BT -501 – Instrumentation and Analytical Techniques

Unit-I

Direct Observation: Light Microscopy, Theory of microscopy Parts of the microscope, Adjusting a microscopy, Contrast, Dark field microscopy, Phase-contrast microscopy, basic theory, uses of the phase microscope, Polarization microscopy, Basic theory, Use of the microscope in biology and biochemistry, Fluorescence microscopy, basic theory, Use of the fluorescence microscope in biological sample analysis.

Unit-II

Electron Microscopy, theory of operation, Methods for preparing sample Freeze-etching and the critical point technique, shadow –casting, Negative contrast technique, Positive staining, Special mechanism of image formation.

Unit-III

Measurement of pH, Radioactive labeling and counting measurement Radioactivity by Liquid Scintillation Counter, Quenching, Chemical quenching, Color quenching, Dilution quenching.

Unit-IV

Membrane filtration and dialysis, Chromatography, Thin layer chromatography, Gel chromatography, Column chromatography, Spectroscopic methods, UV-_visible spectroscopy, NMR ESR Mass spectroscopy.

Unit –V

Autoradiography, Nuclear emulsion used in biological studies, Isotopes commonly used in biological studies, Molecular autoradiography, Centrifugation.

Text/References:

1. A Practical Handbook of Preparative HPLC, Donald Wellings, Elsevier
2. Biochemical Methods - A Concise Guide for Students and Researchers Edited by Pingoud, Alfred / Urbanke, Claus; Hoggett, Jim; Jeltsch, Albert Wiley-VCH
3. Electrochemical Sensors in Bioanalysis, Raluca-Ioana Stefan, Jacobus Frederick van Staden and Hassan Y Aboul-Enein, Marcel Dekker
4. Electrochemistry of Nucleic Acids and Proteins Edited by E. Palecek , F. Scheller and J. Wang Elsevier
5. HPLC: Practical and Industrial Applications, Second Edition Edited by Joel K Swadesh, CRC Press

BT -502 – Biochemistry

Unit I :
Overview of metabolism. Cellular energy requirement for vital functions, energy conversations, photosynthesis and ATP, the food chain, energy content of food materials, vitamins and cofactors. Analysis, design and techniques used in study of metabolism DNA to proteins.

Unit II:
Glycolysis and TCA cycle- glycolysis reactions. TCA cycle and the glyoxylate cycle, mitochondrial shuttles. Bioenergetics. Oxidation–reduction concepts, free energy and high energy molecules, thermodynamic considerations. Electron transport chain, chemiosmotic coupling, mitochondial metabolism. Photosynthesis. Comparison to oxidative phosphorylation, photophosphorylation, Calvin Cycle.

Unit III:
Glyconeogenesis – urea cycle, amino acid degradative pathways, biosynthetic pathway of amino acids in microorganisms. Fatty acids metabolism – b- oxidation pathway, ketone bodies , biosynthesis of fatty acids.

Unit IV:
Control of metabolism – biosynthetic and catabolic perspectives. Control of level of glucose in blood, hormonal integration of metabolism, signal transduction cascades – an introduction, regulatory mechanisms, genetic disorders of metabolism.

Unit V:
Determination of Amino Acid sequence in proteins. The secondary, tertiary, and quaternary structure of proteins and enzymes. Introduction- Classification, Factor affecting rate of enzyme catalysis, Michaelis- Menton equation, methods of plotting the kinetic data, enzyme inhibition, Reversible – competitive and non-competitive. Irreversible.Kinetics of Bisubstrate reaction Regulation of the enzymes. Active Site determination, Allosteric control, Mechanism of enzyme action. Coenzymes and Cofators,. Classification of Coenzymes as group transfer and hydrogen transfer.

Text/References:
1. Principles of Biochemistry, Nelson Cox
2. Biochemistry, Jeremy M. Berg, John L. Tymoczko and Lubert Stryer
3. Zubay’s Biochemistry
4. Harper’s Biochemistry
5. Biochemistry, Delvin

BT -503 – Bioremediation Technology

Unit-I

Bioremediation introduction, constraints and priorities of Bioremediation, Sources, types of pollutants, effect of pollutants, control measures, microbes involve in bioremediation, Biostimulation, Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation, Phytoremediation, Composting, Bioventing & Biosparging.

Unit-II

Water quality parameters: Physical, Chemical & Biological, Hardness of water – estimation of hardness, sludge formation prevention – treatment: Internal conditioning – phosphate, carbonate conditioning methods – External: Zeolite, ion exchange methods - desalination – reverse osmosis and electrodialysis - domestic water treatment.

Unit-III

Biological treatment of waste Water-Aerobic and Anaerobic Systems, Biological processes for domestic and industrial waste water treatments; Aerobic systems - activated sludge process, trickling filters, biological filters, rotating biological contractors (RBC), Fluidized-bed reactor(FBR).

Unit-IV

Removal of Specific Pollutants : Sources of Heavy Metal, Pollution, Microbial Systems for Heavy Metal Accumulation, Biosorption & detoxification mechanisms, Biooxidation-Direct and Indirect Mechanisms; Bio-oxidation Kinetics; Bacterial oxidation of Chalcopyrite and Pyrite.; Extraction of metals from ores; Recovery of metals from solutions.

Unit-V

Xenobiotic compounds: Aliphatic, Aromatics, Polyaromatic Hydrocarbons, Polycyclic aromatic compounds, Pesticides, Surfactants and microbial treatment of oil pollution, Use of Genetically Engineered Organisms. Emerging biotechnological processes in waste treatment; Applications include treatment of municipal and industrial waste and wastewaters.

Text/References:

1. Environmental Microbiology, W.D. Grant & P.E. Long, Blakie, Glassgow and London.
2. Microbial Gene Technology, H. Polasa (ED.), South Asian Publishers, New Delhi.
3. Biotreatment Systems, Vol. 22, D. L. Wise (Ed.), CRC Press, INC.
4. Standard Methods for the Examination of Water and Waste Water (14 th Education), 1985. American Public health Association
5. Environmental Biotechnology by Bruce Rittmann and Perry McCarty
6. Biotransformations : K. Faber (1995), Springer- Verlag.

BT -504 – Bioprocess Engineering

Unit-I

Units and dimensions, the mole Unit, mole fraction and mass fraction, analyses of a mixture, concentrations, basis of calculations, predicting P-V-T properties of gases using the following equations of state: ideal gas law, Van der Waals equation, Redlich-Kwong equation, calculation of density.

Unit-II

Basics of chemical equation and stoichiometry, limiting reactant, excess reactant, conversion, selectivity, yield. Basic concepts involved in material balance calculations, material balance problems without chemical reactions: membrane separation, mixing, drying, crystallization.

Unit-III

Nature of fluids: incompressible and compressible, hydrostatic equilibrium, manometers, potential flow, boundary layer, the velocity field, laminar flow, Newtonian and non-Newtonian fluids, Newton's-law of viscosity, turbulence, Reynolds number and transition from laminar to turbulent flow, Eddy viscosity, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary-layer formation in straight tubes.

Unit-IV

Molecular diffusion, steady state molecular diffusion in fluids at rest and in laminar flow, molecular diffusion in gases-steady state diffusion, equimolal counter diffusion, in multicomponent
mixtures. Effect of temperature and pressure on diffusivity.

Unit-V

Transport phenomena in Biological systems, Regime analysis of bioreactor processes, Correlations for oxygen transfer; Scale-up criteria for bioreactors based on oxygen transfer and power consumption. On-line data analysis for measurement of important physico-chemical and biochemical parameters.

Text/References:

1. Pauline.M.Doran ., "*Bioprocess Engineering Principles*";Academic press
2. Michael L.Shuler and Fikret Kargi, "*Bioprocess Engineering Basic concepts*", Prentice Hall, 1992.
3. Warren L. Mccabe, Julian C. Smith and peter Harriott, "***Unit** Operations of Chemical Engineering*", 6thdn., McGraw Hill International Edition, NewYork 2
4. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
5. 2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts,2nd Edition,Prentice Hall, Engelwood Cliffs, 2002.

BT -505 – Recombinant DNA Technology

Unit-I

Cloning vehicles, restriction enzymes, restriction modification, linkers, adaptors, homopolymeric trailing, restriction mapping. Expression and purification of recombinant proteins, prokaryotic and eukaryotic expression vectors, in vivo homologous recombination, large scale expression and purification of proteins.

Unit –II

Introduction to cDNA & genomic DNA, library construction and screening, preparation of DNA, RNA probes immunoscreening and blotting techniques, Colony hybridization, Restriction maps & Mapping techniques.

Unit-III

Prokaryotic Gene Control of transcriptional initiation, negative control of transcriptional initiation and Positive compound control of transcription initiation. Control of regulatory proteins, Control of transcriptional termination, Bacteriophage, Global control in *E. coli* stability of biopolymers in bacterial cell.

Unit-IV

Genome sequencing methods – top down approach, bottom up approach. PCR principle, applications, different types of PCR, mutagenesis and chimeric protein engineering by PCR, RACE, Kuntels' method of mutagenesis. Gene transfer & Gene therapy**,** Introduction of foreign genes into plant and animal cells, creation of transgenic plants& animals. Animal knockouts.

Unit-V

Molecular marker in genomic analysis, DNA Foot printing, DNA finger printing RFLP, RAPD and AFLP, Role of finger printing in forensic science, Disease diagnosis and genetic counseling. Application of Recombinant DNA technology in Medicine, Agriculture & Veterinary Sciences.

Text/References:

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc