UNIT II: Respiration: Citric acid cycle, plant mitochondria electron transport, plant mitochondria ATP synthesis, biochemical basis of photo–respiration. Photomorphogenesis: Phytochromes, cryptochromes, photomorphogenesis. Transport processes in plant: Active and passive transport systems, xylem and phloem transport, intra cellular movement of macromolecules, ion channels, driving forces and flow, transport of metabolites from the source to the sink, genetic regulation of transport systems in response to nutrients availability and growth status.

UNIT III: Mineral nutrition and assimilations of inorganic nutrients: Plant microrrhiza association, nitrogen metabolism, sulfur metabolism, phosphate metabolism, calcium metabolism, assimilation of cations, chloride dynamics. Lipid metabolism in plants: Fatty acid biosynthesis, membrane lipid biosynthesis, lipid desaturation, triacylglycerols, complex lipids, cell wall lipids.

UNIT IV: Plant hormones: Introduction and concept, types of growth regulators. (a) Auxin: The master growth hormone, Avena coleoptiles bioassay, discovery, distribution, roles and functions, auxin mutants, perception, and binding proteins, signal transduction, auxin responsive genes/promoters/factors. Model for gene regulation, derepression of early auxin genes, Acid theory, polar auxin transport, chemiosmotic model, applications.(b) Gibberellins: Foolish seedling disease, location, forms, functions, mechanism, signal transduction and mechanism of action of Gas - alpha-amylase as an example, commercial applications.(c) Cytokinins: Location, functions and mechanism of action, commercial applications.(d) Ethylene: Discovery, locations and functions, mutants, mechanism of actions, applications.(e) Abscisic acid: Natural stress hormone, discovery, location and functions, mutants VP1, ABA and ABI, mechanism of action.(f) Brassinosteroids, Jasmonic acid, Salicylic acid, Polyamines.

UNIT V: Plant immune system: Plant defense system, genetic basis of plant pathogen interaction, systemic acquired resistance, MAM, PAM, PAMP-Triggered Immunity (PTI) and effector-triggered immunity (ETI), hypersensitive response, functions, relevance with diseases, apoptosis, Importance in plant development, role and model of programme cell death.

Suggested Readings

1. Plant Physiology - by Frank Salisbury, Cleon Ross

2. Introduction to Plant Physiology - by W.G. Hopkins

3. Plant Physiology - by Taiz and Zeiger

4. Plant-pathogen Interaction - by N. Talbot

5. Biochemistry and Molecular Biology of Plants - by Buchanan et al

Semester 7Subject Code: LIF072Credits :4

Title: Immunology

UNIT I : INTRODUCTION TO THE STUDY OF IMMUNOLOGY: Historic perspective, Overview and Concepts, Mile stones in immunology, Discovery of humoral and cellular immunity, Functions of humoral and Cell- Mediated Immunoresponses. Components of immunity, Innate and Adaptive immunity, Cells and Tissues of the Immune System: Lymphoid organs, lymphoid cells and other cells involved in immunological responses.

UNIT II : ANTIGENS AND IMMUNOGENICITY. Nature of Antigens and antibodies.Theories of Antibody formation.Antibody structure, structural basis of Antibody diversity; Immunoglobulins as Antigens, Properties of Immunoglobulins, subtypes. Antigen - Antibody Reaction, Strength of Antigen and Antibody reaction, Cross reactivity, Precipitation and Agglutination reactions, Radioimmunoassay and ELISA. B-cell generation, activation and differentiation.Antibody production, Regulation and Diversity.Complement and its role in Immune Responses.

UNIT-III: VACCINES AND IMMUNOLOGICAL TECHNIQUES.
Vaccines - killed attenuated organisms, toxoid, recombinant vaccines, subunit vaccines, DNA vaccines, synthetic peptide vaccines, antiidiotypic vaccines. Immunization practices-immunoprophylaxis and immunotherapy.Immunological techniques - Production of polyclonal and monoclonal antibodies.Immunoprecipitation, RIA, ELISA, fluorescent immunoassay, avidin-biotin mediated assay, immunohistochemistry, immunoelectrophoresis, immunoblotting. Complement fixation test.

UNIT-V: HYPERSENSITIVITY, AUTOIMMUNE AND IMMUNODEFICIENCY DISORDERS
Hypersensitivity - definition and classification - type I, II, III, IV and V hypersensitivity, mechanism involved, diagnosis and treatment. Autoimmunity and autoimmune diseases - mechanism of development, diagnosis and treatment.Immunodeficiency disorders-B cell deficiencies, T cell deficiencies, secondary immunodeficiency diseases-pathogenesis, diagnosis and treatment of AIDS.

UNIT-IV: GENETIC BASIS OF IMMUNOLOGY, TRANSPLANTATION AND TUMOR IMMUNOLOGY
MHC complex - gene organization - HLA genes class I and II antigens. Structure and function. Histocompatibility testing - lymphocytotoxicty test - cross matching.MHC and disease association.Transplantation - types, genetics of transplantation - graft versus host reactions.Tissue matching and immuno suppressive agents.Tumor immunology - immune surveillance, tumor antigens, immune response to tumors, immunotherapy of tumors.

TEXT BOOKS

1. Coleman, Lombard and Sicard. Fundamental Immunology, WCB publishers 1992.

2. Goldsby RA, Kindt TJ, Osborne BA. Kuby Immunology, Fourth Ed, W.H. Freeman and company, New York, 2000.

REFERENCE

1. Hudson, L. and Hay, F.C. Practical Immunology, Black Well publishers 1989.

2. Dixon, F.J. Advances in Immunology, Academic Press 1986.

Semester 7Subject Code: LIF076 Credits : 3

Title: ImmunologyPracticals

1. Immunization and generation of Anti-sera in rabbit against antigen
2. Separation of immunoglobulin G fractions using affinity chromatography
3. Single Diffusion methods of Immunoelectrophoresis
4. Double diffusion method of Immunoelectrophoresis
5. Raising antibodies from animals (from different Models), Development of polyclonal antibodies,
6. Purification of IgG antibodies from serum samples
7. ELISA for detection of Antigens and Antibodies
8. Sandwich ELISA
9. SDS-PAGE and Immunoblotting
10. Diagnostic PCR
11. Separation of CD cells using Flow cytometry
12. Isolation and identification of lymphocytes.

Semester 7Subject Code: LIF073Credits : 3

Title:Biophysics and Structural Biology

Unit I- Structure and Conformation of proteins, Different levels of protein structure: Primary, secondary, tertiary and quaternary structure. Main chain and side chain torsion angles. Alpha helix, beta sheet, turns. Ramachandran map - Allowed conformations for a pair of linked peptide units - (map for glycine and alanine residues), Motifs and domains-examples such as hairpin motif, Greek key motif, alpha helix bundles, alpha-beta barrels etc.

Unit II- Classification of proteins, Based on structure – globular, fibrous. Based on functions - structural proteins, collagen, keratin, actin, myosin, silks fibroin as examples.Enzymes- Lysozyme as example, Transport proteins- Hemoglobin as example - allostery and co-operativity.Immunoglobulins Receptors.Hormones-insulin as example, Membrane proteins.

Unit III- Structure and Function of Nucleic Acids, Nucleosides and nucleotides, Structure of oligonucleotides, Structure of DNA - Watson and Crick model - base pairing and base stacking, DNA polymorphism - A, B and Z forms. Supercoiling of DNA.Structure of tRNA.Genetic code.

Unit IV- Macromolecular assemblies, Protein-protein interactions, protein-nucleic acid interactions, chromatin and ribosomes.DNA binding motifs-HTH, Leucine zipper, Zn-finger motifs. Protein folding, Forces stabilizing the macromolecular structure and assembly: Disulphide bonds, Hydrophobic Interactions, Electrostatic Interactions and Hydrogen Bonding. Kinetic factors of protein folding. Burying of hydrophobic side chains.Chaperonins.

UNIT V: Techniques in Biophysics, Basics of spectroscopy – X-ray crystallography – NMR – UV etc. Different techniques of crystallization, Data collection- x-ray generators and detectors, diffractometer, imaging plates, phase determination, Patterson method, direct methods, Molecular replacement methods, isomorphous replacement method, anomalous dispersion. Structure refinement.Important software for visualization and refinement. R-factor, Validation of the structures.

Text books:

1. Principles of Protein Structure by G. Schulz and R.H. Schirmer, Springer - Verlag, 1984.
2. Introduction to Protein Structure by C. Branden and J. Tooze, Gar land Publishing, 1991.
3. Proteins Structure and Molecular Properties Thomas E. Creighton, W.H. Freeman and Company, New York, 1993.
4. Principles of Nucleic acid Structure, W. Saenger, Springer verlag, 1984.
5. Biophysics by W. Hoppe. et. al., Springer - Verlag, 1989.
6. Biophysics by VasanthaPattabhi and N. Gautham, NarosaPublishmg House, New Delhi,2002.
7. Essentials of Biophysics by P. Narayanan, New Age International (P) Ltd. Publishers, New Delhi, 2000.

Semester 7Subject Code: LIF074 Credits : 4

Title: Advanced Molecular Biology

UNIT-I: DNA REPLICATION ,Types of replication, evidence for semiconservative replication - Meselson and Stahl experiment, replications in circular chromosomes - Cairns model, rolling circle model. Replication in prokaryotes and inhibitors of replication, replication bubble, bidirectional replication, replicon, action of SSB, primase, DNA gyrase, topoisomerases, DNA polymerase I, II, and III, lagging and leading strand synthesis, Okazaki fragments, replication in RNA virus, plasmid replication, reverse transcriptase, retroviruses, temporal control of replication. Eukaryotic replication.

UNIT-II: TRANSCRIPTION,Transcription - definition, coding strand, template strand, sense strand and antisense strand, promotor, foot-printing experiment, DNA - dependent RNA polymerase role of Prinbnow box, template binding, prokaryotic transcription, Rho - dependent and independent transcription, posttranscriptional processing in prokaryotes, split genes, overlapping genes, housekeeping genes, biosynthesis of rRNA and tRNA, eukaryotic transcription, RNA editing - post-transcriptional modifications of eukaryotic RNAs, RNA splicing, introns and splicing reactions, self-splicing introns - group I and group II, exons, spacer sequences, enhancers.

UNIT-III: GENETIC CODE AND TRANSLATION ,Genetic code - definition, deciphering of the genetic code, codon dictionary, salient features of genetic code. structure of tRNA, activating enzymes, binding of amino acids to tRNA, wobble mechanism and its significance, composition of prokaryotic and eukaryotic ribosomes, leader region, Shine-Dalgarno sequence, reading frameshift, prokaryotic and eukaryotic protein biosynthesis - initiation, elongation, translocation and termination, polysomes, post-translational modifications in prokaryotes and eukaryotes, role of endoplasmic reticulum, role of signal peptide, signal hypothesis, inhibitors of protein synthesis.

UNIT-IV: PROTEIN TRANSPORT AND GENE EXPRESSION ,Protein targeting, translocation, heat shock proteins, glycosylation, SNAPs and SNAREs, bacterial signal sequences, mitochondrial, chloroplast and nuclear protein transport, endocytosis-viral entry, ubiquitin TAG protein destruction, gene expression and regulations, molecular mechanism of regulation, prokaryotes - operon model, lac, trp, arabinose operons, repression and attenuation, eukaryotes - C value paradox, repetitive DNA, gene dosage and gene amplifications.

UNIT-V: MUTAGENESIS, DNA DAMAGE AND REPAIR ,Mutagenesis and replication fidelity, numerical mutations involving full chromosome set - causes, structural chromosome mutations - balanced and unbalanced - causes, karyotype mixing, misincorporation of nucleotides during DNA synthesis, transient and spontaneous chemical changes in DNA, frameshift mutagenesis, DNA damage - different types, DNA repair - direct reversal repair, direct repair of nicks, excision repair, nucleotide excision repair, mismatch repair, long and short patch mismatch repair, recombination error, SOS response and mutagenic repair.

Text Books:

1. Molecular biology by Robert F. Weaver McGraw-Hill
2. Advanced molecular biology by R. M. Twyman,
3. Genes VII by B. Lewin Oxford University Press, Cell Press, London
4. Cell and molecular biology by G. Karp, John Wiley & Sons Inc
5. Biochemistry by D.Voet and J. Voet. John Wiley and Sons Ltd

Semester 7Subject Code: LIF077 Credits : 3

Advanced Molecular Biology Practicals

1. Isolation & purification of genomic DNA from bacteria
2. Isolation & purification of plasmid DNA from bacteria
3. Isolation & purification of genomic DNA from plants
4. Agarose gel electrophoresis of chromosomal
5. Agarose gel electrophoresis of plasmid DNA
6. Determination of purity of DNA spectrophotmetrically
7. Restriction digestion of chromosomal & plasmid DNA
8. Isolation of DNA fragment from agarose gel
9. Characterisation of secondary metabolites by polycrylamide gel electrophoresis silver staining of protein on gels and HPLC.

Reference Books:

1. Freifelder D, " Molecular Biology ", Jones and Bartlett Publishers Inc. 1987.

Semester 8Subject Code: LIF081 Credits : 4

Title: BIOTECHNOLOGY

UNIT-I: TOOLS OF GENETIC ENGINEERING

Basic principles - mechanism of natural gene transfer by Agrobacterium, generation of foreign DNA molecules, restriction enzymes, their types and target sites, cutting and joining DNA molecules, linkers, adapters, homopolymers, enzymes used in genetic engineering, cloning vehicles and their properties, natural plasmids, in vitro vectors, cosmids and T-DNA based hybrid vectors.

UNIT-II: DNA CLONING AND SEQUENCING

Cloning strategies - cloning with single strand DNA vectors, cDNA cloning and gene libraries, recombinant selection and screening methods, expression of cloned genes-problems and solutions, shuffle vectors, DNA sequencing strategies - Sanger's and Maxam - Gilbert's methods, applications of PCR and DNA hybridization, Southern, Northern and Western blotting.

UNIT-III: GENE TRANSFER AND APPLICATIONS

Techniques of tissue culture-culturing explants and haploids, protoplasts fusion and embryoids, methods of gene transfer to plants, animals and bacteria-Ca transfection, electroporation, shotgun and others, transgenic plants, GM foods, and biopesticides, gene knockouts and transgenic animals, animal pharming and xenogarfting, biodegradation, stimulation and its applications, bioleaching.

UNIT-IV: INDUSTRIAL BIOTECHNOLOGY AND GENE THERAPY

Applications of biotechnology-industrial biotechnology-fermentors, principle, types product recovery and purification of ethanol, citric acid, vitamin B 12, streptomycin, enzyme biotechnology-production and uses of industrially important enzymes such as protease, immobilization of enzymes and their applications, waste treatment, bioenergy and biogas production. Gene therapy (somatic)-the principle and approaches.

UNIT-V: BIOSAFETY AND BIOETHICS

Biotechnology - potential hazards, biological weapons, biosafety of GM foods and GMOs - substantial equivalence and safety testing, gene drain, the tangled genes, human genome research - the objectives and approaches, genomics and genome prospecting - the controversies, issues of biotechnology-social and scientific, technology protecting systems and the terminator, IPR, its concepts and conditions -patenting of genes, cells and life forms, evaluation of life patenting.

Text Books:

1. Genes - VIII by Lewin B Oxford University Press.
2. Ratledge&Kristianeen, Basic Biotechnology Cambridge University press
3. Gene cloning - an introduction by TA Brown, Chapman and Hall.
4. Glick & Pasternak, Molecular Biotechnology, Panima Publications.

Semester 8Subject Code: LIF082 Credits : 4

Title: BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

UNIT I: Overview of Bioinformatics, Overview of Bioinformatics – History – Objectives - Literature databases – Biological databases: Sequence and Structure databases – Protein Sequence databases – SWISS-PROT, PIR - Nucleic Acid Sequence Databases – GenBank, EMBL, DDBJ –pattern and motif searches databases – PROSITE, BLOCKS, PRINTS, PFAM – structure databases – PDB – structural classification – SCOP, CATH , PRINTS, BLOCKS, PRINTS, PRODOM, PFAM.

UNIT II: Alignment algorithms

Sequence alignment algorithms: pairwise alignment - Local and Global alignment concepts – dynamic programming methodology-Needleman and Wunsch algorithm, Smith-Waterman algorithm – Databases searches for homologous sequences - FASTA and BLAST - Multiple sequence alignment – Progressive Alignment - Clustal W, T-Coffee – Application of multiple sequence alignment -– principles and methods – methods for phylogenetic tree construction – NJ, ML and MP – evolutionary models.

UNIT III: Structure Prediction, Structure Prediction Methods – Homology Modeling – Fold Recognition Methods – a*b initio* methods – Rosetta – CASP – prediction of secondary structure – Chou-Fasman, Garnier-Osguthorpe-Robson (GOR) methods (qualitative aspects only) –Protein 3-D structure comparison and alignment – structure superposition – RMSD – structure alignment methods – DALI, SSAP, CE – multiple structure alignment, transmembrane structure prediction.

UNIT IV: Genomics and Proteomics ,Genome diversity – taxonomy and significance of genomes – Bacterial, Yeast, *Coenorabditis, Homo sapiens, Arabidopsis thaliana.*Comparative genomic databases – PEDANT, Cluster of Orthologous Groups (COG), Kyoto Encyclopedia of Genes and Genomes (KEGG) – Metabolic pathway databases. Introduction to Proteome - proteome and technology - information and the proteome – Primary attributes for protein identification - protein species of origin - Protein N- and C-terminal sequence tags - cross species protein identification - Modifications that influence protein change on 2-D PAGE - Detection and analysis of Co- and Post-translational modification – Specialized protein sequence databases – GPCRDb, YPD, ENZYME.

UNIT V: Applied Bioinformatics: Commercial Bioinformatics – Survey of bioinformatics companies in India and abroad – Economics prospects – Scope of Bioinformatics - Pharmacogenomics –Chemoinformatics – Medicinal Chemistry – Drug Discovery – Medical Informatics – Agri-informatics – Machine learning in Bioinformatics.

Text Books:

1. SørenBrunak, Pierre F Baldi, Bioinformatics: The Machine Learning approach, MIT Press.
2. Steffen Schulze-Kremer, Molecular Bioinformatics: Algorithms and Applications, Walter de Gruyter,
3. BalasKausikNatarajan, Machine Learning: A Theoretical Approach, Morgan Kaufmann,

Semester 8Subject Code: LIF084 Credits : 3

Title: Bioinformatics And Computational Biology Practicals

1. Programming in FORTRAN- Solving of mathematical and biological problems using FORTRAN.
2. Demonstration of biological databases – PDB, Gen BANK
3. Demonstration of biological sequence alignment methodologies.
4. Informatics using Drug design
5. Informatics using Vaccine design
6. Basic of UNIX commands.
7. Biomolecular and cellular computing
8. Micro array analysis

References:

1. Bergeron,B. “Bioinformatics Computing”. PHI, 2002Dan Gusfield, "
2. Algorthms on Strings Trees and Sequneces ", Cambridge University Press, 1997.
3. P.Baldi,SBrunak, Bioinformatics; " A Machine Learning Approach ", MIT Press, 1998.
4. Introduction to Bioinformatics by Arthur M. Lesk, University of Cambridge.

Semester 8Subject Code: LIF083 Credits : 3

Title:Ecology and Biodiversity

UNIT I: Aquatic and terrestrial ecology, concept of population and community, succession process, competition and coexistence, types of interactions, predations, parasitism, antibiosis, commensalism, cooperation and mutualism, population growth. Abiotic and biotic environment, limiting factors, adaptation, habitat and niche, nature of environment. Biosphere, biomes, population parameters, structure, growth regulation, interactions between populations.

UNIT II: Ecosystem, types, characteristics, structure and function of ecosystems, population dynamics, carrying capacity, sustainable field, components of ecosystem, food web, producer, consumer, decomposer, biotic and abiotic components, ecological pyramids, bioaccumulation and bio-magnifications- mass and energy transfer successive tropical level.

UNIT III: Energy flow and fixation, ecological pyramids. Biogeochemical cycles, hydrological cycle, carbon, oxygen, nitrogen, sulfur and phosphorus cycles – their importance and applications. Ecological succession, primary and secondary successions, ecological climax, impacts of development on ecosystem.

UNIT IV: Biodiversity - Concept, components, types, ecological and economical importance, key stone, umbrella and flagships species, ecotone and niche.7. Biodiversity - values, national and global status, hotspot; threatened species - IUCN Red list, endangered species, vulnerable species, rare species, extinct species and endemic species; effects of climate change.

UNIT V: Biodiversity conservation - in situ & ex situ, species management, bio-prospecting, commercialization, gene banks, transfer of technology and related IPR issues; roles of International bodies, UN, WTO, FAO, WIPO.

Text books:

1. Fundamentals of Ecology - by Eugene P. Odum

2. Biological Diversity: Frontiers in Measurement and Assessment – by A.E. Magurran, B.J. McGill

Semester 8Subject Code: LIF085 Credits : 6

Title:Project work

Semester 9Subject Code: LIF091 Credits :4

Title:Biology of Human Diseases

UNIT I:The nature and investigation of diseases: characteristic features of diseases, etiology, pathogenesis, manifestations of diseases, outcome of a disease, classification of diseases, epidemiology of diseases, investigating diseases, types of pathology laboratories, role of hospital laboratory tests, evaluation of laboratory tests, reference ranges, quality of test results and clinical auditing.

UNIT II:Infectious diseases and treatment: infections of the skin, eyes, ears and CNS, respiratory system, gastrointestinal system, and Urogenital system, sepsis and systemic infections , preventing infectious diseases, controlling the spread of pathogens, treatment of infectious agents, antiviral, antibacterial, antifungal, antiprotozoal, antihelminthic drugs, and combination therapy.

UNIT III:Disorders of the immune system, Primary Immunodeficiency disease, classification of autoimmune disorders, autoimmune disorders affecting endocrine glands, antiglomerular basement membrane disease, Myasthenia gravies, Rheumatoid arthritis, Systemic lupus erythematosus, Type I hypersensitivity, Type II hypersensitivity, Type III hypersensitivity, Type IV delayed hypersensitivity,

UNIT IV:Disorders of the endocrine system: Hormone production and mechanism of action, Causes of endocrine disorders, Disorders of pituitary function, Growth hormone disorders, Thyroid hormone disorders,disbetes mellitus, hypoglycemia, Addison's disease, Cushings syndrome, Congenital adrenal hyperplasia, Conn's syndrome, disorders of sex hormone.

UNIT V: Disorders of Blood and cardiovascular system: Microcystic anemia, Macrocystic anemia, sickle cell anemia, thalassemia, Favism, Hemophilia, Thrombocytopenia and thrombocytosis, Endocarditis, abnormal heart rhythms, atrial fibrillation and flutter, ventricular tachycardia, ventricular fibrillation, heart block, chronic heart failure, acute heart failure, Ischemic heart disease, Cardiomyopathies, Heart valve disorders, heart tumors, angina, myocardial infarction, pericardial diseases, disorders of arteries and veins.

Text books:

1. Biology Of Disease, Nessar Ahmed
2. Biology Of Disease,Jonathan Phillips, Paul G. Murray, Paul Kirk

Semester 9Subject Code: LIF092 Credits : 2

Title:History and Philosophy of Science

Unit-I

Theories about the aims and methods of science, Historical development of science, History of science, Illustrate different views about science, relations between the sciences and between science and religion.

Unit-II

Philosophy of science Nature and definition of science History of scientific thought in mind, study of philosophical problems connected with thought experiments, confirmation and disconfirmation of theories, falsifiability and pseudoscience, induction, explanation, empirical equivalence and underdetermination, realism, and other related themes.

Text books

1. Timothy McGrew, Marc Alspector-Kelly, and Fritz Allhoff (eds.), Philosophy of Science: An Historical Anthology

Semester 9Subject Code: LIF093 Credits : 3

Title:Neurobiology

UNIT I:Developmental Neurobiology: Organogenesis and neuronal multiplication, axonal and dendritic growth, glial multiplication and myelination, growth in size, regeneration and repair mechanisms, plasticity.

UNIT II:Neuromorphology and neurocellular anatomy: Central nervous system General features of neurons, cellular organization of neurons, Dendritis and Axons, neurotubules, neurofilaments, synapse neuralgia, astrocytes,oligodendrocyte, ependymal cells, Schwan cells. Peripheral nervous system (PNS): Muscle, nerve endings, sensory receptor and effector endings; peripheral nerves, spinal and cranial nerves: Plexuses ganglia, afferent pathways and sense organs. Spinal cord: Topographical anatomy, spinal nerves, spinal meanings, joint reflexes, gray and white matter of spinal cord.

UNIT III: Neurotransmitters: Acetylcholine, Dopamine, Norepinephrine, Serotonin, Histamine, Epinephrine, Gamma-aminobutyric acid, Glycine, Glutamate, Aspartate, NO2, and CO - Chemistry, synthesis, storage and release of neurotransmitters, transmitter action, synaptic modulation and mechanism of neuronal integration. Secondary Messengers: Importance of cyclic nucleotides and protein phosphorylations in nervous system. Involvement of protein kinases and calcium in neuronal metabolism. Neuropeptides: Classes of neuropeptides, mode of action, role of neuropeptides in obesity and pain neuropeptide receptors.

UNIT IV: Learning and Memory: Correlation of behavioral and biochemical events, measurement of learning and memory, agents affecting learning and memory, biochemical correlates of excitation, learning and behavior.

UNIT V: Neurodegenerative diseases: Parkinson s, Alzheimar s disease, amyotrophic lateral sclerosis, senile dementia. Psychopharmacology and Biochemical theories of Mental Disorder: Chemistry of neuroleptics and anxiolytics, antidepressants, hallucinogenic agents, biochemical theories of mental disorders.

Text books:

1. Text Book of Medical Physiology: Guyton A. G, and Harcourt Hall
2. Review of Medical Physiology: Lange Ganong W. F

3. Neuro anatomy: Grossman S. R, and Neavy O Squire, Fundamental Neuroscience (3rd Edition), Elsevier, Brady, Basic Neurochemistry (8th Edition) Academic Press,
4. Squire, Fundamental Neuroscience (3rd Edition), Elsevier,
5. Kendel, Principles of Neural Science (4th edition), McGraw Hill,
6. Duchene E. Haines, Fundamental Neuroscience for Basic & Clinical Applications (3rd
7. Edition), Churchill Livingstone,
8. Bear, Neuroscience-Exploring the Brain (Edition), Lippincott,

Semester 9Subject Code: LIF094 Credits : 3

Title:Electives

Semester 9Subject Code: LIF095 Credits : 8

Title:Project

Semester 10Subject Code: LIF101 Credits :2

Title:Seminar and Assignment

Semester 10Subject Code: LIF102 Credits : 18

Title:Project